

EXPLORE

Newsletter for the Association of Exploration Geochemists

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Nigel Radford

PRESIDENT'S MESSAGE

The AEG will shortly be holding its Annual General Meeting during the 20th International Geochemical Exploration Symposium in Santiago de Chile. At this time it is required that the Association's President summarizes the year past. This I will do, but I cannot, at this auspicious point in the Association's history, begin an address to our members without looking forwards, not backwards. Those of us fortunate enough to be in Santiago are about to take part in the 20th IGES. Our colleagues on the Local Organising Committee have carried out herculean tasks to get us to this point, and we are about to enjoy a veritable feast of the best science our disciplines have to offer. Congratulations to the LOC for a great job!

How appropriate it is that the 20th IGES is being held in South America! Surely this is one of the few theatres in the mineral exploration industry where all is not doom and gloom? Parts of South America are still largely under-explored by modern techniques and there are rich prizes out there to be found. We all know of impediments to exploration in other parts of the world, and I will not depress you by elaborating on them. Suffice it to say, exploration seems to me to be more vibrant here than anywhere else I have visited recently.

How can geochemistry contribute to the successful discovery of new mineral resources? The talks presented over the next few days at the 20th IGES will provide some answers. So the lucky ones who are able to be in Santiago will hear the answers

"from the horses' mouths", if the various speakers will forgive me for describing them so! But what of the rest of our members, and also those not fortunate or enlightened enough to be members of the AEG? Well this is where the second of this year's great new ventures comes into play. By the time you read this message the first volume of **GEOCHEMISTRY: EXPLORATION; ENVIRONMENT; ANALYSIS** will have arrived in your mail box. AEG has entered into an agreement with the Geological Society of London to bring you a new Journal dedicated to our science. The title says it all! The new journal seeks to bring into one place scientific developments in all

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Technical Note

Geochemical Variations in Post-Mineral Cover — Implications for the use of Partial Extraction Geochemistry for Porphyry Copper Exploration in Northern Chile

Introduction

In the mid-to-late 1990's, several mineral exploration companies began using a variety of partial extraction geochemistry methods in the search for covered porphyry copper deposits in the Atacama Desert of northern Chile. The application of partial extraction geochemistry in this region is difficult due to the high concentration of water-soluble saline minerals and a high geochemical background resulting from vast regions with internal drainage. In addition, problems such as colloidal interference, variable leach pH conditions induced by the sample matrix, and reabsorption of dissolved elements can further complicate the interpretation of data from these methods.

Beginning in 1995, several studies were conducted by BHP Minerals that were aimed at understanding the environment and characterizing secondary geochemical dispersion for covered porphyry copper exploration. This study reports on the detailed

geochemical variations in vertical and horizontal profiles on the scale of a few meters using 4 partial extraction methods.

The location of the study area was selected because it provides excellent vertical exposure of typical overburden in the Atacama. The exposures are the result of natural stream

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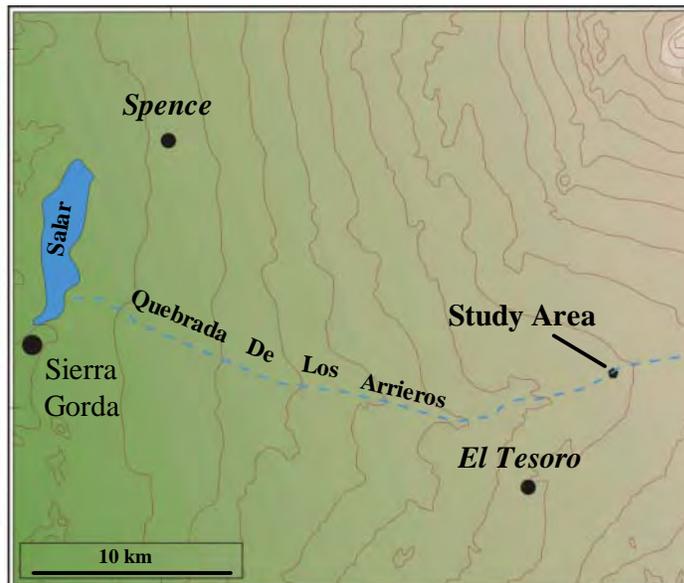


Figure 1. Location of study area in northern Chile showing the Spence (porphyry copper) and El Tesoro (exotic copper oxide) deposits.

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erosion along a small tributary to Quebrada De Los Arrieros, located 30 km east of Sierra Gorda in the Antofagasta province of northern Chile.

Environment

The Atacama Desert is the driest desert in the world with annual precipitation estimated at less than a millimeter (Ericksen, 1981). Measurable rainfall of more than 1 mm may occur as infrequently as every 5 to 20 years; heavy rainfall greater than a centimeter may occur only a few times each century. The region is devoid of plant growth, although sparse vegetation does occur locally in the Central Valley where the groundwater table is near the surface. The region has a mean average temperature of 15 °C (Stoertz and Ericksen, 1974).

The hyper-arid climate has existed since mid-Miocene time and is attributed to three factors: 1) the Humbolt Current which brings frigid water from Antarctica north along the west coast of South America; 2) a counterclockwise air circulation

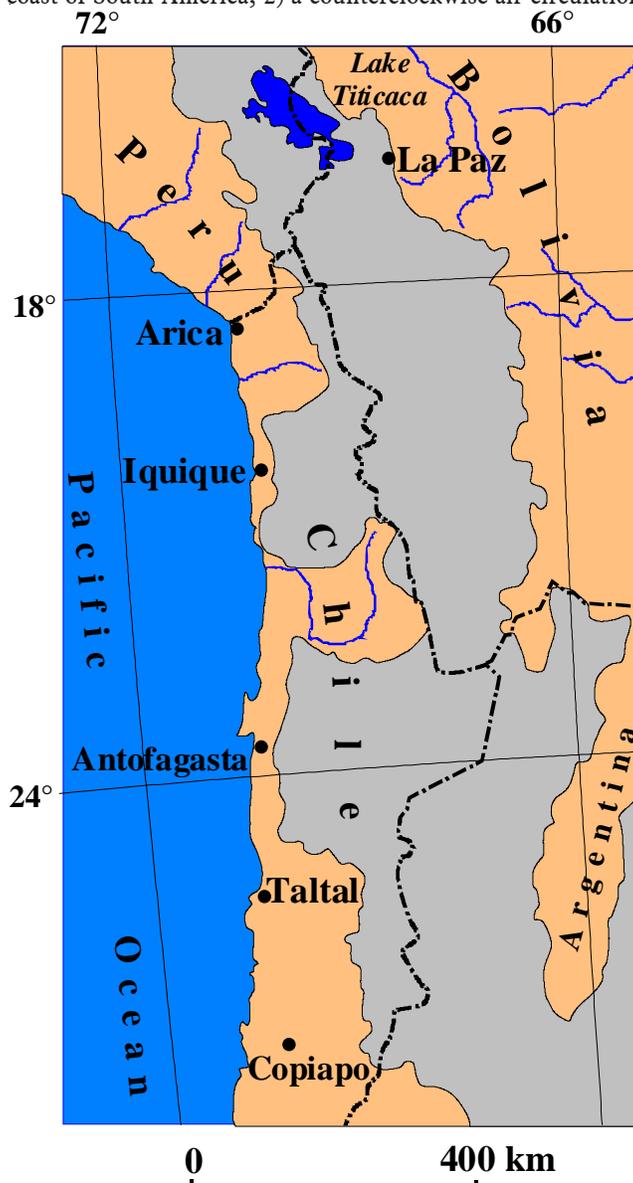


Figure 2. Regions of the Central Andes with internal drainage (shaded area). Modified from Stoertz and Ericksen, 1974.

pattern centered west of the coast that brings cool air over the ocean from the southwest across northern Chile and southern Peru; and 3) the Andes Mountains that inhibit the movement of moist air from the east (Alpers and Brimhall, 1988; Stoertz and Ericksen, 1974). This hyper-arid climate resulted in the formation of economic concentrations of nitrate in several locations throughout northern Chile (Ericksen, 1981).

Regional Geology

The porphyry copper deposits of northern Chile occur as three north-trending belts that decrease in age to the east starting with Early Cretaceous (~130 Ma) through Paleocene (66-58 Ma) to late Eocene to early Oligocene (42-31 Ma) (Sillitoe and McKee, 1996). The majority of copper mineralization is related to the last two events. The tectonic evolution of northern Chile produced four structurally-bound geomorphic provinces related to the subducting Nazca plate beneath the Americas plate (Mortimer and Saric, 1975; Sillitoe and McKee, 1996). From west to east, these are: 1) Coastal Range; 2) Central Valley; 3) Pre-Cordillera; and 4) Andean Cordillera. Uplift and erosion in early to mid-Tertiary time under semi-arid conditions produced thick alluvial gravels, some of which host exotic copper oxide deposits (Munchmeyer, 1996). Most of northern Chile now lies within a region of internal drainage that has persisted since late Tertiary time with a hyper-arid environment (Fig. 2; Stoertz and Ericksen, 1974). Accumulation of sediments during this time includes evaporites, alluvium, playa sediments, and eolian deposits intercalated with volcanic ash and mudflows.

Quebrada De Los Arrieros

Quebrada De Los Arrieros is a shallow arroyo incised into Miocene gravels that drains west into a small salar just south of the Spence porphyry copper deposit (Fig. 1). The drainage receives sediment from outcropping areas that include Paleozoic granite and rhyolite, Jurassic marine evaporites, Cretaceous granodiorite, and minor Tertiary felsic intrusives. The only significant mineralization known to occur in the drainage basin is El Tesoro, located 7 km to the southwest of the study area. El Tesoro consists of exotic copper oxides hosted in Miocene gravels and occurs at an elevation slightly higher than the sampled profiles. The hypogene source of the deposit has never been discovered. The deposit was undeveloped at the time of sampling.

At the sample site, alluvium is exposed over 2.53 vertical meters. The vertical profile consists of a polymictic surface lag underlain by thin powdery soil referred to as "chusca", chusca with a friable network of gypsum, and dense caliche-cemented alluvium. The caliche is largely gypsum with halite and other soluble salts. A prominent feature at Quebrada De Los Arrieros is the occurrence of vertical fissures that are 2-30 cm wide and truncate the stratigraphy (Fig. 3). The spacing between the fissures is irregular but they generally occur every 5 to 10 meters. The interior of the fissures is lined with thin, vertically laminated salt indicating the movement of water along the open fractures (Fig. 4).

One continuous vertical profile and two horizontal profiles were sampled. The vertical profile consisted of samples collected continuously from the surface lag to the base of the exposure at 253 cm. The profile was located away from vertical fissures and sample intervals varied from 1-30 cm. The horizontal profiles consisted of one near the surface within the thin chusca horizon, and the other directly below on the

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vertical exposure at 170 cm depth within the dense caliche-cemented alluvium (Fig. 3). Both horizontal profiles were centered on the vertical fissure shown in Figure 3 with a sample interval of 30 cm (i.e., the width of the fissure in this location).



Figure 3. Exposure showing dense caliche-cemented alluvium and prominent vertical fracture. Horizontal profiles were collected at the surface within the thin chusca horizon and at 170 cm depth within the dense gypsum-rich caliche zone.



Figure 4. Close-up view of a typical vertical fracture showing laminated salt.

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Sample Preparation and Analysis

The lag sample and samples collected from the dense caliche intervals were crushed prior to sieving; all samples were sieved to <250 microns (<60 mesh). Samples were randomized and standards were inserted prior to analysis. Samples were analyzed by the methods listed in Table 1 in increasing order of strength. The target extraction phase is also listed, although none of these methods are selective due to the high concentration of water-soluble phases in this environment.

Table 1. Partial Extraction Methods

Extraction Method (Abbreviation)	Analysis	Lab	Targeted Phases
De-ionized Water (DI)	ICPMS	Chemex, Vancouver	Water soluble phases
Enzyme Leach (EL)	ICPMS	ACTLABS, Ontario	Amorphous Mn oxides
Cold Hydroxylamine Hydrochloride/HNO ₃ (CH)	ICPMS	Chemex, Vancouver	Amorphous Mn oxides
Hot Hydroxylamine Hydrochloride/HCl (HH)	ICPMS	Chemex, Vancouver	Amorphous Fe and Mn oxides

Results

Vertical Profile

Results for selected major elements, trace elements and halogens are shown in Figures 5-7. High concentrations of sodium and calcium for all methods (where analyzed) reveal the high saline composition of the alluvium (Fig. 5). Calcium is low in the lag and chusca samples, but has a high concentration within the friable gypsum and caliche zones. Sodium is largely

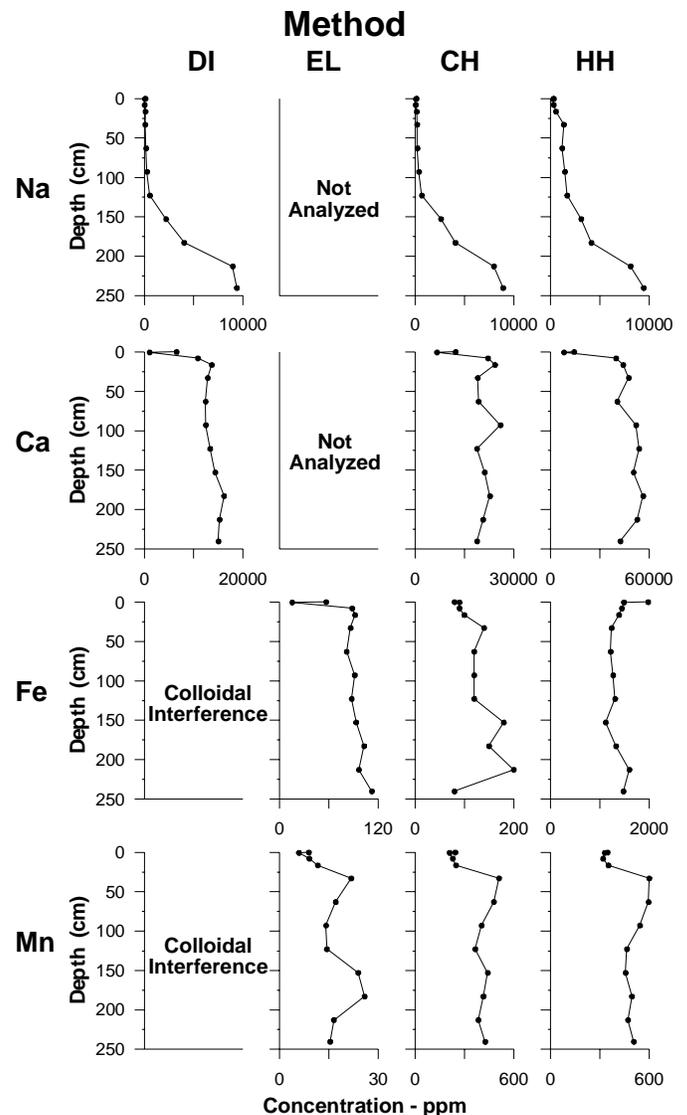


Figure 5. Major element results by each method for the vertical profile (see Table 1 for method abbreviations). From top to bottom, samples are: 1) lag at surface; 2) thin chusca (1 cm interval); 3) chusca with friable gypsum (14 cm interval); 4) thin gypsum hardpan (3 cm interval); and 5) dense caliche-cemented alluvium (30 cm intervals in succession).

absent in the upper part of the profile, and systematically increases in the lower part, below 125 cm. Iron by Enzyme Leach and cold hydroxylamine show similar concentrations. The order of magnitude higher concentration for iron by hot hydroxylamine reflects the partial dissolution of magnetite. Manganese is low for all methods in the upper part of the profile with increased concentration coincident with the caliche-cemented zones.

Copper and arsenic show similar patterns to each other for all methods with the highest concentrations in the lag and chusca samples at the top of the profile (Fig. 6). Copper by Enzyme Leach shows a slight increase in concentration with depth. Molybdenum shows a consistent increase with depth, starting with the top of the caliche-rich part of the profile. Rhenium was only detected by the Enzyme Leach method. Rhenium occurs in low concentrations in the upper part of the profile and shows a systematic increase in concentration starting at 150 cm depth.

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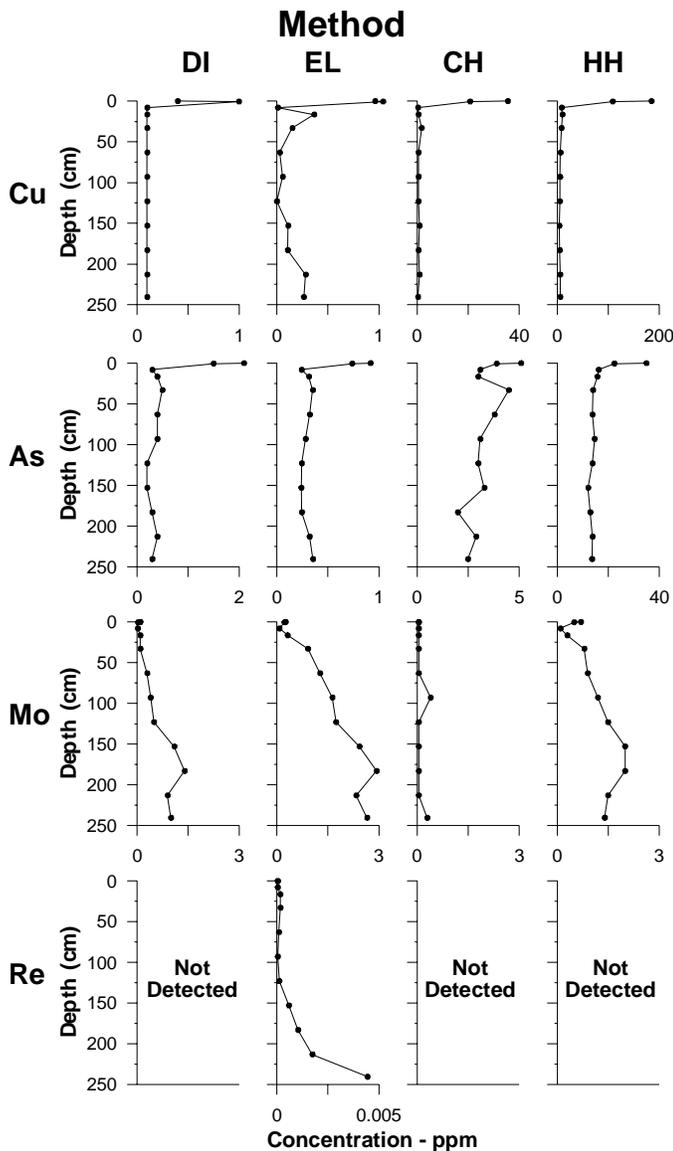


Figure 6. Trace element results by each method for the vertical profile (see Fig. 5 for further explanation).

Overall, the halogens show low concentrations in the upper part of the profiles and increasing concentrations with depth (Fig. 7). Iodine extracted by cold and hot hydroxylamine show a slightly more complex pattern, with a slightly elevated concentration in the upper part of the profile, a prominent spike at 93 cm depth, and a gradual increase with depth. Enzyme Leach shows a significantly lower iodine concentration than de-ionized water and hot hydroxylamine is lower than cold hydroxylamine. This difference is likely due to calibration error.

Horizontal Profiles

Results for the same selected major elements, trace elements and halogens are shown in Figures 8-10. Sodium is almost completely absent from the surface chusca horizon, but percent level concentrations detected by all methods exist at

Continued on Page 6

IGES Geosoft Meeting Notice

Geosoft is pleased to announce that it will be holding a Geochemistry Forum on Sunday May 6, 2001 prior to the IGES conference in Santiago for its Chimera Exploration Geochemistry software users. The event will feature a preview of future technology directions as well as Chimera presentations from senior explorationists and scientists at Anglo American, BHP, WMC, and Geological Survey of Denmark and Greenland (GEUS).

One of Geosoft's geological / geochemical experts will also be on hand to show highlights from the recently released upgrade to Chimera. The upgrade includes new mapping and tri-plotting capabilities focused to the needs of exploration professionals. Other topics will focus on new Oasis montaj technology developments, including 3D surface plotting of exploration geochemistry, geophysical and geological results, and new methods for accessing and sharing spatial data via the Internet.

The event is scheduled to run between 3:30 and 5:30 pm at the Hyatt Regency hotel, Santiago. Other interested geology or geochemistry professionals who would like to learn about how the Chimera application and the Oasis montaj spatial data system (SDS) can be used to address their specific exploration problems are invited to visit Geosoft's booth at the IGES.

For final details on the Geochemistry Forum arrangements, please visit www.geosoft.com after April 15, 2001.

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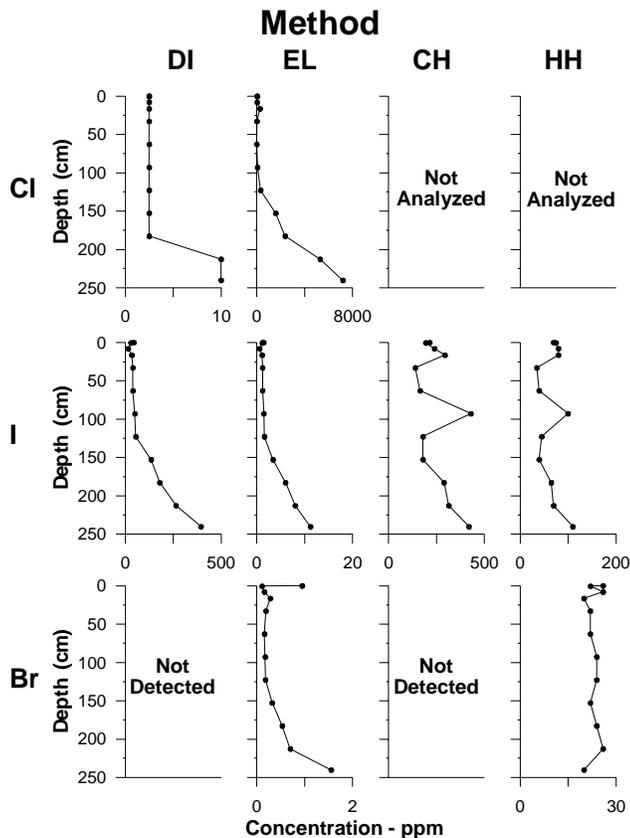


Figure 7. Halogen results by each method for the vertical profile (see Fig. 5 for further explanation).

170 cm depth (Fig 8). A prominent spike in concentration within the fissure occurs for the cold and hot hydroxylamine methods. Calcium shows greater variability in the surface

profile and has slightly lower concentrations than the profile at 170 cm depth. Iron shows a positive concentration spike within the fissure at depth for all methods. Enzyme Leach-extractable manganese shows a spike within the fissure, but this does not occur with the other methods.

Copper and arsenic generally have higher concentrations in the surface profile compared to the profile at depth for all methods (Fig. 9). However, within the lower profile, concentrations reach a maximum in the fissure for copper and arsenic by all methods. Molybdenum shows very low concentrations at surface and elevated concentrations at depth. Deionized water

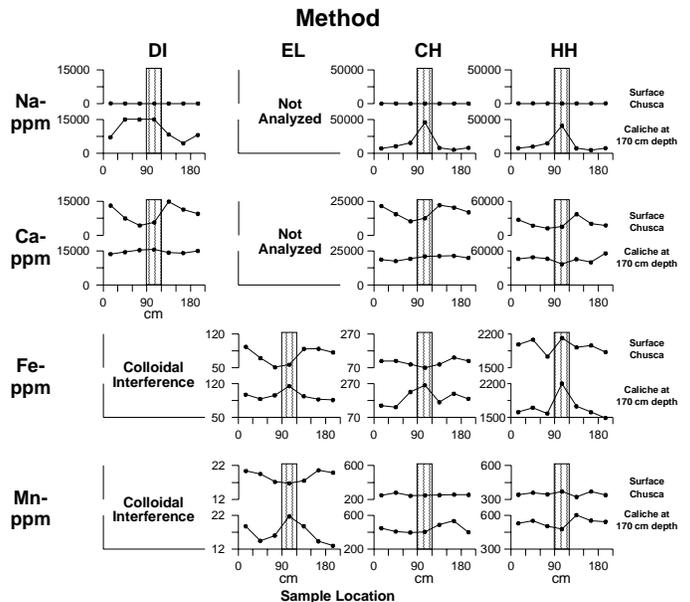


Figure 8. Major element results by each method for the horizontal profiles (see Table 1 for method abbreviations). Upper profile shows results for samples collected at the surface within the thin chusca horizon. Lower profile shows results for samples collected in the dense caliche-cemented alluvium at 170 cm depth. Samples were collected continuously using 30 cm intervals. Each profile was centered on the fissure shown by the vertical bar.

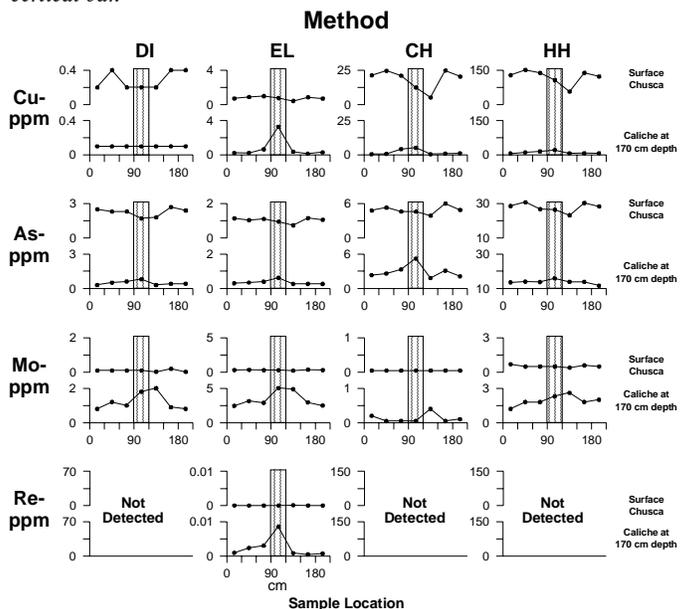


Figure 9. Trace element results by each method for the horizontal profiles (see Fig. 8 for further explanation).

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and Enzyme Leach show higher concentrations for molybdenum in and adjacent to the fissure at depth. Again, rhenium was only detected by the Enzyme Leach method. Rhenium concentrations in the surface profile are below detection but they are elevated at depth and reach 8.5 ppb within the fissure.

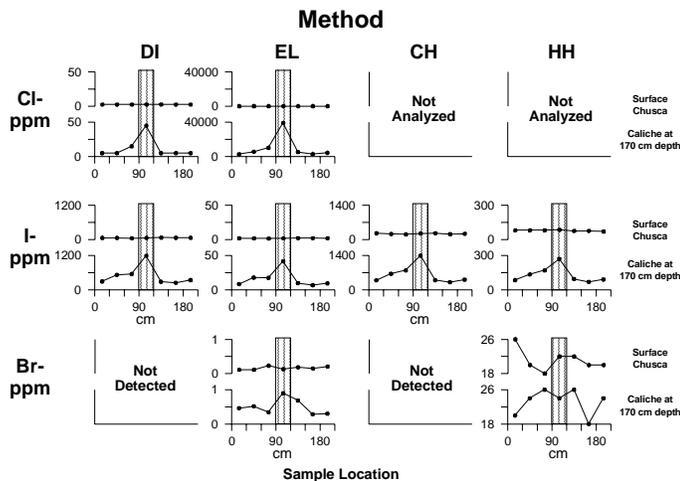


Figure 10. Halogen results by each method for the horizontal profiles (see Fig. 8 for further explanation).

The halogens show low concentrations in the surface profile, high concentrations in the lower profile, and a prominent concentration spike in the fissure at depth for all methods (Fig. 10).

Discussion

Field relations at Quebrada De Los Arrieros indicate the following sequence of events, from oldest to youngest: 1) deposition of Miocene gravels; 2) cementation of gravels by gypsum and other salts to form dense caliche; 3) vertical fracturing of brittle caliche-cemented alluvium, and 4) deposition of salts within the open fissures. The age of cementation of the gravels is uncertain, although it likely occurred when the water table was relatively high. Gypsum can form from the evaporation of downward percolating surface water or by the evaporation of sulfate-rich groundwater in the capillary fringe above the water table (Ericksen, 1981; Drever, 1988). Ericksen (1981) found that condensate derived from coastal fog is rich in sulfate and Alpers and Whitmore (1990) documented sulfate rich groundwater within the Escondida deposit and in salars to the east and south. Since caliche-cemented alluvium is regionally extensive in northern Chile the majority of gypsum in caliche is likely related to groundwater.

Brittle fracturing and formation of fissures in the alluvium is almost certainly related to seismic activity. The Central Andes is a region of high seismicity related to the subducting Nazca Plate. Hanus et al. (2000) recognized the coincidence of seismically-active corridors and mineral deposits in the Central Andes. Noting that the deposits within these corridors transcend time, these authors concluded that the corridors reflected permanent fracture zones that were reactivated through time. Deposition of salt within the fissures could have formed from downward percolating surface water or from over pressured groundwater expelled during seismic events.

Cameron (1998) proposed the concept of "seismic pumping" as a mechanism for moving mineralized, saline water from

a deep target, e.g., a porphyry copper deposit beneath gravels, up faults and fractures, where the water floods the surface to form an anomaly. The anomalies are created incrementally by water flooding from multiple seismic events and are preserved in the hyper-arid climate, with minimal soil erosion in the flat pampas (Cameron, pers. Comm., 2001).

The constant concentration of calcium in the vertical profile is consistent with the gypsum observed in the exposure. However, results from this study clearly show that the most soluble salts (such as halite) are removed from the upper part of the profile. For instance, sodium, molybdenum, rhenium, and the halogens show low concentration in the upper part of the profile and increasing concentrations with depth. This is consistent with the removal of soluble salts and mobile oxyanions by rare infiltrating surface water and is similar to the leaching and concentration mechanism proposed by Ericksen (1981) for the nitrate deposits. The sequence of precipitation of salts from evaporation of saline water is gypsum, halite, and chlorides and sulfates of magnesium and potassium (Drever, 1988). Thus, surface water would dissolve these minerals in reverse order, with gypsum being the most insoluble. Although a significant amount of the saline minerals are halite and gypsum, a variety of other sulfates, nitrates, borates and iodates of varying solubilities are common in northern Chile (Ericksen, 1981).

The porphyry copper-related pathfinder elements (Cu, As, Mo, Re) presented here have anomalous concentrations compared to other surveys conducted in this environment and those found at Radomiro Tomic (Seneshen, 1997) and Chimborazo (McEwen, 1999), both of which are porphyry copper deposits. The elevated molybdenum and rhenium within the caliche indicate that the groundwater had anomalous concentrations of these elements. This groundwater may have been affected by the exotic copper mineralization at El Tesoro or perhaps the undiscovered hypogene source. A groundwater survey conducted around the buried Casa Grande porphyry copper deposit in Arizona, USA showed anomalous molybdenum extending 7 km away from the deposit (Nowlan et al., 1981).

Results for the profiles show that copper and arsenic are enriched in the upper part of the profile, particularly in the lag and chusca horizons. In nearly all cases, concentrations are higher in the lag sample (crushed to <250 microns) than the underlying chusca sample. This suggests that the source of high copper and arsenic is related to the composition of the lithic fragments on the surface. Similar lithic fragments likely occur in the cemented alluvium below but those samples are effectively diluted by the caliche. The source of the anomalous lithic fragments is not known but it may be related to mechanical dispersion from an unknown source.

The salt filling the fissures that cut the caliche resulted from movement of saline water along the open fissures. The vertical profile shows that the leaching of soluble salts is strongest above 125 cm depth. The horizontal profile at 170 cm depth is below the level of strongest leaching and thus better reflects the original composition of the profile. In addition to sodium and the halogens, copper, arsenic, and rhenium show their maximum concentrations within the fissure. This suggests that the water was elevated in these elements and perhaps similar to the earlier groundwater that formed the caliche. This also supports the seismic pumping of groundwater as the source for the saline metalliferous water.

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Conclusions

A vast part of northern Chile lies within a region of internal drainage creating an environment of geochemical recycling. The uplift and weathering of porphyry copper deposits produced mechanical and chemical dispersion and a high geochemical background. Surficial processes and the interaction with groundwater control the redistribution of pathfinder elements in this environment. Processes that are considered important are: 1) mechanical dispersion of mineralized and altered material; 2) weathering of this material producing additional release of pathfinder elements and incorporation in less labile phases; 3) deposition of saline minerals within alluvium in the capillary fringe above the water table; 4) brittle fracturing of the caliche-cemented overburden by seismic activity; and 5) deposition of saline minerals in fissures related to the seismic pumping of groundwater as proposed by Cameron (1998). Thus, the composition and distribution of groundwater plays an important role in the chemical redistribution of porphyry copper-related pathfinder elements.

Acknowledgments

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References Cited

- Alpers, C. N., and Brimhall, G. H., 1988, Middle Miocene climatic change in the Atacama Desert, northern Chile: Evidence from supergene mineralization at La Escondida: GSA Bulletin, v. 100, p. 1640-1656.
- Alpers, C. N., Whittemore, D. O., Hydrogeochemistry and stable isotopes of ground and surface waters from two adjacent closed basins, Atacama Desert, northern Chile in Kharaka, Y. K. (editor), Barnes, H. L. (editor), Water-rock interactions, *Applied Geochemistry*, 5 (5-6), p. 719-734, 1990.
- Cameron, E. M., 1998, Deep penetrating geochemistry, CAMIRO Study, Phase I Report, 117 pp.
- Drever, J. I., 1988, The geochemistry of natural waters, Second Edition, Prentice Hall, Englewood Cliffs, New Jersey, 437 pp.
- Ericksen, G. E., 1981, Geology and origin of the Chilean nitrate deposits, USGS Professional Paper 1188, 37 pp.
- Hanus, V., Vanek, J., and Spicak, A., 2000, Seismically active fracture zones and distribution of large accumulations of metals in the central part of the Andean South America, *Mineralium Deposita*, 35, p. 2-20.
- McEwen, R. M., 1999, Chimborazo copper deposit, Region II, Chile: Use of secondary multi-element geochemical dispersion to detect buried mineralization in a hyperarid environment, Unpub MS Thesis, Colorado School of Mines, Colorado.
- Mortimer, Cedric and Saric, R. Nicholas, 1975, Cenozoic studies in northernmost Chile: *Geologische Rundschau*, v. 64, no. 2, p. 395-420.
- MunchMeyer, C., 1996, Exotic deposits – products of lateral migration of supergene solutions from porphyry copper deposits, in *Andean Copper Deposits: New discoveries, mineralization styles and metallogeny*, SEG Spec. Pub. Number 5, p 43-58.
- Nowlan, G. A., Ficklin, W. H., and Preston, D. J., 1981, Geochemistry of waters from deep irrigation wells in the vicinity of a deeply buried porphyry copper deposit near Casa Grande Arizona; SME Preprint 81-392.
- Seneshen, D., 1997, The applicability of partial extractions to mineral exploration in areas of transported overburden, Unpub. PhD Thesis, Queens University, Ontario, 406 pp.
- Sillitoe, R. H., and McKee, E. H., 1996, Age of supergene oxidation and enrichment in the Chilean porphyry copper province, *Economic Geology*, Vol. 91, p 164-179.
- Stoertz, G. E., and Ericksen, G. E., 1974, Geology of salars in northern Chile, USGS Professional Paper 811, 65 pp.

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Distinguished Lecturer Tour

It is hoped that Dr Clemens Reimann will be able to deliver a series of AEG Distinguished Lectures while visiting Australia and North America in September/October 2001. Abstracts of his five possible lecture topics are in Explore No 109. Anybody interested in hosting Dr Reimann should contact D.Garnett, either through the AEG office or directly at naa@bq.com.au.



President's Message

Continued from Page 1

aspects of the geochemistry of natural resources; their discovery, management, exploitation and remediation. The proceedings of the 20th IGES will be published in GEEA as soon as practical. So the word will be spread!

The long-term success of GEEA depends on the quality and quantity of papers it carries. This is where **YOU**, the members of the Association must play your part. Papers do not just “materialise” out of thin air, they have to be written, cajoled out of people with ideas in their heads, dusted down out of cupboards. We cannot rely on “someone else” to do this. It’s our new Journal, we have to ensure it is a success.

So now to a brief retrospective of the past year. The AEG has been firmly yet tactfully guided by Paul Taufen over the last year. We owe Paul a great debt of gratitude for the skill of his presidency. For me one of the great advances made under Paul’s guidance has been the growth of our web site (www.aeg.org). The website was launched by the hard work of Beth McClenaghan. Beth acquired a new mission in life, her son, Connor, and has passed the website on into Steve Amor’s capable hands. Thanks Beth for all your hard work! AEG has provided funding to employ the services of a programmer to help with the day to day “nuts and bolts” of maintaining the web site. I think the expansion of the web site has been a major achievement of the last year.

One of the issues AEG Council felt strongly about in 2000 was the inevitable gap in delivery of journals to you. The last AEG-sponsored edition of JGE came out in early 2000, and as noted above the first edition of GEEA arrived almost a year later. In order to help compensate members for this hiatus, we have published a book entitled *Drift Exploration in Glaciated Terrain*, (Geological Society of London Special Volume 185), edited by M.B. McClenaghan, P.T. Bobrowsky, G.E.M. Hall and S. Cook. We had hoped to distribute this volume in late 2000, but circumstances conspired to delay publication. I hope that by the time you read or hear this message, you will have it. We are very grateful to all our members for their patience during this transition. There have been very, very few complaints. Thanks for your forbearance! I know that GEEA will be a huge success and that the wait will have been worthwhile.

A further highlight of the last year is the election of two of our members, Eion Cameron and Alan Coope, to the ranks of Honorary Membership of AEG. It’s hard to comprehend how these men found time to offer so much to the Association and to contribute in such massive ways to exploration geoscience and the interests of their employers. I cannot imagine two more worthy recipients of Honorary Membership of the Association.

I’m fortunate to have discovered the excitement of geochemical exploration as a young man, largely inspired by Dr Cliff James, then at Leicester University. I’ve been lucky enough to be paid to visit many fascinating parts of the world. I was going to add “and some less so”, but now I come to think of it I can’t remember any of the less fascinating ones! This industry has given me an exciting and stimulating career. I view the chance to serve as your president as a great honour and hope to put back into the industry a very little of what it’s given me.

But make no mistake, things are not as they were. The mining industry is in decline: it is “on the nose” in public opinion terms. Whilst one hopes this will be a temporary feature, increasingly I’m not so sure. I don’t believe the speculative capital will ever come back to the exploration Juniors, at least not like before. With the Majors cutting back on exploration,

especially green-fields, it’s increasingly hard to see who is going to find the new ore bodies the industry needs for long term stability. These cut backs in mineral exploration inevitably lead to reductions in funding for teaching, less money for research and a lower profile for our science at government level, putting geological survey organisations under further pressure. There *will* be a new order, one day, but what it will be, I cannot predict! Keeping our Association relevant to scientists involved in all aspects of the geochemistry of natural resources in this new order, whatever it may be, is a huge challenge, and one that I hope AEG Council can continue to deal with this coming year. We will be asking the AEG voting members to consider and vote on some issues that relate to our By Laws and Constitution. It is fundamental to our long-term direction and the well being of the Association, that all members make their views clear to Council. Please consider these issues carefully and let Council know what you think. It is your association after all!

Have a great 20th IGES, and good fortune in your exploration activities!

Nigel Radford

AEG President, 2001.

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THE AEG MEMBERSHIP DEBATE.

AEG has expanded the scientific scope of its flagship publication. Our new journal is called “***Geochemistry: Exploration, Environment, Analysis***”. The name says it all! This single move has opened the way for an even broader range of geochemists to publish in our journal. We attracted a surprising number of environmental papers even before, but with the word Environment in our title, I believe we will get still more. In so doing we will all learn from each other. Our science will benefit.

We are in the process of re-writing our By Laws, and the proposed changes need to be put to the voting members soon. AEG Council should ensure that all the changes likely to be required in the foreseeable future have been taken into account. So the issue of widening the scope of the Association itself comes into consideration again. It is especially pertinent as we try to establish Student Chapters. The last formal review of AEG’s scope was carried out in 1990 and reported in EXPLORE number 73 in 1991. I urge any members who have not done so, to read this review. The Executive Summary is being placed on the AEG web site. Ten years later the issue of whether or not to widen the scope of the Association is still the proverbial “hot potato”.

Why consider changes to the scope of AEG? Well we don’t *have* to. We can carry on as at present. What AEG does and stands for is still highly relevant to many of its members. However there are some points to consider.

- The issue of widening the membership comes up again and again, and has done for at least 15 years. Ultimately the voting members have to resolve the issue.
- The total membership of the Association is declining. In 1980 we had 653 members, in 1990 we had 1200, 1995 we had 1165, and in 2000 we had 798. Does this simply reflect the exploration industry downturn, or are we losing our relevance, or both?
- Environment is consistently the second most popular area of

Continued on Page 10

AEG Membership Debate... *continued from Page 9*

interest in our membership surveys. This was true in 1980 and is true in 2000.

- Nevertheless, exploration geochemistry has always been the predominant interest of our members, consistently rated first by >80% members.
- “Divisions” between exploration and environmental geochemistry are pretty much arbitrary anyway.

In trying to formulate some proposals to put to Council and the Members on this subject I am greatly indebted to David Garnett for his insights. So what are the options, at least some of them?

Environment has always been the second most popular choice in our members’ interests survey, after mineral exploration. In 1980 40% of our members placed Environment either first (7%) or second (33%). In 2000 those percentages were little changed at 7% and 29%. Many of our members have worked in exploration and moved with the times into environmental science. So environment has always been a popular subject with our members, but it is secondary to mineral exploration. Its popularity has not grown in recent years.

As I said above, we can argue that no changes are needed to the Association and that in due course the exploration industry will recover. Hopefully our membership numbers will recover too. We can continue to “pick off” ideas from environmental geochemistry that have relevance to exploration.

A second position might be to say that our core focus remains in Exploration Geochemistry, but that we widen the By Laws to allow membership to people working actively and presently in environmental geochemistry as it relates to natural resources. At present they are excluded by the wording which only allows fellowship to those who are “actively practicing exploration geochemistry at the time of application” (By Laws section 2.06 iii) and membership to those who are “actively engaged in geochemical exploration at the time of application and for at least two years prior thereto” (By Laws Section 2.09 i). We could easily widen the scope here by changing “exploration geochemistry” to “geochemistry of natural resources”.

The use of this phrase comes from David Garnett. David has made a suggestion that involves re-writing the Preamble to the By Laws. The section PURPOSE currently reads:

PURPOSE. The purposes for which the Association of Exploration Geochemists is constituted are: to form a united and representative group of persons specialising in the field of exploration geochemistry; to advance the science of geochemistry, especially as it relates to exploration and associated research; to foster the common scientific interests of exploration geochemists; to facilitate the acquisition of professional knowledge and information relevant to exploration geochemistry and to promote the interchange thereof among its members; to encourage research and development of geochemical exploration methods; to advance the status of the profession of exploration geochemistry; and to promote and maintain high standards of training and ethics among its members.

David has suggested that we could change it to:

PURPOSE. The purposes for which the Association of Exploration Geochemists is constituted are: to form a united and representative group of persons specialising in the geochemistry of natural resources; to advance the science of geochemistry, especially as it relates to the geochemistry of natural resources - their exploration, exploitation and reclamation; to foster the common scientific interests of geochemists; to facilitate the acquisition of professional knowledge and information

relevant to the geochemistry of natural resources and to promote the interchange thereof among its members; to encourage research into dispersion of geochemical species, both natural and anthropogenic, and to use this knowledge for the development of methods for the improved detection of these dispersion patterns; to advance the status of the profession and to promote and maintain high standards of training and ethics among its members.

If this re-write of the preamble were to be adopted, it would allow us to replace “exploration geochemistry” with “geochemistry of natural resources” throughout the By Laws.

The above is one possible solution. But should we do even more? We could change the name of the Association as well. If we want to embrace fully the concept of an Association dedicated to the geochemistry of all aspects of natural resource geochemistry we might change the name to the Association of Exploration and Environmental Geochemists. Alternatively we might decide that our prime focus is still to be mineral exploration and our Association name is still the appropriate description for our interests. It is worth noting that the 1990 ad hoc committee specifically recommended not to “unreservedly embrace environmental geochemistry”.

However, the 1991 ad hoc committee did recommend that AEG expand its interactions with environmental geochemistry. Our joint meetings with other societies (eg the Vail meeting in 1997), the explicit inclusion of Environment in the title of GEEA and the regular inclusion of environmental papers in recent editions of JGE, all demonstrate this to have taken place. Some might argue that our By Laws should catch up with this reality. However, do we want to go further and re-define the Association with a name change?

There seem to be 3 options. One is that no change is needed. Two is to expand the Purpose of the Association and substitute the words “geochemistry of natural resources” for “exploration geochemistry”, but not to go further. Three is to do two and change the name of the association to specifically include the word “environment”. The only people who can make such changes are the Association’s Fellows, the voting members. Their opinion, once expressed, should put an end, for the foreseeable future, to any further discussion of the issue.

However, tempting though it may be to place these three options in front of the members at one time for a decision, there are serious drawbacks to referenda that pose more than two options. In a 3 way question, it is eminently likely that the point that receives the most votes, and hence is adopted, will in fact not have been supported by a majority. To my mind, this does not settle anything. Therefore I would support putting something like the following to the Members:

In order to revise the By Laws of the AEG, which of the following do you support?

1. No change to the purposes of the Association, or its membership requirements should be considered.
2. The Purpose of the Association be amended (along the lines quoted above) and the requirements for membership and fellowship be expanded to allow for this, but that mineral exploration remains the principal focus of the Association of Exploration Geochemists.

Discussion of the possibility of changing the name of the Association to my mind has to follow resolution of the two issues above. If the vote favours no change, clearly any change in name is irrelevant.

I invited discussion of this subject with an article on page 17 of **EXPLORE 108** last year. Both then and now, I have tried to put these issues forward with as little as possible of my own prejudices. I urge you all to think about these issues, and to

AEG Membership Debate... *continued from Page 10*

discuss them in the columns of Explore and on the web page. Contact any member of Council and pass on your opinions. This issue will be on the agenda for the forthcoming AGM in Santiago at the 20th IGES. This edition of **EXPLORE** is scheduled to contain at least two divergent opinions on the subject, from Tod Wakefield and Philippe Freyssinet. Please have your say! For those of you who feel strongly, but are not voting members, now is the time to upgrade your membership to Fellow status, so that your voice can be heard. Fellowship costs the same as Ordinary membership, so there's no excuse not to have your say.

Nigel Radford.

President AEG 2001.

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Committee Reports

By-Laws Review Committee

Discussion on revision of the By-Laws has continued within Council. It was hoped that there would be useful input from members as a result of Nigel Radford's review of current issues relating to the By-Laws in Explore No 108. The response was disappointing and the Committee feels that we should not delay too much longer before finalising proposals for changes to the By-Laws. It is clear that whatever is proposed will not satisfy all members but it is now rapidly approaching the time when outstanding issues should be resolved by majority vote.

David Garnett

Chairman By-Laws Review Committee

AEG Admissions Committee Annual Report - 2000

The Admissions Committee processed thirty-two applications for membership (5 Fellows, 23 Members, and 4 Students) during the year. This is again a significant decrease in total applications from the previous year. Hopefully, the upcoming IGES in Santiago and the arrival of the new journal will result in an upturn in 2001.

Lloyd James

Chairman, Admissions Committee

Treasurer's Report, March 2001

The October 2000 issue of Explore contained a summary of our audited financial statement for 1999; that for 2000 will not be complete for several months yet. The situation for 2000 will be very different because there will be no journal royalty, the major source of revenue for the AEG. The members' journal subscription allotment for 2000 is going towards covering the cost of the hard-back book on Drift Prospecting, edited by Beth McClenaghan et al and due out imminently. Our present financial holdings are as follows:

CIBC Canadian	\$4,552.62
CIBC US	\$23,177.47
Canada Trust Canadian	\$959.06
HSBC Investments Canadian	\$643,395

Gwendy Hall

AEG Treasurer

Business Manager's Report

For year 2000, the AEG had a total membership of 798, compared to 939 members for 1999. The year 2000 total comprises 267 Fellows (voting members), 490 Members (affiliate), 15 Corporate, 15 Student, 9 Explore only and 2 Honorary memberships. This total includes 29 new memberships.

As a reminder to our members, your AEG membership for 2000 did not include the new Journal but a copy of a hard cover book entitled "Drift Exploration in Glaciated Terrain" edited by Beth McClenaghan and others. This book is expected to reach our members by mid April 2001. As well, our members for 2000 received four issues of the EXPLORE newsletter and access to the "members only" component of our website.

Our membership database indicates that 649 members have email addresses, while 149 members do not. Members are encouraged to submit email addresses if they have not done so, in order that we might use this tool for next year's membership renewal drive and save on postage costs. Any members who do not provide email addresses will receive their renewal notices in the mail.

Secretary's Report

Since the Association's last Annual General Meeting in November 2000, Council and Executive held two regularly scheduled meetings by telephone conference in November 2000 and February 2001. Significant accomplishments included:

1. Initiating a review of AEG Committees and the goals of these committees.
2. Establishing a Web Site Committee chaired by Steve Amor to oversee the AEG web site.
3. Electing two Honorary Members: Alan Coope and Eion Cameron.
4. Filling the vacant Regional Councilor position for China. Dr. Xueqiu Wang of the Institute of Geophysical and Geochemical Exploration in Lang fang, Hebei was nominated and agreed to accept the position.
5. Completing the election process for Ordinary Councilors for the Association for 2001-2003. The new Councilors are: Mary Doherty, Christopher Oates, Dave Kelley, Steve Amor, and Cliff Stanley.



NOTICE OF AGM

The AEG Annual General Meeting will be held in Santiago, Chile at 4:30 pm on the 9th of May, 2001. See the attached 20th IGES flier for details.

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Technical Note

$$Z_i = \frac{X_i - \bar{X}}{S}$$

Geochemical Data Quality: The “Fit-for-Purpose” Approach

Leigh Bettenay and Cliff Stanley

This contribution is motivated by several recent attempts by government agencies and geochemical consultants to institute formal assessment procedures for the quality of geochemical data produced by geochemical laboratories, using a data-driven statistical approach. We contend that this approach is philosophically unsound and can be thoroughly misleading. A better strategy is to assess data quality in terms of whether it is suitable for the task at hand. This we will call the “Fit-for-Purpose” approach.

A recent example of the data-driven approach is given in Steger (1999) with reference to proficiency testing of laboratories by the CCMET (Canada Centre for Mineral and Energy Technology). The CCMET “PTP-MAL” program seeks to provide a procedure for assessing laboratory proficiency. Clearly, given the present trend towards laboratory certification in a competitive and depressed analytical market, it is vital that laboratories perform well in proficiency testing. However, several key questions must be addressed before proficiency testing can assume a credible footing:

- *What is laboratory proficiency and how do we measure it?* In particular, shouldn't both accuracy and precision factor in?
- *How good is ‘good enough’?* Shouldn't the necessary level of laboratory proficiency be only as good as the survey objectives require?

In our view, the various proficiency testing programs presently underway have not given adequate consideration to these questions. Although we will focus on the PTP-MAL program to illustrate these points, it should be noted that a comparable approach underlies several laboratory performance programs used in Australia. Thus it is the philosophical and statistical approach, rather than the specific program, that we wish to question.

The procedures outlined by Steger (1999) for assessing laboratory performance in the PTP-MAL program are complicated, but they are all based essentially on the assessment of standardized scores of the results of four samples with element concentrations within the “target range” for each participating laboratory. The standardized scores (or z-scores) are calculated by re-scaling the data using the mean and standard deviation of the observed data distribution. The scores are thus merely the result of a linear transformation of the original data into a new variable, and have a mean of zero and a standard deviation of unity.

In this application, a z-score is calculated for each determination of a particular element in a particular sample with unknown concentration by:

where \bar{X} and S are the mean and standard deviation of the data population (the “consensus values”; Steger 1999), and are derived from *all* of the results from *all* laboratories for that element in that particular reference material, derived from that round of testing.

We note in passing that it is generally accepted that transformations like the z-score in geochemistry should first involve the recognition and removal of outlying data in order to obtain robust estimates of both the mean and standard deviation of each set of data (e.g. Ramsay, 1993; Ramsay et al., 1992). It is not clear how the PTP-MAL program does this, although references to ‘by eye’ have been reported (pers. comm. – H.F. Steger, May 1999).

After calculation of the z-scores for each element, the assessments of each laboratory’s performance are then made according to how the respective z-scores compare with the balance of the participating laboratory results. Several assessments are made using both individual elements and in combination, but all are ultimately based on the z-scores for each element. A rating is then given to each laboratory with possible values of “Good”, “Satisfactory”, “Questionable” and “Unsatisfactory”.

Problems

We believe that there are several fundamental and possibly fatal problems with this approach.

- 1) The scaling measure used to determine the level of proficiency (the z-scores) comes entirely and exclusively from the participating laboratories, and only those laboratories participating in that round of testing.

Given a normal distribution of results (the assumption implicitly employed in the PTP-MAL program), some laboratories will inevitably report on the outskirts of the data distributions. This is a fact no matter how tightly clustered or spread the results might be (excepting in the trivial case where all results are identical). However, this does not mean that all or any of these ‘outlying laboratories’ are ‘unsatisfactory’, because a certain percentage of results are guaranteed by the normal distribution to be on the outskirts of the population. Furthermore, it is possible that the ‘outlying laboratories’ may be the only ones that produced results that are accurate. Conversely, laboratories with element concentrations nearer to the central tendency of the data cannot be considered necessarily ‘satisfactory’ using this approach, because the majority of the laboratory results could be wrong. In fact, all laboratories could be ‘wrong’, whether they cluster within the majority group or not, and no indication of this condition would be evident as a result of proficiency tests based solely on z-scores.

Effectively, the statistical tests undertaken in programs like PTP-MAL merely serve to determine whether the results of a particular laboratory are similar to or different from results from the other laboratories in that round of the proficiency testing program. The assessment therefore tests neither the accuracy (results are not compared with a known, accepted value) nor the precision (just one analysis of each sample for each element is undertaken so reproducibility remains unassessed). Thus in our view, such tests fail to adequately assess laboratory proficiency.

- 2) The entire premise for the statistical tests employed in the proficiency-testing program, namely that the results are derived from a normal distribution, is neither justified nor tested during the evaluation procedures.

This fundamental shortcoming further undermines the

Continued on Page 21

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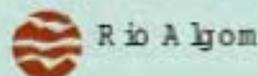
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Monday May 7th to Thursday May 10th 2001 Technical Sessions

A total of approximately 50 oral presentations will be made on the following subjects: Gold, Platinum Group Metals, Base Metals, Partial Leach, Regional Studies and Environment. An extensive set of subjects will also be presented as simultaneous posters. Commercial exhibits will feature some of the latest exploration technology.

Monday May 7th 2001 Plenary Session

The Plenary Session will feature addresses made by several distinguished speakers including: Francisco Camus, Codeico and Josef Ambrus, GeoVectra.

Abstracts titles submitted to date include the following:

- Proterozoic mineralization identified by integrated regional geochemistry, geophysics, and bedrock mapping in Western Australia. Paul A. Morris, Ezean Pezain, and Sergey Shevchenko
- Evaluation of selective extractions in glaciated permafrost terrain at the Pb-Zn Swain deposit, Yukon Territory, Canada. Dr. K. Fletcher and J. Bond
- Dispersion of gold in a rain forest stream in the S.Kali region, Sabah, Malaysia: implications for exploration. Dr. K. Fletcher and James Prida
- Dispersion of gold in Slesse Creek, British Columbia. Dr. J. Hubbard and W.K. Fletcher
- Exploration geochemistry of stream sediments and surficial deposits at Pasqua-Lama, Mt. Emily District and W.K. Fletcher
- Environmental Geochemical Atlas of Southern Sardinia. M. Bani, B. De Vivo & A. Lima A. Muzicelli & S. Presti
- Environmental geochemical exploration in the area of an old copper mine, Asturias, Spain. Jorge Laredo, Andrés Álvarez-Walumborke, Almudena Ordóñez, and Jesús García Iglesias
- Heavy metals in groundwater around massive sulphide deposits - Exploration and environmental aspects. Héctor Pizarro's, Marie-Lou Tenlen-Waebler, Miguel Arenas, Ricardo Castroviya, Yves Deschamps, Flavio Gualerini, Anaull Lastin, Ascencio Molina
- The selective extraction of arsenic in selected minerals and tailing samples. Patrícia C., Ferreira da Silva, E., Cardoso Fonseca, E.
- Radon in groundwaters from Guaraní aquifer, South America: environmental and exploration implications. Daniel Marcos Benito and Lawrence Caprioglio
- Fluid inclusion for exploration - The acoustic decapsulation method. Kingsley Burrows
- Objective assessment of new analytical geochemistry exploration methods: Distinguishing between scientifically valid approaches and 'witching sticks'. Prof. Clifford R. Stanley
- Primary lithochemical alteration halos associated with the Carlingford Broken Hill-type Ag-Pb-Zn sediment hosted massive sulphide deposit, Mt. Isa Inlier, Queensland: implications for genesis and mineral exploration. Stanley, C.R., Walters, S., Jeffrey, S., and Lewis, D.
- Primary dispersion halos about the Mt. Charlotte mesothermal Au-Quartz vein system, Kalbarrie, Western Australia: Implications for distal lithochemical exploration parameters and deposit genesis. Stanley, C.R., and Badford, N.
- Origin of manganese and base metal anomalies in Paleozoic cover rocks overlying the Eastern margin of the Arabian Shield. Ahmad M. Al-Saleh
- Factors controlling the dispersion of gold in stream at Timberie, NSW. D.R. Cohen, A.C. Dunlop and T. Rose
- "Daughnuts" in the Desert: Success in the Application of Partial Extraction Geochemistry to Deep Cover Mineral Exploration. Peter J. Rogers
- SGG™ - A new soil gas hydrocarbon technique for mineral exploration under deep cover. Eric L. Hoffman, Dale Sutherland, J.R. Clark, Greg Hill and David Leng
- Dispersion into the Tertiary Southern Cross Formation sediments from the Scott and Cindy Lakes, Palfring, N.E. Queensland. Ian D.M. Robertson
- Application of groundwater geochemistry to exploration for paleochannel roll front uranium. House Embayment, South Australia
- MAGSAM: An effective exploration tool for PGM Mineralisation. Craig S. Regless, Ziggy Lubieniecki and Adrian Vanderplank
- New discovery of gold mineralization in Bleida mine (South of Morocco) using geochemistry tool. Y. Zinbi, L. Maacha, A. Saquaque and H. Beaulou
- Exploration for epithermal gold mineralization in the Andes of Ecuador using enzyme leach soil analysis. T.M. Williams and A.G. Grant
- Partial and selective extraction studies in the Yindal Greenstone Belt, Yilgarn Craton, Western Australia. J.E. Wildman, R.R. Anand and G.D. Longman
- Exploration for platinum, palladium and kimberlites in forested terrain of Canada using spruce tree trunks. Colin E. Dunn, Bob Scogel, Larry Lohusen, Dave Seneshen, Gwendy Hall, Andy Bantz
- History, ethnography and archaeology in prospecting. Prof. Dr. Alexander L. Kovalevskii
- Deposits of PGE in weathering crust of deep faults zone. Prof. Dr. Alexander L. Kovalevskii
- Formation conditions of barker-shaped etridal platinum deposits. Prof. Dr. Alexander L. Kovalevskii
- Biogeochemistry and exploration for mineral deposits in the USSR and Russia. Prof. Dr. Alexander L. Kovalevskii
- Ecologic biogeochemistry of mercury in the republic Buryatia. Prof. Dr. Alexander L. Kovalevskii
- Wide-spaced geochemical survey in arid saline terranes, northwestern China. Aueqiu Wang, Qinghua Chi, Zhizhong Cheng, Dawen Liu, Wenchi Zhang and Youquan Yang
- Fluid inclusion petrography and microthermometry as an assisting tool in exploration: An example for precious metals epithermal mineralization in the Chilean Patagonia. Brian K. Townley
- Application of geostatistical methods to the recognition of geochemical anomalies in the Montemiro-Novo area, S. Portugal. Rev. A.R. Sousa, A.J., and Cardoso Fonseca, E.
- Geochemical Exploration as a tool to optimize the Biodegradation Processes of Petroleum Hydrocarbons in Soils. J.L. R. Gallego, J. Loredo, J. Llamas
- Groundwater flow in playa lake environments: Impact on Gold and pathfinder element distributions in groundwaters surrounding mesothermal gold deposit, St Ives Area, Eastern Goldfields, Western Australia. Carey P.L., McPhail, D.C. and Teufen, P.M.
- Data processing for geochemical mapping: An example from Central Colombia. Gonzalez, L.M., Calderin, J.L.
- Westrock Characterization and management: A case study from New Mexico. R.J. Howell and J.V. Parshley
- A Mass Balance Approach to estimate the dilution and removal of pollutants in the Lago Junin drainage, Central Highlands, Peru. R.J. Howell, A. Brignelli, R. Dorey, E. Uria and J. Tomasini
- A systematic classification of regolith gold. Bob Howell and Philippe Freyssinet
- Gold mobility in the regolith at Cobber, N.S.W., Australia: Implications for geochemical exploration and oxide gold resources. K.G. McQueen, K.M. Scott and I.D.M. Robertson
- Fundamentally new geochemical method for quantitative evaluation of magnetic ore deposits. Emelianenko T.I., Solovov A.P. and Malveev A.A.
- Water characterization in Drake mining area, NSW, Australia. Harry Esterio
- Stream Sediment Source Accounting: Locating the sources and magnitudes of stream sediment anomalies. Peter Holyland and Graeme Broadbent
- GeoDAS - A New GIS System for Spatial Analysis of Geochemical Data Sets for Mineral Exploration and Environmental Assessment. Qiuming Cheng, Graeme Bonham-Carter, and Gary L. Ballew
- Naturally occurring Cr⁶⁺ in shallow groundwaters of the Yilgarn Craton, Western Australia. D.J. Gray
- Gold redistribution in the regolith at the Twin Peaks and Monty Dam deposits, Western Australia. Nikita B. Sergeev and David J. Gray
- Lithochemical Vectors Associated with the Kabanga Ni-Cu Deposit in North Western Tanzania. Sitton, A., and C.D. Okijieli
- The Nature and Patterns of Element Dispersion in Aeolian Overburden Associated with Selected Gold Mineralization in Semi-Arid Areas of Southern Africa. Okoyi, C.D., and Acken, P.
- Supergene gold mobility at the Mount Joel prospect, Western Australia. Peter, C.G.; Gray, D.J. & Sergeev, N.B.
- Environmental Geochemistry of Heap Leach Closure. J.V. Parshley & R.J. Howell
- The use of partial extraction geochemistry for copper exploration in Northern Chile. D.I. Keiley, G.E.M. Hall, R. M. McEwen, L.G. Cross, M. Valdez, I. Hamilton
- Geochemical maps of West Greenland: Signatures of environments with gold, high technology metals and kimberlites. Agnete Stenfelt
- Complementary Selective Extraction and Biogeochemical Patterns at the I-10 and Dragon Skarn/porphyry Deposits, Cochise County, Arizona. Gregory T. Hill, J. Robert Clark and Kenneth A. Lovstrom
- How useful is ground based hyperspectral data for the geochemist? Sasha Pomual, Nick Merry and Julian Bartlett
- Three-dimensional investigations of gold dispersion and regolith at the Argo and Apollo deposits, Kambalda, Western Australia. A.F. Brit and D.J. Gray
- Fundamentally new geochemical method of evaluation of hypsometrical level of magnetic deposits ore zone. Emelianenko T.I., Solovov A.P., Malveev A.A.
- Gold Exploration in Covered Areas: Gold Nugget Morphology and Core Crystalgeochemistry as an Exploration Aid. Brian K. Townley, Carlos Melaces M., Victor Maksovi J., and Gerard Herail
- Integrated Geochemical and Geophysical Exploration for Gold: Case History of the Serra de Jacobina Project, Central Brazil. Tracy Minton, Jim Misener, Greg Holyer and Liane Kelly
- Statistical analysis of hydrogeochemical data from a survey in Nova Scotia. Graeme Bonham-Carter, Bahram Daneshfar, Qiuming Cheng, Gwendy Hall and Peter Rogers
- Major morphological and chemical features of regolith gold. Philippe Freyssinet and Bob Howell
- Complementary soil geochemical and subsurface studies in the Abitibi belt, Ontario: comparison of selective leach methods for locating mineralization in overburden-covered terrain and evaluation of processes of element migration. Stewart Hamilton, Eion Cameron, Gwendy Hall and Beth McClenaghan
- Geochemical Dispersion from Tin Deposits in the Western Seward Peninsula, Alaska - Input to Environmental and Exploration Problems. Cynthia C. Farrow and J. Graham Cross
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- Fluoride Problem in Geothermal Waters of India. Dr. S.K. Sharma
- The Geochemical Image of Ore Objects in Country Rock and Thick Cover. I.S. Gopldberg, G.J. Abramson and V.L. Ios
- An Overview of Hyperspectral Remote Sensing as Applied to Precious Metals Exploration. Phoebe L. Hauff, William A. Peppin, Douglas C. Peters and Gary A. Borsard
- Environmental Site Characterization Using Hyperspectral Data: The International Smelter Area and Beger Mill, Utah. Douglas C. Peters, Phoebe L. Hauff, Eric D. Dillenbeck, William A. Peppin, Eric C. Prash and Gary A. Borsard

PROGRAM DETAILS

A full and varied Social, Technical and Cultural program awaits you in Santiago

Note: It is now possible to register for the Field Trips and Workshops without attending the main conference.

Monday April 30th to Saturday May 5th 2001: PRE-SYMPOSIUM FIELD TRIPS

The participant has a choice of trips visiting different ore hosting environments which include a strong emphasis on appropriate geochemical exploration methods. Additional background information will be provided on the trips.

Note that the registrant is responsible to arrange travel to and from the starting point of each of the field trips. Registration deadline is now April 1st, 2001 and a minimum of 10 people are required for each trip.

F1. Northern Chile Porphyries. <i>Brian Townley, Universidad de Chile.</i>	US\$ 1,100
F2. Southern Peru Porphyries. <i>Chris Benn, BHP</i>	US\$ 1,400
F3. Northern Peru Epithermal Gold Deposits. <i>Owen Lavin, Newmont</i>	US\$ 1,300
F4. Brazil, Carajas Region, Amazon. <i>Cláudio de Castro Magalhães, CVRD/DOCEGEO</i>	US\$ 1,050

Details of the itineraries are included on the AEG web page at www.aeg.org.

Sunday May 6th to Thursday May 10th 2001: TECHNICAL AND SOCIAL PROGRAM - SANTIAGO

	Morning				Afternoon				Evening	
	9:00-9:30	9:30-10:30	10:30-11:30	11:30-1:00	1:00-2:30	2:30-4:30	4:30-5:30	5:30-8:30	8:30-10:30	
Sunday, May 6th	Commercial Booth Set Up						Registration		Ice Breaker Reception - Booths Open	
Monday, May 7th	Opening	Technical 1	Coffee	Technical 2	Lunch	Technical 3	Coffee	Plenary Session	Chile Night	
	Accompanying Persons Program: Santiago Sight Seeing								Buses Assemble	
	Commercial Booths									
Tuesday, May 8th	Technical 4	Coffee	Technical 5	Lunch	Technical 6	Coffee	Technical 7	Free Night		
	Accompanying Persons Program: Wine Tour and Valle Central									
	Commercial Booths									
Wednesday, May 9th	Technical 8	Coffee	Technical 9	Lunch	Technical 10	Coffee	AEG Annual General Meeting	Cocktail	AEG Awards Banquet	
	Commercial Booths									
Thursday, May 10th	Technical 11	Coffee	Technical 12	Lunch	Technical 13	Coffee	Technical 14	Assemble	Pub Night	
	Accompanying Persons Program: Vina del Mar and Valparaiso									
Friday, May 11th	Workshops		Coffee	Workshops		Lunch	Workshops		Coffee	
Saturday, May 12th	Workshops		Coffee	Workshops		Lunch	Workshops		Coffee	

Friday May 11th to Saturday May 12th 2001: PROFESSIONAL SKILLS UPGRADING WORKSHOPS

We are pleased to offer a wide variety of courses for professional skills upgrading. Please note that the deadline for registration is April 1st, 2001. The following workshops are being offered:

W1. Regolith Geology And Exploration Geochemistry In Deeply Weathered Terrains - A Perspective From Three Continents. <i>I.D.M. Robertson and R. R. Anand - CRC LEME, Perth, Australia, Philippe Freyssinet - BRGM, Orleans, France, M. L. da Costa - University of Belem, Brazil and C.G. Porto - Institute of Geoscience, Rio de Janeiro, Brazil</i>	US\$450
W2. Gold-Rich Porphyry Deposits and Lithocaps for the Explorationist. <i>Richard Sillitoe, London, UK</i>	US\$600
W3. Epithermal Gold deposits — Field Aspects. <i>Greg Corbett, Sydney, Australia (1 day only, May 11th)</i>	US\$225
W4. Standard Quality Control. <i>Richard Beane</i>	US\$450
W5. Stream Sediment Drainage Geochemistry. <i>K. Fletcher, Vancouver, Canada (1 day only, May 11th)</i>	US\$225
W6. Spectral and Hyperspectral Remote Sensing in Mineral Exploration. <i>Bob Agar, Lesmurdie, Australia</i>	US\$600
W7. Applications of Geochemistry to Environmental Problems Associated with Mining and Minerals Exploration. <i>William Chavez, USA</i>	US\$450
W8. Lithogeochemical Exploration using Pearce Element Ratio Analysis. <i>Cliff Stanley, Canada (1 day only May 12th)</i>	US\$225

A special student rate is being offered at 50% of the above prices. This offer is subject to availability and proof of student status from the appropriate school or university.

Further details of the courses are available at www.aeg.org.

REGISTRATION FORM: (Note that all quoted costs are in US\$, Form also available electronically at www.aeg.org)

Symposium Contact Information

E-mail to : IGES20@netline.cl • Fax to : 562 748 6772 (Acme Chile) • Information Phone : 562 748 6771 (Acme Chile)
Mial : IGES20 c/o Acme Analytical Laboratories S.A., Av. Claudio Arrau (ex Oceanica) 7152, Pudahuel, Santiago, Chile

Accommodation in Santiago -please note that each delegate is to make his or her reservations directly with the hotel. Space is limited at the special room rate so register early.

**Hotel Hyatt Regency, Av. Kennedy 4601, Santiago, the convention rate is - US\$ 95 to US\$ 115 double.
Phone 562 218 1234 Fax 562 218 2513 • e-mail: Daniela Palma Salcedua <dpalma@hyatt.cl> • www.santiago.hyatt.com**

Other hotels are available in the area. A partial list of hotels will be posted on the web site www.aeg.org but the conference cannot accept any responsibility for the service provided. We will gladly provide you with any additional information which is not found on the web site. All foreign residents should be aware that Chilean VAT/GST of 18% (or IVA in the local dialect) can be avoided on hotel room rates by demonstrating foreign residence and paying with a major credit card or cash.

Delegate Contact Information

Title (Prof/Dr/Mr/Mrs/Ms/Miss): _____ Name: First, Initial, Last, _____
Preferred name on name badge: _____
Position: _____ Organization: _____
Address : _____
State: _____ Post code : _____ Country: _____
Tel.: Country Code, Area Code, City Code, Number _____
Fax : Country Code, Area Code, City Code, Number _____
e-mail: _____ Alternative e-mail: _____
Guest Preferred name on badge: (for social functions) _____
Author/Presenter: _____
Abstract Title: _____
AEG Membership number: _____ Other Society Member: indicate _____

Payment Details indicate selection (by a tick) - ALL CHARGES ARE IN US\$ FUNDS

Registration Date 2001	Member*	Non Member****	Student **	AccompanyingPersons	Commercial Booth***
March 1st to April 1st	300	400	100	200	1100
After April 1st	350	450	100	200	1200
After May 5th (walk in)	400	500	150	250	N/A

Notes :

* Member - includes AEG, SEMA and Sociedad Geologica de Chile members in good standing and with fully paid up dues. Otherwise they will be charged the Non Member rate as applicable.
** Student means registered at an approved university with study related to mineral exploration and must provide proof of status, a letter from the university, to obtain this rate.
*** Commercial booths do NOT include complimentary registration for the conference but does include the opening reception held in the booth area and all 4 days of the conference from May 6th to May 10th 2001. Maximum of 2 people allowed per booth.
The AEG membership rate is lower than the Non Member rate and registrants are encouraged to join the AEG to obtain the lower rate.

Pre-symposium Field Tripsindicate order of preference (Minimum 10 persons)

___ F1: Chile US\$ 1100 ___ F2 : S.Peru US\$ 1400 ___ F3 : N.Peru US\$ 1300 ___ F4 : Brazil US\$ 1050

Post Symposium Professional Skills Upgrading Workshopsindicate order of preference (Minimum 10 persons)

___ W1 : US\$ 450 ___ W2 : US\$ 600 ___ W3 : US\$ 225 ___ W4 : US\$ 450
___ W5 : US\$ 225 ___ W6 : US\$ 600 ___ W7 : US\$ 450 ___ W8 : US\$ 225

Social Programme ... indicate selection (by a tick)

___ Chile Night US\$30 ___ AEG Awards Banquet US\$50 ___ Pub Night US\$20

Payment Details

Credit Card - Register by credit card (Visa, MasterCard or Discover) via the AEG's website at www.aeg.org
Wire Transfer - Santiago Exploration and Mining Association,
Account No. 00-4017135-5-00
Banco Santander, Banco Preferente, Santiago, Chile - Codigo Swift: BDERCLRM
At the time the transfer is made, please advise our treasurer Mike Easton at <measton@entelchile.net>
Cheque - Santiago Exploration and Mining Association (Chilean pesos only)
Cash - US funds accepted but Chilean pesos preferred

Payment Summary

1 Symposium Registration Fee...	US\$	_____
2 Pre Symposium Field Trips...	US\$	_____
3 Post Symposium Professional Skills Upgrading Workshops	US\$	_____
4 Social Program.....	US\$	_____
Grand Total US\$ Funds	US\$	_____

**20mo Symposium Internacional de Exploración Geoquímica
(IGES)**

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The Santiago Exploration and Mining Association
Sociedad Geológica de Chile**

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Sesiones Técnicas Lunes 7 a Jueves 10 de Mayo

El programa contempla del orden de 50 presentaciones orales que abarcarán los tópicos siguientes: Oro, Metales del Grupo Platino, Metales Básicos, Lixiviación Parcial, Estudios Regionales y Medioambiente. Otro importante conjunto de temas serán presentados en pósters, todo ello complementado con exhibiciones de productos comerciales de las más recientes aplicaciones tecnológicas en exploraciones.

Sesión Plenaria Lunes 7 de Mayo

La Sesión Plenaria consulta exposiciones de invitados distinguidos, entre ellos Francisco Camus de Codelco y Josef Ambrus de GeoVectra.

A continuación se señalan los Trabajos recibidos a la fecha:

- Proterozoic mineralization identified by integrated regional geochemistry, geophysics, and bedrock mapping in Western Australia. Paul A. Morris, Franco Pirajno, and Sergey Shevchenko
- Evaluation of selective extractions in glaciated permafrost terrain at the Pb-Zn swim deposit, Yukon Territory, Canada. Dr. K. Fletcher and J. Bond.
- Dispersion of gold in a rain forest stream in the S.Kull region, Sabah, Malaysia: implications for exploration. Dr. K. Fletcher and Joanes Mada.
- Dispersion of gold in Slesse Creek, British Columbia. Dr. J. Hobday and W.K. Fletcher
- Exploration geochemistry of stream sediments and surficial deposits at Pascoá-Lama. Ms. Emily Chastain and W.K. Fletcher.
- Environmental Geochemical Atlas of Southern Sardinia. M. Boni, B. De Vivo & A. Lima A. Marcello & S. Pretti.
- Environmental geochemical exploration in the area of an old copper mine, Asturias, Spain. Jorge Laredo, Andrés Álvarez-Wurtenberger, Almudena Ordóñez, and Jesús García Iglesias.
- Heavy metals in groundwater around massive sulphide deposits: Exploration and environmental aspects. Hélène Pauwels, Marie-Lou Tercier-Waebel, Miguel Arenas, Ricardo Castroviejo, Yves Deschamps, Flavio Grazzotin, Arnault Lassin, Ascención Molina.
- The selective extraction of arsenic in selected minerals and tailing samples. Patrícia, C., Ferreira da Silva, E., Cardoso Fonseca, E.
- Radon in groundwaters from Guarany aquifer, South America: environmental and exploration implications. Daniel Marcos Bobatto and Lourenço Caprioglio.
- Fluid inclusion for exploration - The acoustic decrepitation method. Kingsley Burlinson.
- Objective assessment of new analytical geochemistry exploration methods: Distinguishing between scientifically valid approaches and 'witching sticks'. Prof. Clifford B. Stanley.
- Primary litho-geochemical alteration haloes associated with the Cannington Broken Hill-type Ag-Pb-Zn sediment hosted massive sulphide deposit, Mt. Isa Inlier, Queensland: Implications for genesis and mineral exploration. Stanley, C.R., Walters, S., Jeffrey, S., and Levine, D.
- Primary dispersion haloes about the Mt. Charlotte mesothermal Au-Quartz vein system, Kalgoorlie, Western Australia: Implications for distal litho-geochemical exploration parameters and deposit genesis. Stanley, C.R., and Radford, N.
- Origin of manganese and base metal anomalies in Paleozoic cover rocks overlying the Eastern margin of the Arabian Shield. Ahmad M. Al-Saleh.
- Factors controlling the dispersion of gold in stream at Timbarra, NSW. D.R. Cohen, A.C. Dunlop and T. Rose.
- "Doughnuts" in the Desert: Success in the Application of Partial Extraction Geochemistry to Deep Cover Mineral Exploration. Peter J. Rogers.
- SGH™ - A new soil gas hydrocarbon technique for mineral exploration under deep cover. Eric L. Halfman, Dale Sutherland, J.R. Clark, Greg Hill and David Leng.
- Dispersion into the Tertiary Southern Cross Formation sediments from the Scott and Cindy Lodes, Paljingo, N.E. Queensland. Ian D.M. Robertson.
- Application of groundwater geochemistry to exploration for paleochannel fill from uranium, Frome Embayment, South Australia.
- MAGSAM: An effective exploration tool for PGM Mineralisation. Craig S. Ragless, Ziggy Lubieniecki and Adrian Vanderplank.
- New discovery of gold mineralization in Biéida mine (South of Mozambique) using geochemistry tool. Y. Zinbi, I. Maacha, A. Saquaque and H. Baouakil.
- Exploration for epithermal gold mineralization in the Andes of Ecuador using enzyme leach soil analysis. T.M. Williams and A.G. Gunn.
- Partial and selective extraction studies in the Yandoo Greenstone Belt, Yilgarn Craton, Western Australia. J.E. Wildman, B.R. Anand and G.D. Longman.
- Exploration for platinum, palladium and kimberlites in forested terrain of Canada using spruce tree tops. Colin E. Dunn, Rob Scogel, Larry Lohsen, Dave Seneshe, Gwendy Hall, Andy Rencz.
- History, ethnography and archaeology in prospecting. Prof. Dr. Alexander L. Kovalevskii.
- Deposits of PGE in weathering crust of deep faults zone. Prof. Dr. Alexander L. Kovalevskii.
- Formation conditions of blanket-shaped eluvial platnoid deposits. Prof. Dr. Alexander L. Kovalevskii.
- Biogeochemistry and exploration for mineral deposits in the USSR and Russia. Prof. Dr. Alexander L. Kovalevskii.
- Ecologic biogeochemistry of mercury in the republic Buryatia. Prof. Dr. Alexander L. Kovalevskii.
- Wide spaced geochemical survey in arid saline terraces, northwestern China. Kueqiu Wang, Qinghua Chi, Zhihong Cheng, Dawen Liu, Wenzhi Zhang and Youqian Yang.
- Fluid inclusion petrography and microthermometry as an assisting tool in exploration: An example for precious metals epithermal mineralization in the Chilean Patagonia. Brian K. Trimley.
- Application of geostatistical methods to the recognition of geochemical anomalies in the Montemor-o-Novo area, S. Portugal. Reis, A.P., Sousa, A.J., and Cardoso Fonseca, E.
- Geochemical Exploration as a Tool to optimize the biodegradation Processes of Petroleum Hydrocarbons in Soils. J.L. R. Gallego, J. Toledo, J. Ullrich.
- Groundwater flow in playa lake environments: Impact on Gold and pathfinder element distributions in groundwaters surrounding mesothermal gold deposits, St Ives Area, Eastern Goldfields, Western Australia. Carey, M.L., McPhail, D.C. and Taulen, P.M.
- Data processing for geochemical mapping - An example from Central Colombia. González, L.M., Calderón, J.I.
- Waterrock characterization and management: A case study from New Mexico. R.J. Bowell and J.V. Parsley.
- A Mass Balance Approach to estimate the dilution and removal of pollutants in the Lago Junin drainage, Central Highlands, Peru. R.J. Bowell, A. Brignetti, R. Dorey, E. Uta and J. Torrealva.
- A systematic classification of regolith gold. Rob Bowell and Philippe Freyssinet.
- Gold mobility in the regolith at Cobar, N.S.W., Australia: Implications for geochemical exploration and oxide gold resources. K.G. McQueen, K.M. Scott and I.D.M. Robertson.
- Fundamentally new geochemical method for quantitative evaluation of magnetite ore deposits. Emelianenko T.I., Solovov A.P. and Marveev A.A.
- Water characterization in Drake mining area, NSW, Australia. Harry Estero.
- Stream Sediment Source Accounting: Locating the sources and magnitudes of stream sediment anomalies. Peter Holyland and Graeme Broadbent.
- GeoDAS - A New GIS System for Spatial Analysis of Geochemical Data Sets for Mineral Exploration and Environmental Assessment. Qiuming Cheng, Graeme Boham-Carter, and Gary L. Raines.
- Naturally occurring Cr6+ in shallow groundwaters of the Yilgarn Craton, Western Australia. D.J. Gray.
- Gold redistribution in the regolith at the Twin Peaks and Monty Dam deposits, Western Australia. Nikita B. Sergeev and David J. Gray.
- Litho-geochemical Vectors Associated with the Kabanga Ni-Cu Deposit in North Western Tanzania. Simon, A., and C.D. Okajeni.
- The Nature and Patterns of Element Dispersion in Aeglees Overburden Associated with Selected Gold Mineralization in Semi Arid Areas of Southern Africa. Okajeni, C.D., and Ackon, P.
- Supergene gold mobility at the Mount Joel prospect, Western Australia. Pons, C.G., Gray, D.J. & Sergeev, N.B.
- Environmental Geochemistry of Heap Leach Closure. J.V. Parsley & R.J. Bowell.
- The use of partial extraction geochemistry for copper exploration in Northern Chile. D.L. Kelley, G.E.M. Hall, R. M. McEwen, L.G. Clout, M. Valdez, I. Hamilton.
- Geochemical maps of West Greenland: signatures of environments with gold, high-technology metals and kimberlites. Agnieszka Steenliet.
- Complementary Selective Extraction and Biogeochemical Patterns at the 1-10 and Dragon Skarn/Porphyry Deposits, Cochise County, Arizona. Gregory T. Hill, J. Robert Clark, and Kenneth A. Lonstrom.
- How useful is ground based hyperspectral data for the geochemist? Sasha Potrusal, Nick Merry and Julian Bartlett.
- Three-dimensional investigations of gold dispersion and regolith at the Argo and Apollo deposits, Kambalda, Western Australia. A.F. Britt and D.J. Gray.
- Fundamentally new geochemical method of evaluation of hypothermal level of magnetite deposits are zinc. Emelianenko T.I., Solovov A.P. and Marveev A.A.
- Gold Exploration in Covered Areas: Gold Nugget Morphology and Core Crystal Chemistry as an Exploration Aid. Brian K. Trimley, Carlos Palacios M., Victor Maksiev J. and Gerard Herall.
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DETALLES DEL PROGRAMA

Un completo y variado programa Social, Técnico y Cultural le espera a su llegada a Santiago.

Nota : Se ha abierto la posibilidad de registrarse en los Salidas a Terreno y los Talleres sin estar inscrito en las conferencias del Symposium.

Lunes 30 de abril al Sábado 05 de mayo 2001: SALIDAS A TERRENO PRE-SYMPOSIUM

Los participantes pueden escoger entre las varias opciones de viajes los cuales contemplan distintos ambientes mineralizados con énfasis en las condiciones de aplicabilidad de los diferentes métodos de exploración geoquímica. Cada grupo estará a cargo de un líder quien proveerá de los antecedentes disponibles en las visitas.

Quienes se registren en las salidas a terreno deben tomar nota que será de su responsabilidad arreglar el viaje de ida y regreso al lugar de inicio de la Salida a Terreno y a su propio costo. La fecha límite de inscripción se ha extendido hasta el 1 de Abril del 2001 y cada excursión requiere de un mínimo de diez participantes.

F1. Pórfidos del Norte de Chile, Brian Townley, Universidad de Chile	US\$ 1,100
F2. Pórfidos del Sur de Perú, Chris Benn, BHP.	US\$ 1,400
F3. Yacimientos Auríferos Epitermales del Norte de Perú, Owen Lavin, Newmont	US\$ 1,300
F4. Brasil, Región de Carajas, Amazonas, Cláudio de Castro Magalhães, CVRD/DOCEGEO	US\$ 1,050

Mas detalles de los itinerarios están incluidos en la página web www.aeg.org.

Domingo 6 a Jueves 10 de Mayo 2001: PROGRAMAS TECNICO Y SOCIAL, SANTIAGO.

	Morning				Afternoon				Evening	
	9:00-9:30	9:30-10:30	10:30-11:50	11:30-1:00	1:00-2:30	2:30-3:30	3:30-4:30	4:30-5:30	7:00-8:30	8:30-10:30
Sunday, May 6th	Commercial Booth Set Up				Registration				Ice Breaker Reception - Booths Open	
Monday, May 7th	Opening	Technical 1	Coffee	Technical 2	Lunch	Technical 3	Coffee	Plenary Session	Chile Night	
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	Commercial Booths									
Tuesday, May 8th	Technical 4	Coffee	Technical 5	Lunch	Technical 6	Coffee	Technical 7	Free Night		
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	Commercial Booths									
Wednesday, May 9th	Technical 8	Coffee	Technical 9	Lunch	Technical 10	Coffee	AEG Annual General Meeting	Cocktail	AEG Awards Banquet	
Thursday, May 10th	Technical 11	Coffee	Technical 12	Lunch	Technical 13	Coffee	Technical 14	Assemble	Pub Night	
	Accompanying Persons Program: Vina del Mar and Valparaiso									
Friday, May 11th	Workshops	Coffee	Workshops	Lunch	Workshops	Coffee	Workshops			
Saturday, May 12th	Workshops	Coffee	Workshops	Lunch	Workshops	Coffee	Workshops			

Viernes 11 a Sábado 12 de Mayo 2001: TALLERES DE PERFECCIONAMIENTO PROFESIONAL

Nos es muy grato ofrecer una amplia gama de talleres para mejorar las habilidades profesionales. Agradeceremos tomar en cuenta que la fecha límite para registrarse es el 31 de Abril de 2001. Están a su disposición los siguientes talleres:

- | | |
|--|----------|
| W1. Exploración Geoquímica en Terrenos con Meteorización Profunda, Geología de Regolitos y de Exploración: Una Visión desde tres continentes. I.D.M. Robertson and R.R. Anand - CRC LEME, Perth Australia, Philippe Freyssinet - BRGM, Orleans, France, M. L. da Costa - University of Belem, Brazil and C.G. Porto - Institute of Geoscience, Rio de Janeiro, Brazil. | US\$ 450 |
| W2. Para Exploradores: Litocapas y Pórfidos Altos en Oro, Richard Sillitoe, London, UK. | US\$ 600 |
| W3. Depósitos de Oro Epitermal - Aspectos de Terreno, Greg Corbett, Sydney, Australia.
(Mayo 11, un día) | US\$ 225 |
| W4. Estándares de Control de Calidad, Richard Beane, | US\$ 450 |
| W5. Geoquímica de sedimentos de drenaje Stream, K.Fletcher, Vancouver, Canada, (Mayo 11, un día) | US\$ 225 |
| W6. Sensores Remotos Espectrales e Hiperspectrales en la Exploración de Minerales, Bob Agar. Lesmurdie, Australia. | US\$ 600 |
| W7. Aplicaciones de la Geoquímica a los Problemas de Medioambiente Relacionados con la Minería y la Exploración Minera, William Chavez, USA. | US\$ 450 |
| W8. Exploración Litoquímica utilizando Pearce Element Ratios, Cliff Stanley (Mayo 12, un día) | US\$ 225 |

Los estudiantes podrán optar a un descuento de 50% del valor de la inscripción en los talleres. Esta oferta está sujeta a la disponibilidad de cupos en y que se documente apropiadamente la condición de estudiante conferida por parte la Universidad o Institución.

Mas detalles de los itinerarios están incluidos en la página web www.aeg.org.

FORMULARIO DE INSCRIPCIÓN :

(Disponible en formato electrónico en www.aeg.org. Todos los valores que siguen están expresados en US\$)

Contacto e Información sobre el Symposium

E-mail : IGES20@netline.cl • Fax : 562 748 6772 (Acme Chile) • Teléfono: 56 2 748 6771 (Acme Chile)

Correo: IGES20 c/o Acme Analytical Laboratories S.A., Av. Claudio Arrau (ex Oceanicu) 7152, Pudahuel, Santiago, Chile

Respecto a Alojamiento en Santiago, por favor tome nota que cada participante debe efectuar su propia Reserva directamente con el Hotel. Se dispone de un número limitado de alojamientos a tarifa especial por lo que le recomendamos hacer su reserva con tiempo.

Hotel Hyatt Regency, Av. Kennedy 4601, Santiago, la tarifas para el Symposium son - US\$ 95 a US\$ 115 doble.

Phone 562 218 1234 Fax 562 218 2513 • e-mail: Daniela Palma Salceda <dpalma@hyatt.cl> • www.santiago.hyatt.com

En la página web www.aeg.org encontrará una lista de referencia de otros hoteles del sector, acerca de los cuales la Organización no puede asumir responsabilidad alguna por la calidad y tipo de servicio que ellos provean. Estaremos gustosos de proveerle de cualquiera otra información que Ud. no encuentre en nuestra página web. Todos los residentes en el extranjero deben considerar que es posible exceptuarse del pago del 18% de IVA (VAT/GST) en las tarifas de alojamiento demostrando su residencia en el extranjero y pagando con tarjeta de crédito importante o al contado.

Contacto e Información del Delegado

Título (Prof/Dr/Mr/Mrs/Ms/Miss) _____ Nombre (s) _____ Apellido (s) _____
Nombre elegido para la Tarjeta de Identificación _____ Cargo _____
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Dirección _____ Estado _____ Código Postal _____ País _____
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e-mail : _____ e-mail alternativo _____
Invitado _____ Nombre elegido por el invitado para la Tarjeta de Identificación (para eventos sociales) _____
Autor/Presentador _____
Título del Trabajo _____
Número de Socio AEG _____ Miembro de otra Sociedad, indique _____

Forma de pago...indique su preferencia (con un tick) - **TODAS LAS TARIFAS ESTAN EXPRESADAS EN US\$**

Registration Date 2001	Miembro	No Miembro****	Estudiante **	Personas Acompañantes	Módulo Comercial***
1 de Marzo a 1 de Abril	300	400	100	200	1100
Después del 1 de Abril	350	450	100	200	1200
Después del 5 de Mayo (en el mesón de la Convención)	400	500	150	250	N/D

Notas:

* Miembro - incluye los registrados en AEG, SEMA y en la Sociedad Geológica de Chile, que estén vigentes y al día en sus cuotas. De no ser así, les serán aplicad la tarifa para No Miembros.

** Estudiante - implica estar registrado en una Universidad reconocida que imparta educación relativa a exploraciones de minerales, situación que debe ser probada al inscribirse mediante un carnet o carta de la universidad en que se establezca su condición. De otra manera esta tarifa no le será aplicable.

*** Los Módulos Comerciales No incluyen el derecho de asistencia a la Conferencia. El módulo da derecho de entrada al recinto para dos personas (máximo) durante los 4 días desde el 6 al 10 de mayo y además a participar en la recepción de Apertura que tendrá lugar en el área de módulos.

Cabe notar que la tarifa de los Miembros del AEG es mas baja que la tarifa para los No Miembros, por lo que se invita a los participantes a incorporarse al AEG y de esta manera aprovechar la menor tarifa.

Viajes a Terreno Pre-Symposiumindicar orden de preferencia (Mínimo 10 personas)

___ F1: Chile US\$ 1100 ___ F2 : S.P Perú US\$ 1400 ___ F3 : N.P Perú US\$ 1300 ___ F4 : Brazil US\$ 1050

Talleres de Perfeccionamiento Profesional Post -Symposiumindicar orden de preferencia (Mínimo 10 personas)

___ W1 : US\$ 450 ___ W2 : US\$ 600 ___ W3 : US\$ 450 ___ W4 : US\$ 450
___ W5 : US\$ 225 ___ W6 : US\$ 600 ___ W7 : US\$ 450 ___ W8: US\$ 225

Programa Social ... indicar su elección (con un tick)

___ Noche Chilena US\$ 30 ___ Banquete de Premiación AEG US\$ 50 ___ Noche de PUB US\$ 20

Detalles de Pago

Tarjeta de Crédito - Visa solo disponible por Internet Banking - contacte Internet Secure via www.aeg.org

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Banco Santander, Banca Preferente, Santiago, Chile, Código Swift: BDERCLRM

Una vez efectuado el giro por favor de aviso a nuestro tesorero Mike Easdon al mail: "Michael Easdon" <measdon@entelchile.net>

Cheque - Santiago Exploration and Mining Association (solo pesos Chilenos)

Contado - Se aceptan los pagos en US\$ dólares pero se prefiere sean en pesos Chilenos.

Resumen de Pagos

1 Symposium - Inscripción ...	US\$ _____		
2 Viajes a Terreno Pre Symposium	US\$ _____	4 Programa Social.....	US\$ _____
3 Talleres de Perfeccionamiento Profesional Post Symposium ..	US\$ _____	Gran Total	US\$ _____

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results. Geochemical data can be influenced by numerous possible sources of error that occur at the various stages of analysis. Many of these contributing errors cannot be assumed to be normally distributed. Indeed, for important elements like gold, which suffer from particulate distribution effects, normality is an unlikely condition. As a result, the variations of results reported by different laboratories using slightly different methods cannot be assumed to be normally distributed either.

Without rigorous testing of this assumption of a normal distribution for the results obtained in each round of proficiency tests, no statistical inference tests are justified, and subsequent conclusions are of limited validity. Only after demonstrating through rigorous statistical tests that the proficiency assessment data could be derived from a normal (or some other theoretically reasonable) distribution is it acceptable to perform the statistical tests to determine laboratory proficiency.

- 3) No account is taken during the assessment of the level of accuracy and precision actually required for the analytical data in terms of its application.

Although the expression “proficiency testing” implies to us a measure of effectiveness against a stated benchmark, the procedures do not actually do this. They do not determine whether any of the laboratories are “good enough”, or whether all, including those producing outlier results, are “good enough”.

We contend that real-world geochemistry is about obtaining adequate and cost-effective results, and these need not necessarily be perfect results. All that we require is data that have sufficient precision and accuracy to enable the confident interpretation of results for the task at hand (*e.g.* - the discrimination of anomalies from background, or the definition of resource grade) through determination of element concentrations to a stated degree of confidence. At the same time, we cannot and must not pay extra for analytical data that are of unnecessarily high quality.

As an example, consider the quality requirements in a routine stream or soil geochemistry survey during mineral exploration. We might typically obtain Pb concentration data to a precision level of +/- 5 ppm (2 standard deviations) at a background level of 50 ppm (*i.e.* 10 % precision at the 95 %ile confidence level). If our geochemical anomalies are >200 ppm, clearly it would not make sense spending extra money on higher quality analyses in this application, say with two standard deviation errors of +/- 1 ppm (*i.e.* 2 % precision). This is because the goal of the survey, namely discriminating anomalous concentrations from background ones, could be easily achieved using the lower quality data, with the exception of a few samples with results near to the threshold.

There is no doubt that some laboratories (*e.g.* - geochronology or university research laboratories) could deliver for us a suite of wonderfully accurate and precise lead results to the level of say 50 +/- 0.01 ppm (2 standard deviation precision), but do we need this in the hypothetical example given above? Clearly, we do not. It is highly unlikely that we would gain enough advantage during first-pass exploration to ever justify the cost and time required for such enhanced precision. In fact, our exploration manager would be justified in booting us up the backside for wasting precious time and funds,

as well as for failing to appreciate what was required to get the job done.

Conclusions

While we applaud the concept of independent benchmarking of commercial laboratories, there is a danger that the objectives of the end-user might become lost when benchmarking extends towards certification. In any case, we contend that laboratory proficiency testing needs to be made much more rigorous than simply comparing z-scores of results returned from participating laboratories in a particular round of testing. It must involve assessments of both precision and accuracy to be of any use to the client. Furthermore, it should not exclusively consider total element concentrations, because partial digestions/analyses are commonly used in many geochemical applications and it would be worthwhile assessing laboratory performance for all of these analytical regimes.

Obviously, with these requirements, proficiency testing will need to be much more involved and far more rigorous. Only then, however, will it be of real use to the industry and its practitioners. As it is currently manifested, proficiency testing merely provides a broad measure of a laboratory's comparison to its peers. In our view, this does not provide a sound framework for laboratory accreditation, because it does not formally evaluate either precision or accuracy. Likewise, there is no consideration given to the end-user's objectives in obtaining data that are satisfactory for the task at hand, in other words, “Fit-for-purpose”.

Of course, it is one thing to seek a pragmatic approach but entirely another to define in measurable terms what constitutes data that are “Fit-for-purpose”. The experience of the practitioners in comparable surveys enables some predictions of background and anomalous levels, and the importance of orientation surveys in this regard cannot be stressed too highly.

Likewise, we acknowledge that the quality requirements (in particular accuracy) of analytical data become far more demanding during resource estimations and mining, where the consequences of say a 10% bias could jeopardize the entire operation. Such projects require much tighter quality control and in effect a tighter statement of what constitutes “Fit-for-purpose” data in this context. The general philosophy, however, remains the same: It is neither sensible nor useful to provide accreditation methods without first defining what is or is not acceptable in terms of both precision and accuracy of the application.

We contend therefore that proficiency testing must provide measures of both precision and accuracy within a framework of the various objectives for which the analyses are being determined - what we have termed here the “Fit-for-purpose” approach. How, then do we specify a requirement so that we can measure whether data are “Fit-for-Purpose” or not? That answer is probably best obtained through discussions with a broad spectrum of professional geochemists, and we welcome participation in that process.

References

- Steger, H.F., 1999: Proficiency testing program for mineral analysis laboratories. Short Course Notes, SC-4, “Quality Control in Mineral Exploration”. 19th IGES, Vancouver, April, 1999.
- Ramsay, M.H., 1993: Sampling and Analytical Quality Control (SAX) for improved error estimation in the measurement of

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Pb in the environment using robust analysis of variance. *App. Geochem.*, Suppl Issue no 2, 149-153.

Ramsay, M.H., Thompson, M. and Hale, M., 1992: Objective evaluation of precision requirements for geochemical analysis using Robust analysis of variance. *J. Geochem. Explor.*, 44, 29-44.

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Geochemistry: Exploration, Environment, Analysis — Editor's Report

The first issue of the AEG's new journal, *Geochemistry: Exploration, Environment, Analysis (GEEA)* should have been received by members by the publication date of this volume of **EXPLORE** (April). We now have a home page on the Geological Society of London (GSL) website (<http://www.geolsoc.org.uk>) which is hotlinked to that of the AEG (<http://www.aeg.org>). There will be four issues a year initially (one volume), available in both hard copy and electronically. The latter mode allows the flexibility to include color and additional information (datasets, appendices, software) that may or may not be in the hard copy version. In addition to research papers, review papers, rapid communications and Letters to the Editor are encouraged. Our annual subscription price to libraries is under \$200US. The journal is abstracted and/or indexed in: AGI's Bibliography and Index of Geology, Chemical Abstracts, Current Contents, Engineering Index, GEOBASE, GeoRef, Mineralogical Abstracts, PASCAL/CNRS, GeoArchive.

I attended the annual Geological Society of London journal meeting in February and felt we were most welcome! GEEA complements nicely GSL's present journals (*The Journal of the Geological Society*, *Quarterly Journal of Engineering Geology* and *Hydrogeology, Petroleum Geoscience*) and will also be offered in combination with these journals. We will benefit greatly from the experience, knowledge and marketing skills of GSL and its Publishing House, and will be working closely with editors Mike Collins and Diana Swan, based in Bath, UK.

A sad note: we have lost one of our most active and enthusiastic Board members, Robert R. Brooks (obituary in this issue of **EXPLORE**, page 30). I had just received a review from him with an amusing covering letter stating that he was going in for a routine heart operation and would be out of action for a few weeks. Alas, for all of us, it turned out otherwise. I am hoping to persuade his colleagues at Massey University in New Zealand to edit a special issue of GEEA dedicated to our friend and biogeochemist-extraordinaire, Robert.

Many thanks to our Board members and in particular, to the special editors who have taken a leading role for the 2001 issues, Art Rose, Joe Donovan and Charles Butt.

Gwendy Hall, Editor-in-Chief,
Geochemistry: Exploration, Environment, Analysis



ELSEVIER SPECIAL BOOK OFFER

In addition to their standard offer of 30% discount off list prices to AEGmembers who purchase any of their technical books, Elsevier Science has agreed to a special price of US \$118.00 (40% discount off list price) on the recently published 572 page, hardbound book "*Geochemical Remote Sensing of the Sub-Surface*" providing they get an order for at least 25 copies.

Any members interested in acquiring this book should place their order with Betty Arseneault at the address below. Orders must be accompanied by cheque, or credit card authorization (visa, mastercard or american expressonly). If paying by credit card, please forward your request either by mail, fax or telephone.

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Handbook of Exploration Geochemistry 7, *Geochemical Remote Sensing of the Sub-Surface* (ISBN: 0-444-50439-7)
Edited by M. Hale, International Institute for Aerospace Survey and Earth Sciences and Delft University of Technology, Delft, The Netherlands.

For a description of this book please refer to page 17 of **EXPLORE** Newsletter No. 109 (October 2000).

Betty Arseneault

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Webpage: <http://www.aeg.org>



Applied Geochemistry in the Coming Decades

The International Symposium on Applied Geochemistry in the Coming Decades is being held in Hyderabad, A.P., India on 10-12 August 2001 (with an additional two days of excursions). The symposium is organized by the Indian Society of Applied Geochemistry, P.O. Box 706, Hyderabad 50007, India.

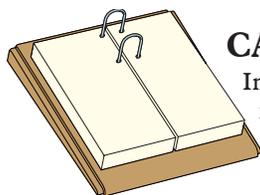
Symposium Topics include:

Magnetism & Metallogeny,

- Geochemistry of Sedimentary Deposits
- Exploration for Metals and Non-metals
- Isotopes in Hydrocarbon Research and Exploration
- Geoanalysis & Geochemical Data Processing,
- Environmental & Experimental Geochemistry

Detailed information can be found under 'Conference and Workshops' at the website of Osmania University: <http://www.osmania.ac.in/>





CALENDAR OF EVENTS

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

- April 5–6, 2001, **Southeastern GSA Sectional Meeting**. Chair: Edward Stoddard, Raleigh, North Carolina. Information: Edward Stoddard, (919) 515-7939, fax 919-515-7802.
- April 9–11, 2001, **Cordilleran GSA Sectional Meeting**. Chair: Peter Weigand, Northridge, California. Information: Peter W. Weigand, (818) 677-2564, fax 818-677-2820.
- April 23–24, 2001, **North-central GSA Sectional Meeting**. Chairs: Robert G. Corbett, Skip Nelson, Bloomington-Normal Illinois. Information: Robert Nelson, (309) 438-7808, fax 309-438-5310.
- April 24-27, 2001, **II International Congress for Prospectors and Explorationists ProEXPLO 2001**, Lima Marriott Hotel. INFORMATION: Hilda Postigo, Phone (511) 349-4262, extension 309, Fax (511) 349-3721. E-mail: proexplo@iimp.org.pe. www.proexplo.com.
- April 29–May 2, 2001, **South-central and Rocky Mountain GSA Sectional Meeting**. Chair: Kevin Urbanczyk, Albuquerque, New Mexico. INFORMATION: John Geissman, (505) 277-3433, fax 505-277-8843.
- May 6-10, 2001, **Geochemistry and exploration in Latin America, Santiago de Chile**. INFORMATION: 20th International Geochemical Exploration Symposium, Santiago, Chili. Phone: 56 2 748 6771. E-mail: proper3@attglobal.net.
- May 20-24, 2001, **Eleventh Annual V.M. Goldschmidt Conference**, Hot Springs, Virginia, USA. LeBecca Simmons at the Lunar and Planetary Institute in Houston, Texas, USA, via e-mail at simmons@lpi.usra.edu or by fax (fax number 281-486-2125). <http://www.lpi.usra.edu/meetings/gold2001/>.
- May 28-31, 2001, **6th International Symposium on Mining in the Arctic - Mining and Man**, KATUAQ, Greenland Cultural Centre, Nuuk, Greenland, by the Bureau of Minerals and Petroleum, Government of Greenland, and the International Arctic Mining Advisory Council. (Hans Kristian Olsen, Bureau of Minerals and Petroleum, Government of Greenland, P.O. Box 930, DK-3900 Nuuk, Greenland, Phone: (+299) 34 68 00 EMail: bmp@gh.gl Web: www.bmp.gl)
- May 25-27, 2001, **Geochemistry of sediments and sedimentary rocks: secular evolutionary considerations mineral-deposit-forming environments**, premeeting MDD-GAC short course, St. Johns, Newfoundland, Canada. INFORMATION: Prof. David Lentz, Dept. of Geology, University of New Brunswick, Box 4400, 2 Bailey Drive, Fredericton, New Brunswick, E3B 5A3 CANADA, Tel: (506) 447-3190. E-mail: dlentz@unb.ca.
- May 27-30, 2001, **Joint Annual Meeting of Geological Association of Canada - Mineralogical Association of Canada**, St. Johns, Newfoundland, Canada, by the Geological Association of Canada and the Mineralogical Association of

Canada. Information: E-Mail: dgl@zeppo.geosurv.gov.nf.ca
Web: <http://www.geosurv.gov.nf.ca>

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

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

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

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

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

■ July 29-August 2, 2001, **International Conference on the Biogeochemistry of Trace Elements**, University of Guelph, Guelph, Ontario, Canada. INFORMATION: Dr. Kim Bolton, Department of Land Resource Science, University of Guelph, Guelph, Ontario, Canada, N1G 2W1, Phone: (519)824-4120 ext. 2531 E-Mail: icobte@lrs.uoguelph.ca Web: <http://icobte.crlc.uoguelph.ca>

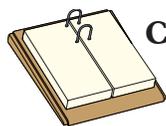
■ August 10-12, 2001, **International Symposium on Applied Geochemistry in the Coming Decades**, Hyderabad, A.P., India. Indian Society of Applied Geochemistry. Information can be found under 'Conference and Workshops' at the website of Osmania University: <http://www.osmania.ac.in/>

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Deadlines for the Next Four Issues of EXPLORE

Contributors's deadlines for the next four issues of EXPLORE are as follows:

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



CALENDAR OF EVENTS

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■ August 27- 29, 2001, **The 6th Biennial Society For Geology Applied To Mineral Deposits, Mineral Deposits at the Beginning of the 21st Century**, Krakow, Poland. <http://galaxy.uci.agh.edu.pl/~sga>

■ Aug 31-Sep 12, 2001 **Field Excursion to the Skaergaard Intrusion, Skaergaard area**, Kangerdlugssuaq, East Greenland, by the Camborne School of Mines, IGCP Project 427, SGA. (Dr. Jens C. Andersen, Camborne School of Mines, University of Exeter, Redruth, Cornwall, TR15 3SE, UK, Phone: +44 1209 714866 EMail: andersen@csm.ex.ac.uk Web: <http://www.ex.ac.uk/CSM/news/conf.htm>)

■ September 6-8, 2001, **Cathodoluminescence in Geosciences: New Insights from CL in Combination with other Techniques**, Society for Luminescence Microscopy and Spectroscopy (SLMS) and the German Mineralogical Society (DMG), Freiberg, Germany. INFORMATION: CL 2001 Secretariat, Freiberg University of Mining and Technology, Department of Mineralogy, Brennhaugasse 14, D-09596 Freiberg, Germany, Tel.: +49-(0)3731-392628, Fax: +49-(0)3731-393129. Jens Götze, e-mail: goetze@mineral.tu-freiberg.de. Ulf Kempe, e-mail: kempe@mineral.tu-freiberg.de. <http://www.mineral.tu-freiberg.de/>

■ Oct. 5-12, 2001, **27th Ann. Conf. of Federation of Analytical Chemistry & Spectroscopy Societies**. Detroit, MI. INFORMATION: Div. of Analytical Chemistry. FACSS, (505) 820-1648, fax (505) 989-1073, Internet: <http://FACSS.org/info.html>

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

■ December 2-3, 2001, **2001 Arizona Conference**, Doubletree Hotel at Reid Park, Tucson, Arizona. INFORMATION: Sam Rasmussen, 2001 Arizona Conference Program Chair, srasmussen@phelpsdodge.com

■ February 25 - 27, 2002, **Society for Mining, Metallurgy, and Exploration (SME) annual meeting**, Phoenix, Arizona. William Wilkinson Jr., Phelps Dodge Mining Co., 2600 N. Central Ave., Phoenix, AZ 85004, (602) 234-6080, Fax: (602) 234-4847. E-mail: wwilkinson@phelpsdodge.com.

■ April 7-11, 2002, **223rd ACS Natl. Mtg. Orange County Convention/Civil Center, Orlando, Fla.** INFORMATION: ACS Meetings, 1155 16th St., N.W., Washington, D.C. 20036-4899, (800) 227-5558, (202) 872-4396, fax (202) 872-6128, e-mail: natlmtgs@acs.org

■ June, 8-14, 2002, **AMERICAN SOCIETY for SURFACE MINING and RECLAMATION (ASSMR) 18th National Meeting**, Lexington, KY. http://www.ca.uky.edu/assmr/Upcoming_Events.htm

■ July 22-27, 2002, **The Earth System and Metallogenesis: A Focus on Africa**, Windhoek, Namibia, by The Geological Society of Namibia, The Geological Society of South Africa, and The Geological Society of Zambia. (The Secretary, IAGOD/ GEOCONGRESS 2002, P.O. Box 44283, Linden 2104, South Africa, EMail: gssa@pop.onwe.co.za Web: <http://www.gssa.org.za>)

■ October 27-30, 2002, **Annual Meeting of the Geological Society of America**, Denver, Colorado. INFORMATION: TEL 1-800-472-1988, meetings@geosociety.org.

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

■ November 2-5, 2003, **Annual Meeting of the Geological Society of America**, Seattle, Washington. INFORMATION: TEL 1-800-472-1988, meetings@geosociety.org. Please check this calendar before scheduling a meeting to avoid overlap problems. Let this column know of your events.

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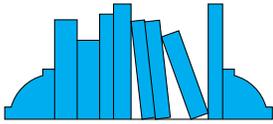
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This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 110. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); the USGS Circular (USGS Cir); and Open File Report (USGS OFR); Geological Survey of Canada papers (GSC paper) and Open File Report (GSC OFR); Bulletin of the Canadian Institute of Mining and Metallurgy (CIM Bull.); Transactions of Institute of Mining and Metallurgy, Section B: Applied Earth Sciences (Trans. IMM). Publications less frequently cited are identified in full. Compiled by L. Graham Closs, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401-1887, Chairman AEG Bibliography Committee. Please send new references to Dr. Closs, not to **EXPLORE**.

- Anon, 2001. Mining Disclosure Standards in Canada – An Update. *Aus. IMM.* Feb. (No. 1): 32-37.
- Anthony, J.W., Bideaux, R.A., Bladh, K.W., and Nichols, M.S., 2000. Handbook of Mineralogy IV. Arsenates, Phosphates, Vanadates. Mineral Data Publishing (Tucson, AZ). 680 p.
- Audetat, A., Gunther, D., and Heinrich, C.A., 2000. Causes for Large-Scale Metal Zonation around Mineralized Plutons: Fluid Inclusion LA-ICP-MS Evidence from the Mole Granite, Australia. *EG* 95(8): 1563-1581.
- Bailey, T.C. and Krazanowski, W.J., 2000. Extensions to Spatial Factor Methods with an Illustration in Geochemistry. *Math. Geol.* 32(6): 657-682.
- Barnes, S.J. and Junilov, V.Y., 2000. Spinel and Mg Ilmenites from the Noril'sk 2 and Talnakh Intrusions and Other Mafic Rocks of the Siberian Flood Basalt Province. *EG* 95(8): 1701-1717.
- Bechtel, A., Ghazi, A.M., Elliott, W.C., and Oszczepalski, S., 2001. The occurrences of the rare earth elements and the platinum group elements in relation to base metal zoning in the vicinity of Rote Faule in the Kupferschiefer of Poland. *Applied Geochem.* 16(3): 375-386.
- Cairns, C.J., McQueen, K.G., and Leah, P.A., 2001. Mineralogical controls on element dispersion in regolith over two mineralized shear zones near the Peak, Cobar, New South Wales. *J. Geochem. Explor.* 72(1): 1-21.
- Castro, A., Fernandez, C., and Vigneresse, J.L. (Eds.), 2000. Understanding Granites: Integrating New and Classical Techniques. *Geol. Soc. (London) Spec. Pub.* 168. 278 p.
- Cawthorn, R.G., 2001. A stream sediment geochemical re-investigation of the discovery of the platiniferous Merensky Reef, Bushveld Complex. *J. Geochem. Explor.* 72(1): 59-69.
- Chandrajith, R., Dissanayake, C.B., and Tobschall, H.J., 2001. Application of multi-element relationships in stream

sediments to mineral exploration: a case study of Walawe Ganga Basin, Sri Lanka. *Applied Geochem.* 16(3): 339-350.

- Chapman, R.J., Leake, R.C., Moles, N.R., Earls, G., Cooper, C., Harrington, K., and Berzins, R., 2000. The Application of Microchemical Analysis of Alluvial Gold Grains to the Understanding of Complex Local and Regional Gold Mineralization: A Case Study in the Irish and Scottish Caledonides. *EG* 95(8): 1753-1773.
- Eilu, P., Mikucki, E.J., and Dugdale, A.L., 2001. Alteration zoning and primary geochemical dispersion at the Bronzewing lode-gold deposit, Western Australia. *Mineral. Deposita.* 36(1): 13-31.
- Farnham, I.M., Stetzbach, K.J., Singh, A.R., Johannesson, K.H., 2000. Deciphering Groundwater Flow Systems in Oasis Valley, Nevada Using Trace Element Chemistry, Multivariate Statistics, and Geographic Information System. *Math. Geol.* 33(8): 943-968.
- Gerlach, R.W., Gustin, M.S., and Van Emon, J.M., 2001. On-site mercury analysis of soil at hazardous waste sites by immunoassay and ASV. *Applied Geochem.* 16(3): 281-290.
- Gorton, M.P. and Schandl, E.S., 2000. From continents to island arcs; a geochemical index of tectonic setting for arc-related and within-plate felsic to intermediate volcanic rocks. *Can. Mineralogist.* Pt. 5: 1065-1074.
- Helmy, H.M. and Mogessie, A., 2001. Gabbro Akarem, Eastern Desert, Egypt: Cu-Ni-PGE mineralization in a concentrically zoned mafic-ultramafic complex. *Mineral. Deposita.* 36(1): 58-71.
- Huston, D.L., 2001. Geochemical dispersion about the Western Tharsis Cu-Au deposit, Mt. Lyell, Tasmania. *J. Geochem. Explor.* 72(1): 23-46.
- Karger, M. and Sandomirsky, S., 2001. Multidimensional statistical technique for detection of low contrast geochemical anomalies. *J. Geochem. Explor.* 72(1): 23-46.
- Klusman, R.W., Moore, J.N., and LeRoy, M.P., 2000. Potential

Continued on Page 26

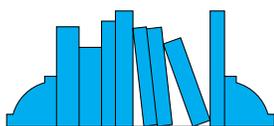
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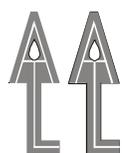
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continued from Page 25

- for surface gas flux measurements in exploration and surface evolution of geothermal resources. *Geothermics*. **29**(6): 637.
- Kozlov, V.D., 2000. Geochemical evolution of the Variscan granitoid magmatism as related to the metallogeny of the Bohemian Massif. *Geol. Ore Deposits* **42**(5): 414-428.
- Kretz, R., 2000. Redistribution of major and trace elements during the formation of biotite-plagioclase reaction zones at boundaries between amphibolite and K-feldspar gneiss, Otter Lake area, Quebec, Canada. *Can. Mineralogist*. Pt. 2: 525-544.
- Li, C., Naldrett, A.J., and Ripley, E.M., 2001. Critical factors for the formation of a nickel-copper deposit in an evolved magma system: lessons from a comparison of the Pants Lake and Voisey's Bay Sulfide occurrences in Labrador. *Mineral. Deposita*. **36**(1): 85-92.
- Lugli, S., Torres-Ruiz, J. Garuti, G., and Olmedo, F., 2000. Petrography and Geochemistry of the Eugui Magnesite Deposit (Western Pyrenees, Spain): Evidence for the Development of a Peculiar Zebra Banding by Dolomite Replacement. *EG* **95**(8): 1775-1791.
- Manceau, A., Schlegel, M.L., Musso, M., Sole, V.A., Gauthier, C., Retit, P.E., and Trolard, F., 2000. Crystal chemistry of trace elements in natural and synthetic goethite. *GCA* **64**(21): 3643.
- Oreskes, N., 2000. *The Refection of Continental Drift Theory and Methods in American Earth Sciences*. Oxford. 420 p.
- Pan, Y. and Therens, C., 2000. The Werner Lake Co-Cu-Au Deposit of the English River Subprovince, Ontario, Canada: Evidence for an Exhalative Origin and Effects of Granulite Facies Metamorphism. *EG* **95**(8): 1635-1656.
- Ruano, S.M., Rosua, F.J.C., Hach-Ali, P.F., Chacon, F. de la F., and Lopez, E.C., 2000. Epithermal Cu-Au mineralization in the Palai-Islica deposit, Almeria, southeastern Spain: fluid inclusion evidence for mixing of fluids as a guide to gold mineralization. *Can. Mineralogist*. Pt. 3: 353-566.
- Steele, I.M., Cabri, L.J., Gaspar, J.C., McMahon, G., Marquez, M.A., and Vasconcellos, M.A.Z., 2000. Comparative analysis of sulfides for gold using SXRF and SIMS. *Can. Mineralogist*. Pt. 1: 1-10.
- Thorleifson, L.H. and Garrett, R.G., 2000. Lithology, Mineralogy, and Geochemistry of Glacial Sediments Overlying Kimberlite at Smeaton, Saskatchewan. *Geol. Surv. Can. Bull.* 551. 40 p.
- Ucurum, A., Lechler, P.J., and Larson, L.T., 2000. Platinum-group element distribution in chromite ores for ophiolite complexes of western Turkey. *IMM Trans.* B112-120.
- van Loon, A.J., 2000. Reversed mining and reversed-reversed mining: The irrational context of geological disposal of nuclear waste. *Earth Sci. Rev.* **50**(3/4): 269-276.
- Wolfe, N., 2001. Science and Innovation – A Political Imperative. *Aus. IMM. Bull.* Feb. (No. 1): 29-30.



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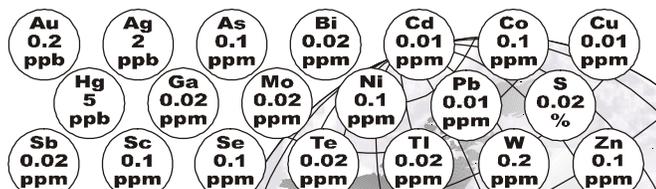


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New Membership Committee — Annual Report, 2001

The organization of Student Chapters is now an established world-wide effort under the direction of Mark Elliott (elliottmark@bigpond.com) as Chair of the Student Affairs Committee. He is working closely with David Cohen (d.cohen@unsw.edu.au) to create several chapters in Australia and coordinating the creation of other Chapters on other continents.

The NMC has launched into a new publicity campaign to bring attention to the AEG's foundation in geochemistry. The first product of this program will be posters honoring AEG Medalists, Distinguished Lecturers, Student Paper Prize winners, and Honorary Members. These will create a photo essay at the IGES Convention Hall in Santiago demonstrating the AEG's vitality. This photo essay will then move to the Website and will grow as our membership is recognized for its accomplishments in the geosciences.

The NMC will be working hard on these and many other programs through 2001 and expect to see a significant increase in AEG membership in the coming years. We welcome any and all ideas the general membership would like us to consider.

Shea Clark Smith
Chairman New Membership Committee

IN MEMORY

Harold Bloom, 1913 - 2001

Harold Bloom, a founding member of the Association of Exploration Geochemists, died in Naples, Florida on January 24, 2001. Born in Brooklyn, NY in 1913, he was educated at Brooklyn College, where he earned a degree in chemistry in 1935.

Hal was employed as a cartographic technician by the U. S. Department of the Interior during World War II. Following the war he joined the U. S. Geological Survey's fledgling Geochemical Exploration Section in Denver as an analytical chemist. It was there, in collaboration with Herb Hawkes, that he developed the ammonium citrate-soluble heavy metals test using the colorimetric reagent dithizone for the on-site analysis of soils and stream sediments – now popularly known as the “Bloom test.” This approach of determining “live” elements, as Hawkes called them – mobile elements dispersed during alteration or weathering of mineral deposits – was a forerunner of the partial extraction methods so widely and effectively used worldwide today.

The early apparent effectiveness of simple colorimetric field analytical procedures in geochemical exploration led Hawkes and Bloom to leave the USGS and join John Riddell and John Webb in an early geochemical-based mineral exploration venture in New Brunswick, Canada.

Following this exploration venture, in 1955 Hal became professor of exploration geochemistry at the Colorado School of Mines. His keen sense of humor and dedication to students' career preparation made his courses popular. As part of his program at Mines, Hal assumed teaching the geochemical exploration short course that had previously been run by the USGS at its Denver laboratories. Several summers he was assisted by Al Levinson, a long-time friend and professor of geochemistry at the University of Calgary. Many exploration geologists from industry gained their introduction to geochemical exploration techniques through this course. Portions of the course were also offered at the summer field course required of all Colorado School of Mines undergraduates.

During his tenure at Mines, Hal, along with two other Mines professors, served as a Fullbright lecturer and short course director in Australia the summer of 1967 under the sponsorship of professor Eric Rudd of the University of Adelaide. Rudd subsequently reported that the success of this program in 1967 was the inspiration that led to his being able to form the Australian Mineral Foundation. Following the Fullbright tour, Hal became a consultant to the United Nations, helping to establish geochemical exploration programs in Senegal, Nicaragua, Mexico, and Bolivia, and he consulted broadly with the mining industry. Hal retired from teaching in 1978, but maintained his contacts with the profession for many years. After retirement, he established a scholarship fund to assist students in exploration geochemistry.

In 1968, Hal teamed with Frank Canney and John Hansuld to organize the second geochemical exploration symposium, held at the Colorado School of Mines. He was co-editor of the proceedings of this symposium, published in January 1969 as Colorado School of Mines Quarterly vol. 64, no. 1, and he was a founding member of the Association of Exploration Geochemists, established as an outgrowth of this symposium, serving as a councillor from 1970 to 1972, and alternately as secretary or treasurer from 1972 to 1974. Hal also was a member of the Committee on Geochemical Analysis and served as the first chairman of the Research and Education Committee. In 1975 on behalf of the AEG, in collaboration with R. F. Horsnail and P. K. Theobald, he conducted a workshop on geochemical exploration for uranium – a hot commodity at the time.

Hal was a competitive tennis player once ranked no. 1 in his class in Florida. He reportedly relished moving into increasing age brackets, as his relative youth in each new bracket increased his competitive advantage. He is also remembered by former USGS colleagues as a formidable lunchtime horseshoe player.

He is survived by his wife, Betty, of Naples, Florida, a daughter, Lillian, and a host of friends and former professional associates. Memorial contributions may be made to the Harold and William E. Bloom Fund, Colorado School of Mines Foundation, 15th and Illinois Streets, Golden, CO 80401.

Compiled by Edwin V. Post, with contributions from Betty Bloom, Graham Closs, Albert Marranzino, Howard McCarthy, Paul Theobald and Robert Weimer.

Information for Contributors to EXPLORE

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

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

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

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

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

Information for Advertisers

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

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

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

EXPLORE

Newsletter No. 111

APRIL 2001

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Please complete the section relevant to the class of membership sought and supply your address on this form.
Mail the completed application, together with annual dues, to the address below.

***Details of requirements and application forms for voting membership (fellowship) can be obtained from the AEG website (<http://www.aeg.org>) or business office.**

MEMBER

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

_____ as a _____
(employer) (employment title)

I am actively engaged in scientific or technological work related to geochemical exploration and have been so for the past two years. Upon receipt of the Code of Ethics of the Association I will read them and, in the event of being elected a Member, agree to honour and abide by them. Witness my hand this ____ day of _____ 19 ____.

(Signature of applicant)

STUDENT MEMBER

I _____ wish to apply for election as a Student Member of the Association of Exploration Geochemists. I am presently engaged as a full-time student at _____, where I am taking a course in pure or applied science. Upon receipt of the Code of Ethics of the Association and in the event of being elected a Student Member agree to honour and abide by them. Witness my hand this ____ day of _____ 19 ____.

(Signature of applicant)

Student status must be verified by a Professor of your institution or a Fellow of the Association of Exploration Geochemists. I certify that the applicant is a full-time student at this institution.

(Signature)

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Please note: Your completed form should be mailed to the Business Office of the Association and will be acknowledged upon receipt. The Admissions Committee reviews all applications and submits recommendations to Council, who will review these recommendations at the next Council Meeting or by correspondence. If no objection is raised the names, addresses and positions of candidates will be listed in the next issue of the Association Newsletter. If after a minimum of 60 days have elapsed following submission of candidate information to the membership no signed letters objecting to candidates admission are received by the Secretary of the Association from any Member, the Candidate shall be deemed elected, subject to the receipt by the Association of payment of required dues. Send completed application, together with annual dues to:

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IN MEMORY

Robert Richard Brooks, BA, BSc, PhD, DSc, FRS April 9th 1926 – January 23rd 2001

On January 23rd the world lost another legendary figure in geochemistry. Born in Bristol to an English father and French mother, Robert Brooks spent the first 30 years of his life in England. During that period he served in the British army in the Middle East and East Africa, then attended Bristol University from which he received his B.Sc (Hons) in Chemistry in 1952. After working for a while as an analytical chemist, he moved to South Africa in 1956 and, under the tutorship of Louis Ahrens, received a PhD in Geochemistry from the University of Cape Town in 1960. That same year he took an academic staff position in New Zealand at Massey University in Palmerston North, where he remained based for the rest of his life. During his 40 years at Massey University, he traveled widely and developed an increasingly broad range of interests and expertise on a wide range of subjects. Among his distinctions, Professor Robert Brooks was the first to receive a D.Sc from Massey University (1975), and became a Fellow of the Royal Society of New Zealand in 1997.

Of particular note in his early career are his fundamental studies in the development of biogeochemical methods and their role in the discovery of mineral resources. His 1972 book entitled 'Geobotany and Biogeochemistry in Mineral Exploration' is a benchmark text that was the first English-language book to appear on this subject. It is an elegant exposition of the principles and methods of this burgeoning field of endeavour, and it remains a classic text and a frequently quoted reference. A decade and some 150 publications later his book 'Biogeochemical Methods of Prospecting for Minerals' (1983) constituted a significant update of his earlier text.

Professor Brooks had an extraordinary geographic breadth of experience, both in field operations and lecturing. These travels were enhanced by his multi-lingual skills that included a BA in German and Russian from Massey University in 1976. I was fortunate to accompany him on several expeditions that he led to Africa and South America, and on many occasions I have stood nearby in awe as he conversed with foreign colleagues and locals in French, German, Spanish, Portuguese, Russian, Arabic, Swahili and Chinese.

Amongst his biogeochemical interests were the geobotanical and botanical study of the flora endemic to serpentine substrates. He initiated, organized and led five expeditions sponsored by the National Geographic Society, to remote areas of ultramafic rock outcrop where the 'serpentine flora' had been poorly documented. Thanks to these major efforts several species new to science have been discovered, and there are now greatly improved databases and collections housed at several major herbaria around the world. In 1987 he published another significant collation of information and data in his book 'Serpentine and its Vegetation – a Multidisciplinary Approach'.

The career of Professor Brooks was punctuated with the publication of 11 books and 331 papers, many of which contained valuable collections and summations of information relevant to plant science. He was a true leader in bringing to the scientific world, in a clear and entertaining manner,



texts that focus on such diverse topics as geobotany, biogeochemistry, phytoarcheology, phytoremediation, hyperaccumulation, and Cretaceous-Tertiary boundary problems. Concurrently, he taught for 40 years at Massey University and led many students through to higher degrees, as well as acting as an associate editor for the *J. Geochemical Exploration* for the past 26 years. He had recently accepted a position on the editorial board of the AEG's new journal *Geochemistry: Exploration, Environment and Analysis*.

He pioneered studies on metal 'Hyperaccumulator' plants, and investigated the potential of phytoremediation for extracting heavy metals from polluted soils, and subsequently harvesting these metals as 'bio-ore'. Much of his efforts in his last few years were directed toward developing these methods.

Robert Brooks was able to 'cut to the 'quick' of a problem and had little time for unnecessary delays – sometimes creating exasperation for him in cultures where a 'mañana' attitude is prevalent. When arranging and leading expeditions he could be completely relied on to have thought of everything – well organized and prepared for a wide range of scenarios. These attributes he carried into his rapid and effective skills at editing and compiling information, and they contributed greatly to his prolific production of publications and proficient and timely editing skills. Yes, there are few who knew him well who would disagree that his character was both colourful and unique: typically sporting a bow-tie at professional functions, and his leather 'chaps' to protect his shins in the field. He had a keen sense of humour, a love of Nature, and a joke or saying for every occasion. He was still planning new work and travels during his last few weeks. He will be remembered for the profound impact he had on several aspects of science, and for the endearing and unique character that he was.

Colin E. Dunn
Sidney, British Columbia
13 February 2001

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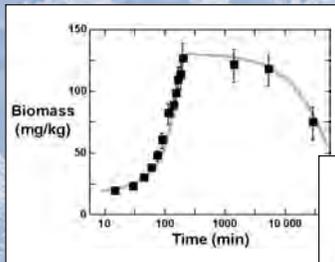
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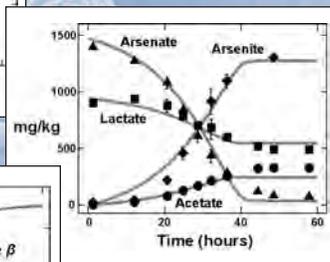
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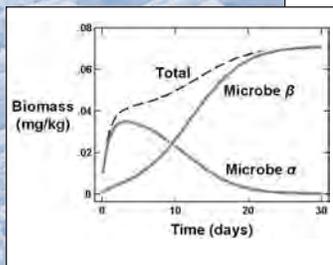
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