EXPLORE
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Newsletter for the Association of Exploration Geochemists

BIOGEOCHEMISTRY

Discovery Using Metal Concentrations in Plants — Bisbee (Cochise County, AZ)

Introduction

A structurally complex area, approximately 20 miles south of the Bisbee porphyry copper mine, was identified in the late 1980's for its gold potential. Exposed Cretaceous siliciclastics were mapped to the margins of Quaternary pediment gravels, which obscured what appeared to be the most structurally favorable areas. Because Mesquite and Acacia were widely distributed over the pediment, biogeochemistry was chosen for targeting the drilling program. Mesquite had been used in many earlier surveys with published results, and it was expected that if mineralization were present, Mesquite tissue would be enriched. However, there was no previous experience with White Thorn Acacia, which is the Acacia species with the widest distribution in this particular area.

Ground water was known to be 500 feet from the surface, yet the mineralization was presumed to be just 100-200 feet deep. This posed a serious problem for the biogeochemical survey because experience predicted that without ground water / mineral interaction only weak biogeochemical indications of deep mineralization could be expected.

Sample collection was done between October 26-27 and December 13-17, 1991. Samples from the October collection were analyzed by neutron activation (INAA), but it was observed that high salt concentrations (indicated by elevated Br concentrations) interfered with the accurate determination of Au at 0.1 to 0.8 ppb levels. Also, vital base metals were not reported by the INAA method. So, both the October and December samples were analyzed by ICP/OES for Au, Ag, Cu, Pb, Zn, As, and Sb.

Geology

Cretaceous undifferentiated siliciclastics are exposed in the western half of the claim block where several south-striking thrust faults have been mapped (age not indicated). A 1000 foot wide "fault zone" that strikes east-southeast and extends into the area covered by Quaternary pediment gravel postdates the thrust faults. At least one south-striking fault dips at a low angle to the east, but most southeast striking faults are high angle. There is only one mapped east-striking fault with some degree of strike-slip offset. Much later southeast-striking range faults, which are revealed by gravity and magnetic data, exist under the pediment.

Quaternary pediment gravels cover the eastern half of the claim block and obscure what appear to be the most structurally favorable areas. Gravel thickness increases to the east to about 200 feet. Gold and silver mineralization under the pediment is related to a zone of southeast-striking faults that parallel the range faults. The biogeochemical data indicate several southwest structures, which were not mapped and may contribute to the structural complexity in the areas where mineralization was encountered by drilling.

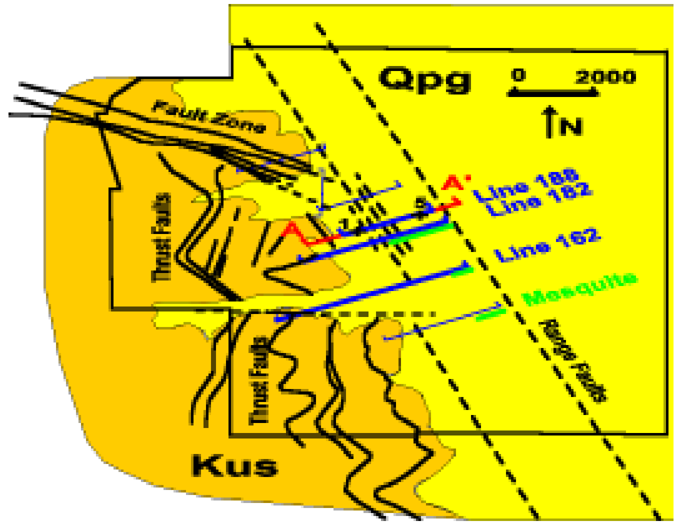

Figure 1. Geology in the area of the Bisbee biogeochemical survey (1991). Mapped faults in the exposed Cretaceous undifferentiated siliciclastics and those divined by magnetic and gravity geophysical surveys underlying Quaternary pediment gravels are shown. Heavy blue lines denote areas where Acacia data is anomalous (thin blue lines where Acacia data is not anomalous). Heavy green lines denote areas where Mesquite samples were taken instead of Acacia. Section A-A' depicted in following figures.

Biogeochemical Results

It was discovered that Mesquite and White Thorn Acacia accumulate comparable levels of metal in their tissues, revealing few if any "species effects". Targets were defined by enrichment of Au, Ag, As, and Sb, accompanied by depletion of Zn and anomalous halos of Br.

The area of best economic mineral potential as defined by the biogeochemical data lies northwest of Line 188, between Lines 188 and 182, and on the southwest end of Line 162. Gold mineralization on Line 188 seems to be zonationally related to Ag mineralization on Line 182. A north-south structure defined by the biogeochemical data runs through the mid-point of Lines 188 and 162. Mineral potential is confined to areas west of this structure on those lines. Mineralization in the middle of Line 162 is characterized by Au-Ag-Sb. A single Au concentration of 5 ppb in Acacia near an old adit on the west end of Line 162 is associated with minor concentrations of Ag, As, lesser Au concentrations and a depletion in Zn. Deeper precious metal zones predominate on the west ends of Lines 188, 182, and 162.

Anomalies on other lines comprise Pb, As, Sb, and Ba, but lack Au and Ag. This association characterizes the "Fault Zone".

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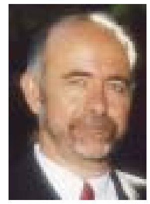

Steve Amor

AEG Presidential Address

My year as President, has gone quickly. The Dublin IGES provided a pleasant and welcome interlude (and I thank the AEG, once again, for enabling me to attend). It was good to meet with so many of you in Dublin and I would like to congratulate the local organizing committee on their achievement in organizing a successful and profitable event, in the face of continuing uncertain times for the mining and exploration industry, in the world in general and Ireland in particular. The LOC of the 2005 Symposium in Perth, well represented in Dublin, are hitting their stride and I am confident that the "IGES momentum" that Dublin maintained so successfully will endure for a good few years yet!

The AGM held on Monday September 1st was marked by an update regarding progress in changing the By Laws, which led to the passing of a motion that the AEG President's term of office be extended from one to two years. There will be further discussion by Council regarding when this takes effect and how it is phrased in the ByLaws. The majority of the meeting was, however, taken up with discussion about the change of our Association's name.

I had been hoping that in this last Presidential Piece appearing under my photograph, I would be able to put a seal on our association's name change. At time of writing, it appears that this will not be possible. Although a majority

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of members at the AEG in Dublin voted that the name "Association of Applied Geochemists" be presented to the Fellows of the Association for a formal vote of approval or disapproval, and it had appeared prior to that meeting that the groundswell of opinion within the AEG had shifted very much in favour of that name, it became obvious almost immediately that many members are not happy with it, the way in which it was arrived at and publicized, and the opportunities that were provided for other name options to be aired, put to the membership and voted upon. Furthermore, many members think that to give our association a name that is so similar to that of an existing journal (Applied Geochemistry) is inviting trouble. Even if the name of the organization that produces it (International Association of Geochemistry and Cosmochemistry) is different, and the IAGC may not be in a position to litigate, it bespeaks insularity and high-handedness on our part, and the company that publishes AG (Elsevier) may not be so shy about protecting the journal's name against what it sees as infringement.

The AEG is a worldwide organization and in between our biennial Symposia, when personal interactions are possible, your Council has to make decisions based on what it believes to be the opinion of the majority, based on opinions that are expressed via the website, email and other methods of remote communication. I believe that in the months that preceded the Dublin Symposium, most Council members had gained the impression that there were neither serious drawbacks, nor opposition, to the choice of "Association of Applied Geochemists" as the new name of our association; yet well-founded objections to it began to be expressed immediately after (and even during) the AGM. We also thought that adequate avenues had been provided for the publicizing of the name-change debate, and for every opinion to be expressed and taken into account, prior to the

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Dear Editor of Explore,
concerning the Association name change
re: Explore No. 120 of July 2003, page 5.

This notice recites the purposes of constitution of the AEG. There it is no mention of other than mineral resources and dispersion patterns. Now, a group of members want to change the name of AEG, however, any other name either limits its scope or broadens it exceeding the original purpose. The truth is that along all the years since its foundation in 1970, the AEG walked slowly away from the purpose followed by its founding members, i.e., toward geology, for which we have many other appropriate organizations on hand.

In one area, for instance, we had an enthusiastic biogeochemist, the late Prof. Dr. Robert R. Brooks. He, as well as a few of the founding members, followed in the footsteps of many Russian biogeochemists. That spirit is slowly dissappearing. Therefore, I concur with GJS Govett that a broader scope as that expressed with AEG, or AEEG (as suggested) is needed if a name change is desired. Although I am inclined to support the suggestions of Francisco Querol-Suñe and Erme Enriquez, I think that "Association of Applied Geochemists" or even better "Association of Geochemists" would be more suitable. I do not see anything wrong with retaining the original name and change the bylaws to broaden the purpose.

Evaldo L. Kothny,
one of the Founding Members.
Walnut Creek, CA, USA

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From "Exploration Geochemistry" to "Applied Geochemistry"

"Exploration geochemistry" is developing from a mineral prospecting technique to a young branch of applied earth science. It is expected that this young science will make extraordinary contributions to solving important resources and environmental problems during the 21th century. This point of view hasn't even been fully acknowledged by a large number of exploration geochemists themselves.

Such strong belief is generated for the following reasons:

(1) Resources are constructed ultimately by elements and isotopes and many environmental problems are ultimately related to the distribution and behaviors of elements, isotopes, and their compounds. Elements and isotopes are the fundamental units in geosciences, equivalent to the fundamental unit "gene" in biosciences.

(2) During the past 20-30 years, geochemical mapping has been carried out on an unprecedented scale using more and more sophisticated techniques, from regional, national to global, from analyzing for a few elements to analyzing for all the elements in the periodic table, from study of element

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distribution in a few medium (rocks, soils and sediments) to study of element distribution in the whole ecosystem or earth surface system (rocks, soils, waters, sediments, air, plant, animals and human organs). These achievements are mainly contributed to exploration geochemists.

(3) Various kind of geological maps are the basic support in the historical development of geosciences. The preparation and study of various kind of “geogene” (geochemical) maps will certainly serve as the basic support for the application of geochemistry to solve various and important resource and environmental problems.

The scope of application of exploration geochemistry will be widened so drastically in the coming decades that the title of “applied geochemistry” will be more suitable for harmonizing its development.

Applied geochemistry as a branch of geosciences, is just taking shape. It is a multi-disciplinary activity by chemists, geochemists, mathematicians, physists, geologists, agronomists, environmentalists etc. There is a scientific journal which bears the same name, but the results of study in this field have been widely scattered in different journals. No scientific society with this title has been organized. So there is a great chance for the Association of Exploration Geochemists to change its name to the Association of Applied Geochemistry, in order to attract a large number of multidisciplinary oriented scientists toward the same end of making greater contributions in solving important resources and environmental problems. The idea of geochemical mapping as the basic support for the development of applied geochemistry will help the multidisciplinary scientists to broaden their horizons from very local problems to problems of regional or even global character.

I would therefore like to heartily urge my colleagues to vote for a new title - The Association of Applied Geochemistry.

Xie Xuejing
Institute of Geophysical and Geochemical Exploration, China

“Geochemical maps represents the most urgent and important task within geology for today’s human society”
L. K. Kauranne, cited from A. G. Darnley, J. Geochem. Explor. 55. 1995.

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Response to Reply. Article “Theory behind the use of soil pH measurements as an inexpensive guide to buried mineralization, with examples” by Barry Smee in Explore 118, Jan 2003.
Response submitted by *Alan W. Mann, Perth, Western Australia, in Explore 120, July 2003.*

Reply to Alan Mann:
Submitted by: Barry W. Smee, Sooke B.C., Canada
Email: bwsmee@geochemist.com

The letter from Alan Mann in EXPLORE issue 120 responds to my previous article in Explore 118 (Smee, 2003) regarding the use of soil pH and its affect on selective or weak extraction (SWE) methods. Dr. Mann takes me to task, at some length, for the first paragraph where I suggest, not too subtly, that some of the reporting of results of certain commercially sold SWE methods may not be offering a clear picture of the difficulties involved in their use. I stand by my claim, without apologies.

My accompanying note in the Explore 118 issue contained the hope that there would be replies to Explore with “sharp wits and enthusiasm”. Perhaps what I should have said is “additional useful data and insights into the Geochemical Process”, which was one of the focus topics of the issue. Alan offers neither useful data nor insights.

Some years ago I reviewed the historical development of SWE methods Smee (1997). That communication quotes several geochemists who gave warnings into the use of SWE methods alone: for example, Boyle and Smith (1968) said that “geochemistry has suffered with a poor reputation” because of the use of SWE methods by untrained personnel. Fisher (1971) in his research on SWE methods showed that the amount of metals dissolved is affected by particle size, complexes formed, mineral composition of the sample and drying time. It appears that much this work has been forgotten or ignored. If it has not, why do the SWE providers not offer methods of correcting SWE data to account for these variables?

Bradshaw et al. (1974) showed that it is complete folly to present SWE data alone without corresponding strong acid extraction data to act as a baseline. They also point out (remember this is now 29 years ago): “The depth of sampling during the soil programme may be very critical as variations with depth can be greater than a factor of ten within 6 inches.” The sampling of specific soil horizons to enhance SWE responses is not at all new news as indicated by Mann et al, 1998.

Govett and Chork (1977) showed that the use of organic analyses was important to the interpretation of SWE geochemistry in sampling mineral soils, while Nuutilainen and Peuraniemi (1977) showed that the metal-organic ratio enhanced geochemical anomalies in humus samples. These papers together clearly implicate the organic content of soil as important to the interpretation of SWE geochemistry, but is different for different soil horizons. Why are the results of commercial SWE methods as used in temperate environments not corrected for the number of organic, iron and manganese binding sites?

My 1983 paper suggested that the organic content of the soil is dependent on soil bacteria concentrations and types, which is in turn affected by soil pH. Stuart Hamilton has recently come to the same conclusion (Hamilton personal comm., 2003) from his excellent work in Ontario. Why are the commercial providers of SWE methods not performing their own research into these topics to aid their clients?

Dr. Mann chides me in not referencing the excellent research undertaken by Gwendy Hall and her team at the

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Geological Survey of Canada, and suggests that I have insulted her by not doing so. Firstly, Gwendy's work is primarily focused on the analytical problems associated with SWE methods rather than geochemical processes. Secondly, I have known and worked with Gwendy for nearly thirty years: if I insulted her I would be the first to hear about it—from her! I have been assured by Ms. Hall that I did not insult her in the Explore 118 article.

Dr. Mann determines, somehow, that I am maligning the use of SWE methods. I have been using SWE methods in mineral exploration for more than thirty years, and continue to do so routinely. However I never use the SWE methods alone as a single means of defining drill targets. I do use the SWE methods along with the corrective actions that have been outlined by workers for over thirty years.

My colleagues may notice that in all of my published work on SWE methods, dating from 1972, (in: Bradshaw et al, 1969, 1970, 1971, 1972a, b) I have never used SWE analyses alone to interpret data. I have attempted to account for as many variables as I know before plotting final data. This is why I use the ratio of the SWE analysis to the hot acid analysis and to the organic carbon content or calcium and/or iron content when applicable. These interpretation methods have proven to hold true over my thirty five years in the geochemical business and have contributed to the discovery of VMS massive sulphides, shale-hosted massive sulphides and a variety of gold deposits. My work on soil pH speaks to the process of anomaly formation and more importantly, anomaly discrimination, not to the exclusion of SWE methods.

I am particularly miffed at the commercial providers of SWE methods who either ignore past work, or re-discover the wheel. The commercial providers of SWE methods are selling a product that charitably they really don't understand. Mann quotes the Birrell and Mann 1999 presentation at the 19th IGES Workshop that showed the carbonate problem with MMI A leach and other unbuffered SWE methods. I illustrated the same problem in Explore 102. Why did it take the MMI providers at least 3 years of commercial sales to discover this relatively simple problem? Did they reanalyze their client's MMI A affected samples with MMI C? What other surprises wait in the wings for the commercial SWE users?

If exploration geochemistry is to understand the complex processes and interactions of ion migration then there cannot be secrets in methods. It is time to open the "black boxes" and get on with discoveries.

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Smee, B.W., 2003: Theory behind the use of soil pH measurements as an inexpensive guide to buried mineralization, with examples. Explore, 118.

IN MEMORY

A Truly Remarkable Man

The world has lost a great geologist and geochemist, and a great Canadian who had contributed to his country for over 60 years. On Monday, August 5th, 2003, *Robert William Boyle* left this world peacefully after a long struggle with illness, and a much longer struggle with failing eyesight. The latter had not curbed his determination to finish his most recent scientific endeavour, his 'History of Cosmochemistry and Geochemistry', which is being considered for publication by the McGill-Queen's University Press. He completed the last editorial work on the Preface the day before his death with assistance from his daughter-in-law Christy Vodden.

Bob, born June 3rd 1920, grew up near Wallaceburg in southwestern Ontario. It was there that he developed his interest and love for the natural world. As a teenager he learned to trap, and saved his earnings from muskrat and mink pelts for his future education. Even from those early days Bob was intrigued with chemistry, and had his own laboratory in the attic of the family farm. It was his friendship with James McCrae, a 70-year-old retired prospector, living two farms away that was critical. One can imagine the impression that the stories of prospecting in Northern Ontario had on the teenager who loved the outdoors. During his last two summers at Wallaceburg High School he decided to earn the money that would enable him go to university and study geology. With contacts from McCrae he joined a prospecting syndicate in northern Ontario, where he started at the bottom — cutting line, and as a driller's helper.

Europe went to war in September 1939, and Bob enlisted in the Royal Canadian Artillery two days before Canada joined the war. He used to tell the story of how two Military Policemen arrived at the farm later to collect the 'errant son' for not reporting for conscription. His mother Jeannie sent them away with a tongue lashing and a copy of Bob's regimental address in England! He spent most of the next six years in the European theatre, where he served with distinction. Initially stationed near Hastings in Sussex, England, as part of the defence of the southern coast, he then took part in the landing in Normandy in 1944 and advanced through France, Belgium, Holland into northwest Germany. Notwithstanding his military service, Bob still made time for geology. While stationed in England, he took geology courses at Imperial College, and correspondence courses from Queen's University, Kingston. It was at Imperial College that he met Professor H.H. Read of Donegal Granite fame. One has to wonder if seeds were not sown there that later grew to fruition in Bob's ideas concerning 'lateral secretion'. Perhaps not out of character, Bob refused a commission and remained a NCO, being discharged on October 26th, 1945, with the rank of lance-sergeant.

Robert W. Boyle

Just eight days later on November 3rd Bob married his childhood sweetheart, Marguerite Brown, who had grown up on a neighbouring Wallaceburg farm. On his honeymoon, it is told, he spent time studying physics for his university admissions test. In January 1946, Bob enrolled in Geology at the University of Toronto as part of an accelerated program available for returning servicemen. In the summer of 1947 he worked underground for Madsen Red Lake Gold Mines. He graduated with a degree in Mining Geology in 1949, his Bachelor's dissertation was on sediments of the Yellowknife Supergroup, based on his work as a summer field assistant for the Geological Survey of Canada (GSC) in 1948. The following year he was again a field assistant for the GSC and J.F. (Fen) Henderson and I.C. Brown in their Yellowknife, NWT, mapping project. In the Fall Bob immediately commenced graduate work at Toronto on the Yellowknife gold deposits, completing his M.A.Sc. in 1950. Through his field mapping with Fen Henderson and graduate work, his potential was recognized by the GSC, and in 1952 he joined as a permanent member of staff. He completed and successfully defended his Doctoral thesis in 1953, subsequently published by the GSC as Memoir 310, 'Geology, Geochemistry, and Origin of the Gold Deposits of the Yellowknife District, Northwest Territories', in 1961.

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It was during his graduate research on the sediments and shear zones at Yellowknife that Bob developed his ideas on 'lateral secretion' as an ore-forming process, and one of the causes of primary geochemical halos surrounding mineral deposits that could be used as guides to their presence.

Bob was a pioneer of the application of geochemistry to mining geology and mineral exploration. In 1955 he persuaded the GSC to provide space for a 'laboratory for geochemical prospecting studies'. This facility was expanded to a full laboratory in 1957, when he hired Peggy Gilbert and Ron Holman, who were working with John Webb at his Geochemical Prospecting Research Centre at Imperial College, London, and Eion Cameron to broaden the group's interests into sedimentary lithogeochemistry. Also in 1957 the GSC's regional geochemistry program commenced with Boyle and Holman's work in Nova Scotia. In 1961 the GSC moved to a new building with new laboratories at its present Ottawa site on Booth Street. With the support of enlightened senior management conscious of the need to bring hard science into geology, Bob designed these geochemistry laboratories to meet the needs of mineral exploration rather than those of traditional petrochemistry, and hired permanent staff, post-doctoral fellows and students, to undertake field and laboratory studies. Over the years, these included Bob Washington, Art Smith, Adrian Debnam, Chris Durham, John Lynch, Willy Dyck, Chris Gleeson, Don Sangster, John Fortescue, Les Davies, Walter Nash, Mohammed Tauchid and Bob Garrett, names familiar in exploration geochemistry and mineral exploration. Bob stood down from leading the 'Geochemistry Section' in 1967 to concentrate on his beloved precious metals, and to write up his voluminous research and observations. Those who visited his office on the 7th Floor at Booth Street will remember the filing card cabinets stacked to the ceiling. Bob had amassed the card predecessor of GeoRef, his key to bibliographic knowledge.

His work at the GSC in the 1950s and 1960s took him to Yellowknife, NWT; the lead-zinc-silver deposits of Keno Hill, Yukon; the barite deposit at Walton, Nova Scotia; the Bathurst, New Brunswick, base-metal camp; and the Cobalt, Ontario, silver-cobalt deposits. Bob's studies led to new insights on the formation of these ore deposits and the development of geochemical methods to aid mineral exploration. When Bob first started work at Walton it was known as a barite deposit. His work led to the discovery of the underlying blind base-metal zone that was subsequently brought into production. How did he come to suspect its presence? He noted high zinc in the spring waters surfacing in the open-pit, and recommended to the mining company that they drill deeper. Similarly, his observations on metalliferous groundwaters at Cobalt contributed to the development of the rich Silverfields deposit. It was around the time he was working in Nova Scotia and New Brunswick that he became fascinated with the ability of bogs to sequester metals such as Cu, Pb, Sb and Au from groundwaters. The result was that many concoctions were 'brewed' in large beakers on window sills in the 7th floor geochemistry labs on Booth Street, and experimental work undertaken to see just how much gold was taken up by humic acids. That was when Bob won for himself the sobriquet of 'Boggy Bob', which stuck with him as closely as gold does to humates for the rest of his days. With respect to the North and permafrost regions, it was Bob's work at Yellowknife and, in particular, at Keno Hill, that demonstrated that geochemical prospecting did work, and that trace elements were dispersed hydromorphically in permafrost regions. Simultaneously Russian geochemists were reaching the same conclusions, confirmed by Bob's National Research Council exchange-visit to the Soviet Union in 1962. One of his favourite lines of evidence that metals were mobile in sub-Arctic environments, were dendritic gold, silver and zinc metal precipitates that he had collected from ice-veins in the Yellowknife and Keno Hill deposits. It was the research he undertook at Keno Hill that guided the development of geochemical prospecting tools ensuring that a 'dying mining camp' continued in production some 30 more years until the 1980s.

Bob's interest in gold, silver, uranium and thorium took him to many parts of the world: the USA, the USSR, Finland, Norway, Sweden, Great Britain, Eire, France, Greece, Bulgaria, Fiji, Australia, New Zealand, Japan, China, India, many countries in Africa, and Brazil. He put together some of his best known publications based on his global observations and knowledge: 'The Geochemistry of Silver and its Deposits' (GSC Bulletin 160, 1968); 'Elemental Associations and Indicators of Interest in Geochemical Prospecting' (GSC Paper 68-58, revised as Paper 74-45); 'The Geochemistry of Gold and its Deposits' (GSC Bulletin 280, 1979); and 'Geochemical Prospecting for Thorium and Uranium Deposits' (IAEA, Vienna, 1981). It is not really appropriate to single out these publications; his contributions were many. Bob was a prolific writer, and during his career published over 160 papers, books and articles. He thought about what he was going to write extensively and thoroughly before he put down his words. At the GSC the quality of his first drafts was legendary. He believed writing should be clear and concise, as he said, 'like a Scotsman sending a telegram'.

In the 1970s, as government and public interests in environmental issues came to the fore, Bob and Ian Jonasson co-authored a series of reports commissioned by the National Research Council of Canada on trace element cycles and abundances in the natural environment. These stressed the importance of geology, mineralogy and geochemistry in understanding the sources, transport and sinks of these elements. The reports have stood the test of time and are still extensively referred to as basic source material in environmental risk assessments.

Bob was interested in history and archeology, and was widely read. Many of his publications included references and anecdotes concerning the history of mining and mineral exploration back to the times of early civilizations in Europe and Asia. It was his interest in history that drove many of his later writings following his retirement from the GSC in 1985: for example, 'Gold: History and genesis of deposits' published by the Society of Economic Geologists in 1987.

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The truth of the matter is that Bob never retired from his love of geochemistry, as evidenced by his commitment to completing his last book just prior to his death.

Bob was a committed family man. One of the joys of the family were summer holidays spent together at places across Canada where Bob was undertaking field work - a luxury for geologists, who are so often in the field during their children's holidays. His children, Heather and Dan, followed him into science, Heather as a biochemist (Carleton and Victoria University of Wellington, NZ) and Dan as a geochemist (Queen's and Imperial College, UK). Although he spoke of it rarely, the loss of Dan, who followed his father to a distinguished career in the GSC, to cancer in 2000, was a grievous blow. Outside the family and work, his love for his vegetable garden was well known to his colleagues, who benefited from the surplus in good harvest years. This love did not extend to farming; he had seen enough of the difficulties of the 1930s to leave bitter memories.

During Bob's career he contributed in many ways to his profession and received recognition for his service. He was elected to the Royal Society of Canada in 1957, astonishingly only four years after obtaining his doctorate, and received the Willett G. Miller Medal for outstanding research in the earth sciences in 1971. The Miller Medal citation stated, "one of Canada's leading exploration geochemists, who has made fundamental advances in the study of the deposition of ores, the dispersion of elements around ore bodies, and the formulation of new methods in the search for natural resources. .... He has won an international reputation for his many contributions to our knowledge of the distribution of metals in the earth's crust, the concentration of these metals in nature as orebodies, and the successful application of geochemistry to the search for hidden ores." Words as true today as they were 30 years ago, and he did not let up in later years. He was elected a Fellow of the Royal Canadian Geographical Society in 1955. His contributions to the minerals industry were recognized by the Prospectors and Developers Association with their Distinguished Service Award in 1993, and induction into the Canadian Mining Hall of Fame in 1997. This is located at the University of Toronto's (his *Alma Mater*) Mining Building, and in today's connected world exists globally as http://www.halloffame.mining.ca.

Similarly, he was recognized by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) with their Barlow Medal in 1966 (with John Jambor), and again in 1983, for outstanding publications in the CIM Bulletin. He was further elected a CIM Fellow in 1993, and in 2002 was awarded their Distinguished Service Medal. This was the same year that Dan posthumously received the Julian Boldy Memorial Award, a singular distinction in that it was the first time two members of the same family received awards in the same year. Bob's contributions to the geology and geochemistry of the Bathurst mining camp were recognized by the local geological community with a Service Award at the 1993 CIM Geological Field Conference held in Bathurst. The penultimate publication to bear Bob's name, as co-author with Steve McCutcheon and Bill Luff concerned Bathurst, 'The Bathurst Mining Camp, New Brunswick, Canada: History of discovery and evolution of geological models', to be published in Economic Geology Monograph 11, 'Massive sulphide deposits of the Bathurst Mining Camp, New Brunswick, and Northern Maine'.

Bob took on responsibilities with the professional societies that supported the science to which he was committed: the Geological Association of Canada (GAC), the Society of Economic Geologists (Councillor, 1981-1985), and the International Association for the Genesis of Ore Deposits (IAGOD). He was a founding member of IAGOD at St. Andrew's University, Scotland, in 1966, its first Treasurer, Vice-President (1978-1989), President (1989-1992) and Chairman of the Organizing Committee for the 8th IAGOD Symposium in Ottawa, June, 1990. That year he was also made an Honorary Professor of the University of Earth Sciences, Changchun, China. In 1971 he received the Public Service of Canada Merit Award for his contributions to science in the federal government. His abilities as an editor, along with his co-editors, were

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Coming soon in the
AEG **EXPLORE** newsletter:

Technical articles and letters to the editor are encouraged as submissions for discussion within the newsletter. Each issue of **EXPLORE** contains a series of short discussion papers which provide either an update on a particular geochemical topic, or present current debates about issues of interest. Suggestions for future "Focus" topics may be forwarded to the editor,

Mary Doherty
(Email: MaryEDoherty@earthlink.net).

Issue: **Focus topic and Contact:**

122 Soil Gas Chemistry
Patrick Highsmith
phighsmith@alschemex.com
Contributor Deadline November 30, 2003
Publication Date: January 2004

123 Update from Universities
Mary Doherty
marydoherty@earthlink.net
Contributor Deadline February 29, 2004
Publication Date: April2004

124 Update from Geochemical Laboratories
Contributor Deadline August 31, 2004
Publication Date: October 2004

A Truly Remarkable Man...

continued from Page 8

recognized by the Society of Technical Communicators' 1991 Award of Excellence for editing 'Sediment-hosted Stratiform Copper Deposits' published by the GAC. In 1992 his long years of service to the Mineralogical Association of Canada were recognized by the award of their Past President's Medal. In 1999 he was made an Honorary Life Member of IAGOD — a rare honour that recognized an outstanding life-time commitment to the geology and geochemistry of ore deposits.

In 1966, driven by his desire to foster the development of geochemical prospecting, Bob organized at the GSC the first of a series of meetings (see GSC Paper 66-54) that were to develop into the biennial International Geochemical Exploration Symposia (IGES). In 1970 he was Chairman of the 3rd IGES in Toronto. It was at that meeting that the Association of Exploration Geochemists (AEG) was founded, and he took an active role in its early years as a member of its first Council (1970-1973), Vice-President (1973-1975) and President (1976).

His significant contributions to exploration geochemistry were recognized by the AEG with his election to Honorary Membership in 1989. He was awarded the Association's Gold Medal in 1999 at the 19th IGES in Vancouver, BC, 33 years after the first meeting of the continuing series he founded. The citation stated, "in recognition of his lifetime of outstanding achievement in exploration geochemistry, during which, through his leadership and productivity, he played a key role in developing the science in Canada, advancing our knowledge of precious metals, applying geochemistry to mineral exploration and to environmental issues in Canada and around the globe, establishing exploration geochemistry at the Geological Survey of Canada, and training young geochemists."

Bob's commitment to training and teaching came through in many ways. The students hired into the GSC for summer field and laboratory work who worked with Bob were exposed to geochemical prospecting, which later became known as exploration geochemistry, and his own enthusiasm. Importantly, Bob inspired many of these students to pursue careers in geochemistry and mineral deposit studies. One such occasion was when he visited the Lakehead, Ontario, while working on his 'Silver Bulletin'. He met Jim Franklin, a future Chief Geoscientist at the GSC, as a student and took time to guide him around the Sibley silver deposits that became the subject of Franklin's graduate thesis.

This was just one of many examples of Bob's willingness to help students. He was a Special Lecturer in Geochemistry at Carleton University, Ottawa, from 1955 to 1975. As part of his Carleton responsibilities he taught a Prospecting Course, and one is tempted to draw the parallel to his exposure to the old prospector James McCrae in Wallaceburg in the 1930s, and how Bob would have given 'new prospectors' an enthusiasm for the search for precious metals.

More formally, he was a constant proponent of exploration geochemistry and was one of its best known ambassadors, either as a visiting lecturer or a consultant to UNESCO, UNDP and the World Bank. He was a Regional Lecturer for the CIM in 1966, 1968 and 1973, and their Distinguished Lecturer for 1980-81; a Senior Lecturer at the International Atomic Energy Agency (1975); and Visiting Lecturer at Jadavpur University, Calcutta, India (1981), and at Escola de Engenharia, Porto Alegre, Brazil (1985).

Bob's connection to precious metals continued to the very last, he died on almost the 100th Anniversary of the discovery of silver at Cobalt, Ontario, August 7th, 1903, http://www.nt.net/cobalt/minemus.htm.

On a personal note, Bob was a wonderful person. He could always add something interesting and provoking to a discussion, he was a superb raconteur, and always generous with his time and his friendship, especially to younger scientists. We have lost a truly remarkable man, and those lucky enough to have met him, known and worked with him, will not forget.

Robert G. Garrett
Geological Survey of Canada
Ottawa

Award of Honorary Membership of the AEG...

G.J.S. Govett

Gerry Govett, the AEG's latest Honorary Member — still on the lookout for innovative techniques in exploration geochemistry.

The Palladian style dining hall of Trinity College, Dublin was completed in 1761. This historic backdrop formed the ideal setting for the award of Honorary Membership of the AEG to Gerry Govett during the IGES Gala Dinner. It was particularly fortunate that not only Gerry, but also his wife, Idelies, could be present at the award ceremony. Honorary Membership is given only to those who have made a distinguished contribution to exploration geochemistry that warrants exceptional recognition. It may be awarded for scientific excellence; for an exceptional contribution to dissemination of knowledge of that science; or for a major contribution towards the growth and well-being of exploration geochemists through such bodies as the AEG. In the case of Gerry Govett it can be argued that he qualifies on all three counts.

He was a founding member of the AEG, serving on Council from 1974 to 1978, including a term as President in 1976-1977. He organised the first regional AEG meeting, in Fredericton, New Brunswick, and also served on the original committee that formulated the guidelines for awarding AEG Honorary Membership, so at least he knows what are the requirements for Honorary Membership. In recent years he has been particularly active in the debate over the changing role of the Association. His contribution to geoscience has not stopped with the AEG. He was Director of Graduate Studies in the Department of Geology, University of New Brunswick (1973-1977) and was also a member of the Canadian Geoscience Council (1975-1977); the Canadian Committee for the Correlation of Caledonian Strata-bound Sulphides Project (1975-1977); the International Nickel Company of Canada Graduate Research Fellowship Committee (1969-1973) and the Australian National Committee for the International Geological Correlation Projects (1978-1988). As if this wasn't enough he was also a Councillor for the Australian Mineral Foundation (1983); and served as Vice-President (1981-1983) and President (1983-1984) of the Australian Geoscience Council. He continues to act as a mentor to present day exploration research scientists in his role as Visitor to the Australian Cooperative Research Centre for Landscape Environments and Mineral Exploration.

His academic progress has been no less impressive. After graduating from the University of Wales in 1955 with First Class Honours in Geology he took just three years to gain both a DIC and a PhD through the University of London's Royal School of Mines, Imperial College of Science and Technology. His PhD was on geochemical prospecting for copper in Northern Rhodesia and the experience of this had clearly infected him with the travel bug because his next move was to the Research Council of Alberta, where he spent seven years as an Associate Research Officer., before the bug struck again and he moved to the University of the Philippines as Technical Expert and Visiting Professor.

A year later he was heading back to Canada, to the University of New Brunswick, first as a Visiting Professor in Geochemistry (1966-1967) and then – after a year working as a consultant geochemist in Cyprus, Jordan and Ethiopia for the United Nations Development Programme — as Associate Professor (1968-1970), followed by Full Professor (1970-1977). While the University of New Brunswick held his attention for most of that time the travel bug was still biting with the result that he took a year's leave-of-absence (1971) to consult on mineral exploration in Greece and to assist in the organisation of State geological bodies. He then made his last major move, to the University of New South Wales, Australia, where he occupied the Chair of Geology (1977-1996), first as Head of the School of Applied Geology (1979-1985) before broadening his responsibilities to become Dean of the Faculty of Applied Science (1984-1996). In this last position he was responsible for some 230 academic and general staff.

The career outlined above would have been more than enough for most people but Gerry Govett is far from being a simple died-in-the-wool academic. He has had extensive exploration experience (planning and implementation) in 15 countries (Australia, Canada, Ethiopia, Fiji, Finland, Greece, Guyana, Jordan, Indonesia, Philippines, Papua New Guinea, Turkey, Zambia, Zimbabwe). He has consulted to the United Nations; OECD and both large international and smaller national mining and he has been Geochemical Adviser and Consultant to the Geological Surveys of Greece (1975, 1980, 1983, 1984, 1986, 1987, 1989) and Finland (1987, 1989). In addition he was a Director of Delta Gold Ltd from the time it listed on the Australian Stock Exchange in 1983 until it merged with Goldfields Limited in 2001 to form AurionGold. During that period he was Chairman of the Board during the company reorganisation in 1994. He remained a member of the Board after the merger until the company was taken over by Placer Dome in 2002. And just to round out his experience he has also been a forensic consultant to the Drug and Murder Squads of New South Wales Police, and the Royal Canadian Mounted Police.

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Biogeochemistry...

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Drill Results

Biogeochemical results were used to target the drilling phase of this project. Ten core holes were drilled: five on Line 188, one about 100 feet northwest of Line 188, one on Line 182, and two on Line 162. A few holes were added to satisfy the whims and biases of the geologist, however all of these were barren.

Holes 1-4 encountered "anomalous" Au concentrations on Line 188 in a zone of several high angle faults, and one low angle fault. Hole 5 was outside the zone and was barren. Holes on other lines encountered very minor mineralization.

Figures 2 through 5 show the relationship of trace metal concentrations in Acacia to the drill results. Relatively high gold concentrations of 0.4 to 0.8 ppb on Line 188 are replaced by relatively high Ag concentrations of 40 ppb on Line 182. Arsenic concentrations halo the Au and Ag occurrences on both lines.

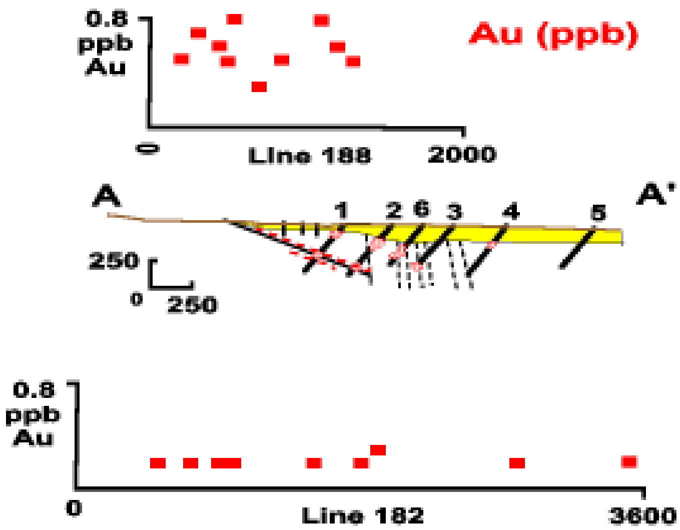

Figure 2. Gold concentrations in twigs (2nd year growth) of White Thorn Acacia on Lines 188 and 182. Section A-A' shows drilling attitude, depth, structures, relative pediment thickness, and "anomalous" Au mineralization on Line 188.

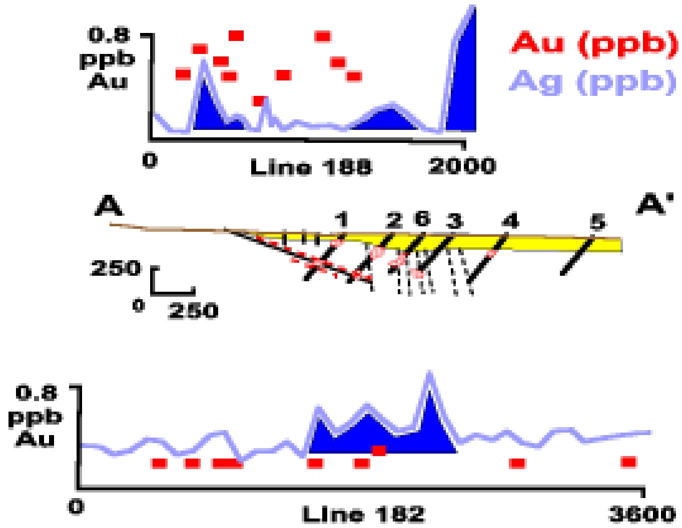

Figure 3. Silver and Au concentrations in twigs (2nd year growth) of White Thorn Acacia on Lines 188 and 182. Section A-A' shows drilling attitude, depth, structures, relative pediment thickness, and "anomalous" Au mineralization on Line 188.

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Biogeochemistry...

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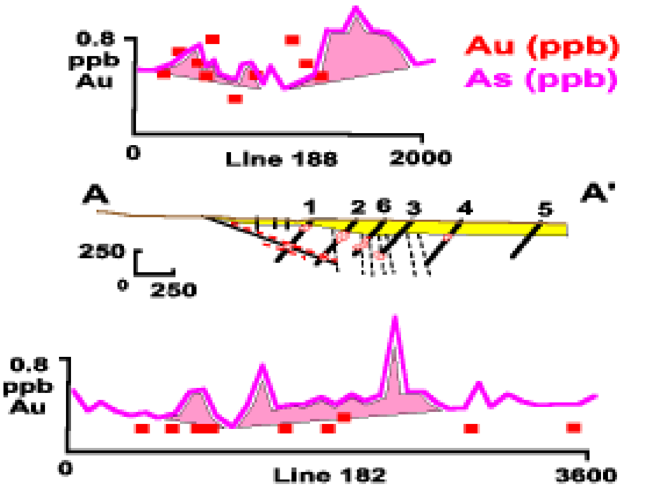

Figure 4. Arsenic and Au concentrations in twigs (2nd year growth) of White Thorn Acacia on Lines 188 and 182. The pattern indicates a structure and contact between two distinct lithologies. Section A-A' shows drilling attitude, depth, structures, relative pediment thickness, and "anomalous" Au mineralization on Line 188.

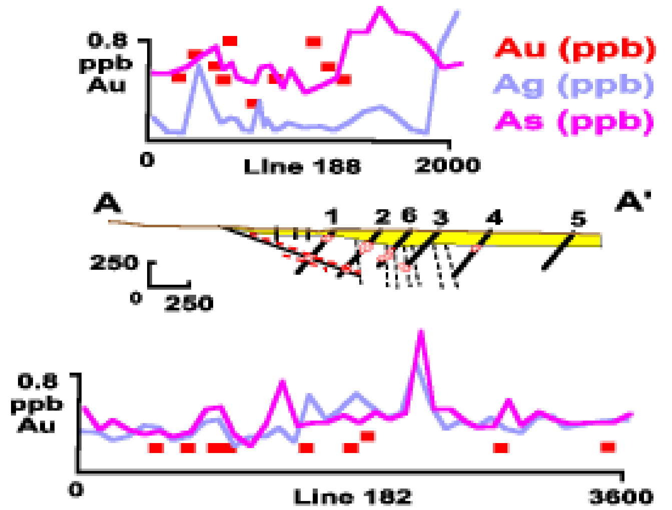

Figure 5. Arsenic, Au, and Ag concentrations in twigs (2nd year growth) of White Thorn Acacia on Lines 188 and 182. Note As and Ag halo Au concentrations. Section A-A' shows drilling attitude, depth, structures, relative pediment thickness, and "anomalous" Au mineralization on Line 188.

Conclusions

Porphyry copper systems have recently been the targets for satellite precious metal deposits. The Bisbee Project was an early assault on this theme. Biogeochemistry was an easy choice for targeting the later drilling phase because of the wide distribution of Mesquite and Acacia in the area. However, White Thorn Acacia had never been used before, yet other common desert shrubs like Creosote, Paloverde, Sagebrush, and others had been used with exceptional success. Because ground water was not likely to be in contact with mineralization (to the drilling depth of 500 feet), subdued concentration profiles were anticipated during the interpretive phase and factored into the distinction between "anomalous" and "background" (based primarily on experience from biogeochemical results at the Pinson Mine, Nevada). Drilling results confirmed the biogeochemical anomalies and additionally found no mineralization in areas

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Biogeochemistry...

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where the biogeochemical data predicted the bedrock to be barren.

Acknowledgement

Thanks to Ken Ballaweg and Placer Dome (US) Inc. for permission to publish this example of exploration biogeochemistry.

Shea Clark Smith
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New Honorary Member...

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In a career that spans well over forty years Gerry has achieved successful transitions both from the northern hemisphere to the southern hemisphere and from academia to business, and in the process has made seminal contributions across the entire field of exploration geochemistry. Whether it was sampling protocols or data analysis he had something constructive and original to say about it. He was an early champion of electrochemical models of element dispersion through transported cover, and while this was more than thirty years ago it is as relevant today as it was then. This, and other, work is documented in more than ninety scientific papers.

He has not only generated knowledge of exploration geochemistry, he has also disseminated it, both his own and the work of others. He has inspired generations of students both in Canada and Australia with his energy, his enthusiasm and the scientific rigour of his ideas, and has managed to translate his academic skill into tangible exploration successes. He served on the editorial boards of *Resources Policy* from 1974-1991 and the *Journal of Geochemical Exploration* (1976-1998) and *Exploration and Mining Geology* (1991-1996).

It is clear that exploration geochemistry owes much to Gerry Govett but it is probably reasonable to argue that his most enduring contribution to has been through his editorship of the Handbook of Exploration Geochemistry. He not only conceived the idea for such a series, in 1974, but he even wrote one of the volumes that we have today – on rock geochemistry. Apart from the work he has contributed himself he has also had the time and energy to persuade (coerce?) many of the world's leading geochemists to provide chapters for the seven volumes produced so far. This has provided an invaluable synthesis of knowledge on exploration geochemistry which would otherwise have been out of reach of all but the most library-bound of exploration geochemists.

To conclude on a brief and slightly lighter footnote note, he can also claim credit for coining the term 'rabbits ears anomaly'.

David Garnett
Chair,
AEG Honorary Membership Committee

Presidential Address...

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meeting. Apparently we were wrong in this, too. If a new round of discussions becomes necessary (and I fear that it will), some thought needs to be given to a means for ensuring that ALL relevant and qualified views are taken into account within a fixed time frame or the name change will never happen.

All AEG Fellows will be receiving a ballot for members of Council for the period 2004-2006. We have eight excellent candidates for five positions and I urge you to read their biographies and cast your vote.

Steve Amor
Bilingual Advisory Teleservices Representative -
IBM CallTeleweb Services, ibm.com Centres, Americas
105 Moatfield Drive, North York, Ontario, Canada, M3B 3R1
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Tie-Line 883-7065
Fax 416 383 7472 06/JD4/105/TOR
email samor@ca.ibm.com

"I do not believe in the collective wisdom
of individual ignorance" *Bertrand Russell*

New Members...

To All Voting Members:
Pursuant to Article Two of the Association's ByLaw No.1, the names of the following candidates, who have been recommended for membership by the Admissions Committee, are submitted for your consideration. If you have any comments, favorable or unfavorable, on any candidate, you should send them in writing to the Secretary within 60 days of this notice. If no objections are received by that date, these candidates will be declared elected to membership. Please address comments to David B. Smith, Secretary AEG, USGS, Box 25046, MS 973, Denver, CO 80225, USA.

FELLOW
Dr. Douglas B. Grant
Principal Research Scientist
CSIRO Land & Water
Wembley, AUSTRALIA

Dr. Neil D. Adshead
Tech. Assistant to EVP Strategic Develop.
Placer Dome Inc.
Vancouver, BC CANADA

Mr. Philip M. Baker
Senior Geochemist
WMC Resources Ltd.
Belmont, AUSTRALIA

MEMBERSHIP
Douglas B. Hensen
Laboratory Manager
Sparks, NV USA

Tom Lane
Consulting Geologist
Toronto, Canada

Mr. Williams H. Heinrich
Managing Director
SGS Lakefield Research Africa (Pty) Ltd.
Johannesburg, SOUTH AFRICA

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New Members…

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Mr. Peter Thurston
Data Administrator
Kennecott Exploration
Salt Lake City, USA

Dr. Chaosheng Zhang
National University of Ireland
Galway, IRELAND

Dr. Stephen Windle
Geochemist, Consultant
Carseldine, QLD, AUSTRALIA

Mr. Joe Cucuzza
Reseearch Manager
Amira International
Melbourne, AUSTRALIA

Ms. Kirsty Reid
Database Analyst,
Chedworth, UK.

Mr. Blair Hostetler
Director
New South Wales, AUSTRALIA

Mr. James Ray
Operations Manager
Carlingford, NSW
AUSTRALIA

STUDENT MEMBERSHIP

Ms. Paula R. Munoz
Universidod de Chile
Santiago, CHILE

Ms. Sandi MacPherson
Bedford, NS, CANADA

Call For Papers

The International Conference on the Monitoring, Simulation and Remediation of the Geological Environment will be held 5 - 7 July 2004, in Segovia, Spain. This conference aims to attract a multi-disciplinary audience of researchers, practitioners and government employees interested in the geological environment from diverse backgrounds, such as geologists, civil engineers, forest and agricultural engineers, geographers, biologists, ecologists, hydrologists, architects and local planners, among others.

Papers are particularly being encouraged under the following topics:

EARTH'S MATERIALS AND RESOURCES
Sustainable exploitation of natural resources, Renewable energy, Surface and Groundwater resources, Soil and rock properties, Mineral resources, Geochemistry.

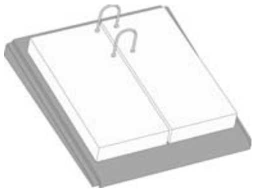
EARTH'S DYNAMICS
Earth's dynamic systems modelling and monitoring, Natural hazards and risks - assessment and mitigation, Oceans and coasts, Flow processes, Geo-indicators.

GEO-ENVIRONMENTAL PLANNING AND MANAGEMENT
Environmental impact assessment (EIA), Environmental planning and management, Geo-ecology and ecological surveys, Geo-technical and geo-environmental engineering, Scenery assessments and landscaping, Urban and regional planning issues, Geological and geomorphological heritage (geo-sites).

ENVIRONMENTAL REMEDIATION
Environmental and ecological restoration of derelict areas, Waste management, treatment and disposal, Remediation and contaminated sites.

GEO-INFORMATION SOURCES
Remote sensing and GIS, Digital Terrain Models, Geo-statistics, Geo-databases.

Full conference details are available at:
http://www.wessex.ac.uk/conferences/2004/geoenvironment04/index.html
Karen Neal, Conference Marketing Manager,
Email: kneal@wessex.ac.uk



CALENDAR OF EVENTS

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

■ Nov 30-Dec 03, 2003, **Cobre 2003**, Santiago, Chile , by the Instituto de Ingenieros de Minas de Chile and Canadian Institute of Mining, Metallurgy and Petroleum. (Information, EMail: info@cu2003.cl Web: http://www.cu2003.cl)

■ December, 8-12, 2003, **AGU Fall Meeting,** San Francisco, Ca. INFORMATION: phone 1-202-462-6900. e-mail: meetinginfo@agu.org. Web: http://www.agu.org/meetings
February 23-25, 2004, **2004 SME Annual Meeting and Exhibit,** Denver, CO. INFORMATION: Meetings Department at 800-763-3132 or 303-973-9550 http://www.smenet.org/meetings/index.cfm

■ March 15-16, 2004**, GSA South-central section meeting**. College Station, Texas. INFORMATION: Chris Mathewson, gsa.aeg@geo.tamu.edu, (979) 845-2488.

■ March 25-27, 2004, **GSA Northeast/Southeast Section meeting**. Tysons Corner, Va. INFORMATION: George Stephens, (geoice@gwu.edu), George Washington University, 2029 G St NW, Washington, DC 20052-0001, Rick Diecchio, (rdiecchi@gmu.edu), George Mason University, Dept. of Environmental Science & Policy, MS 572, 4400 University Dr., Fairfax, VA 22030-4444

■ April 1-2, 2004**, GSA North-central section meeting**, St. Louis, Mo. INFORMATION: Joachim O. Dorsch, dorsch@eas.slu.edu.

■ April 21-23, 2004, **5th Biennial Interstate Technical Group on Abandoned Underground Mines Workshop**, Viscount Suite Hotel, 4855 East Broadway, Tuscon, Arizona, USA , by the Arizona Department of Transportation and Federal highway Administration. (Nick Priznar, 1221 North 21st Avenue, 068R, Phone: 602-712-8089 FAX: 602-712-8415 EMail: npriznar@dot.state.az.us Web: http://www.fhwa.dot.gov/mine/minework.htm)

■ May 3-5, 2004, **GSA Rocky Mountain/Cordilleran**, Boise, Idaho. INFORMATION: C.J. Northrup, Chair, (208) 426-1581, cjnorth@boisestate.edu

■ May 9- 12, 2004, EDMONTON 2004, Canadian Institute of Mining and Metallurgy - Annual General Meeting (CIM-AGM), Mining Industry Conference and Exhibition. More information: www.cim.org

■ May 17-20, 2004, **National Monitoring Conference: Building and Sustaining Successful Monitoring Programs**, Chattanooga Convention Center, Chattanooga, TN , by the National Water Quality Monitoring Council (NWQMC). (National Monitoring Conference Coordinator -, 10045 Red Run Blvd., Ste. 110, Owings Mills, MD 21117, Phone: 410-356-8993 FAX: 410-356-9005 EMail: nwqmc2004@tetratech-ffx.com Web: http://www.nwqmc.org)

■ June 19-24, 2004 **Clay Minerals Society annual meeting**, Richland, WA, USA , by the Clay Minerals Society and Pacific Northwest National Laboratory. (Jim Amonette, Phone: 509-376-5565 FAX: 509-376-7972 EMail: jim.amonette@pnl.gov Web: http://www.pnl.gov/cms/)

■ June 27-July 2, 2004 **11th International Symposium on Water-Rock Interaction**, Saratoga Springs, New York, USA (Dr. Susan Brantley, Secretary General, Dept. of Geosciences, The Pennsylvania State University, 239 Deike Building, University Park PA USA 16802, Phone: 814-863-1739 FAX: 814-863-8724 Web: http://www.outreach.psu.edu/C&I/WRI/)

■ August 20-28, 2004 **32nd Session of the International Geological Congress**, Florence, Italy (Chiara Manetti, Dipartimento di Scienze della Terra, Via La Pira, 4 - 50121 Firenze -ITALY, EMail: casaitalia@geo.unifi.it Web: http://www.32igc.org)

■ September 19-22, 2004, **8th International Congress on Applied Mineralogy (ICAM 2004**), Aguas de Lindoia, Aguas de Lindoia, Sao Paolo, Brazil , by the International Council for Applied Mineralogy (ICAM); International Mineralogical Association - Commission on Applied Mineralogy (IMA-CAM). (Dogan Paktunc, 555 Booth Street, Phone: 613-947-7061 FAX: 613-996-9673 EMail: dpaktunc@nrcan.gc.ca Web: http://www.icam2004.org)

■ September 27-October 01, 2004, **SEG 2004: Predictive Mineral Discovery Under Cover**, University of Western Australia, Perth, WA, Australia , by the Society of Economic Geologists (SEG), Geoconferences WA, and Society for Geology Applied to Mineral Deposits (SGA). (Susan Ho, P.O. Box 80, Bullcreek WA 6149, Australia, Phone: (61 8) 9332 7350 FAX: (61 8) 9310 6694 EMail: susanho@geol.uwa.edu.au Web: http://www.cgm.uwa.edu.au/geoconferences/index.asp)

■ October 10-15, 2004, **SEG International Exposition & 74th Annual Meeting**, Denver, Colorado, US , by the SEG. (Debbi Hyer, 8801 S. Yale, Tulsa OK 74137, Phone: (918) 497-5500 Email: dhyer@seg.org Web: http://meeting.seg.org)

■ November 7-10, 2004, **Annual Meeting of the Geological Society of America**, Seattle, Washington. INFORMATION: TEL 1-800-472-1988, meetings@geosociety.org.

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Calendar of Events

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■ February 28-March 2, 2005, 2005 **SME Annual Meeting and Exhibit,** Denver, CO. INFORMATION: Meetings Department at 800-763-3132 or 303-973-9550. http://www.smenet.org/meetings/calendar/event_calendar.cfm

■ May 15 through May 18, 2005, **Geological Society of Nevada Symposium 2005** Sparks, Nevada USA, INFORMATION: Geological Society of Nevada (gsnsymp@unr.edu)

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

Virginia T. McLemore
New Mexico Bureau of Geology and Mineral Resources
New Mexico Institute of Mining and Technology
801 Leroy Place
Socorro, NM 87801 USA
TEL: 505-835-5521
FAX: 505-835-6333
e-mail: ginger@gis.nmt.edu

RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **Explore** Number 119. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); the USGS Circular (UGSG Cir); and Open File Report (USGS OFR); Geological Survey of Canada Papers (GSC) 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.**

Arndt, N.T., Czamanske, G.K, Walker, R.J., Chauvel, C., and Fedovenko, V.A., 2003. Geochemistry and Origin of the Intrusive Hosts of the Noril'sk-Talnakh Cu-Ni-PGE Sulfide Deposits. EG 98(3): 495-515.

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How to Save Your Company Millions of Dollars

One of the fundamental problems at mining-related environmental sites, particularly Superfund Sites, is the lack of defensible quantitative data that document the background or baseline at the site before/as the mining company started working at the site. Lead by the United States Environmental Protection Agency, other parts of the world are or will soon be holding the mining industry accountable to these same regulations. Exploration professionals can save their company millions of future dollars by conducting early, technically acceptable site characterization studies.

When background or baseline data are not available and the site becomes of concern to an environmental regulatory agency, it is not only difficult but often impossible to reconstruct the background or baseline so that the impact of the mining activity can be appraised. Without documented background or baseline levels, site geochemical data for soils, stream sediments and bedrock are compared to unmineralized areas either adjacent to or miles from the site. The groundwater data are compared to drinking water standards or aquatic criteria. These approaches virtually guarantee that the company will be cleaning up site material that is/was not related to the mining activity and at costs that often exceed a million dollars.

Plumlee and Logsdon (1999) appropriately stated the need:

> "It is critical that the pre-mining environment baseline conditions (those that exist prior to proposed mining) and background conditions (those that existed naturally prior to any mining or human activities) at a proposed mine site and within the watershed(s) surrounding the site be constrained in as much detail as possible prior to any mining development and production."

This means that the exploration geologist/geochemist is the first environmental geochemist at the site and that the responsibility for establishing the background/baseline is theirs. It is impossible to take too many photographs of the prospective site (dates on photographs are very important). We typically establish the difference between geochemical background/baseline and potential soil, stream sediment and/or bedrock signatures that define a drilling target. Environmental agencies commonly have problems accepting these data because the quality of the data is not documented. A few standards and duplicate samples can provide these data with a minimum of cost. The documentation of data quality should be included with the background/baseline data. This procedure will generally result in the acceptance of the data to establish the background/baseline.

Drilling at prospective sites frequently encounters groundwater. The groundwater can create physical problems but could also represent a current or future potential environmental problem. We need to collect a sample of any groundwater encountered during drilling not only to be able to respond to potential environmental concern about its release but also to establish what the groundwater chemistry was prior to any mining activity at the site. The groundwater geochemistry can also be used as another geochemical medium for exploration purposes. Groundwater sampling will involve a little more field equipment and time. The pH can be measured with a relatively low cost meter; however, calibration data must also be reported. The groundwater should be filtered through a field disposable 0.45micron filter prior to filling a bottle from the laboratory that contains sufficient acid to preserve the sample. This sample should then be placed in a cooler and sent to the laboratory for analysis of a suite of metals associated with the mineralization at the site and those of environmental concern. Drinking water standards for specific metals and elements of environmental concern are revised approximately every six months and can be accessed at http://www.epa.gov/OST.

Maps and/or photographs typically document waste piles generated by previous activity at the site. However, frequently little geochemical information is available for these materials unless they are of potential economic interest. Mineralogy and geochemistry of the materials in the piles need to be documented for later evaluation of their potential for environmental concern. Surface water runoff from the waste piles is also of increasing environmental concern. These matters need to be considered prior to moving and/or consolidating waste piles around the site.

The establishment of background / baseline levels at a site is an essential task in mineral resources development today. This will involve taking a little more time during sampling, and documenting the quality of the data through use of standards and duplicates. In addition to assisting exploration, groundwater data can help answer critical environmental concerns at mining sites. Exploration professionals who following these procedures may save their company millions of future dollars in cleanup costs that are unrelated to their current mineral development activities.

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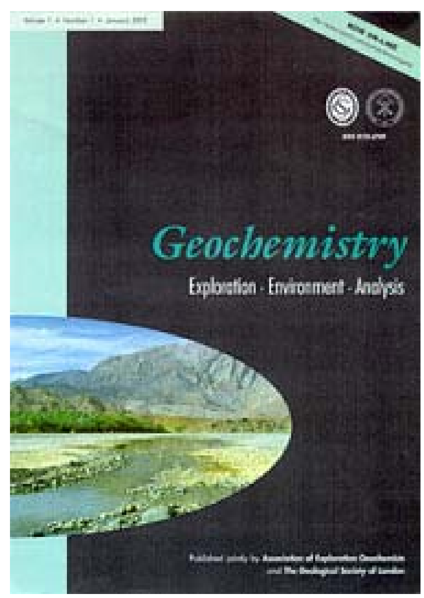

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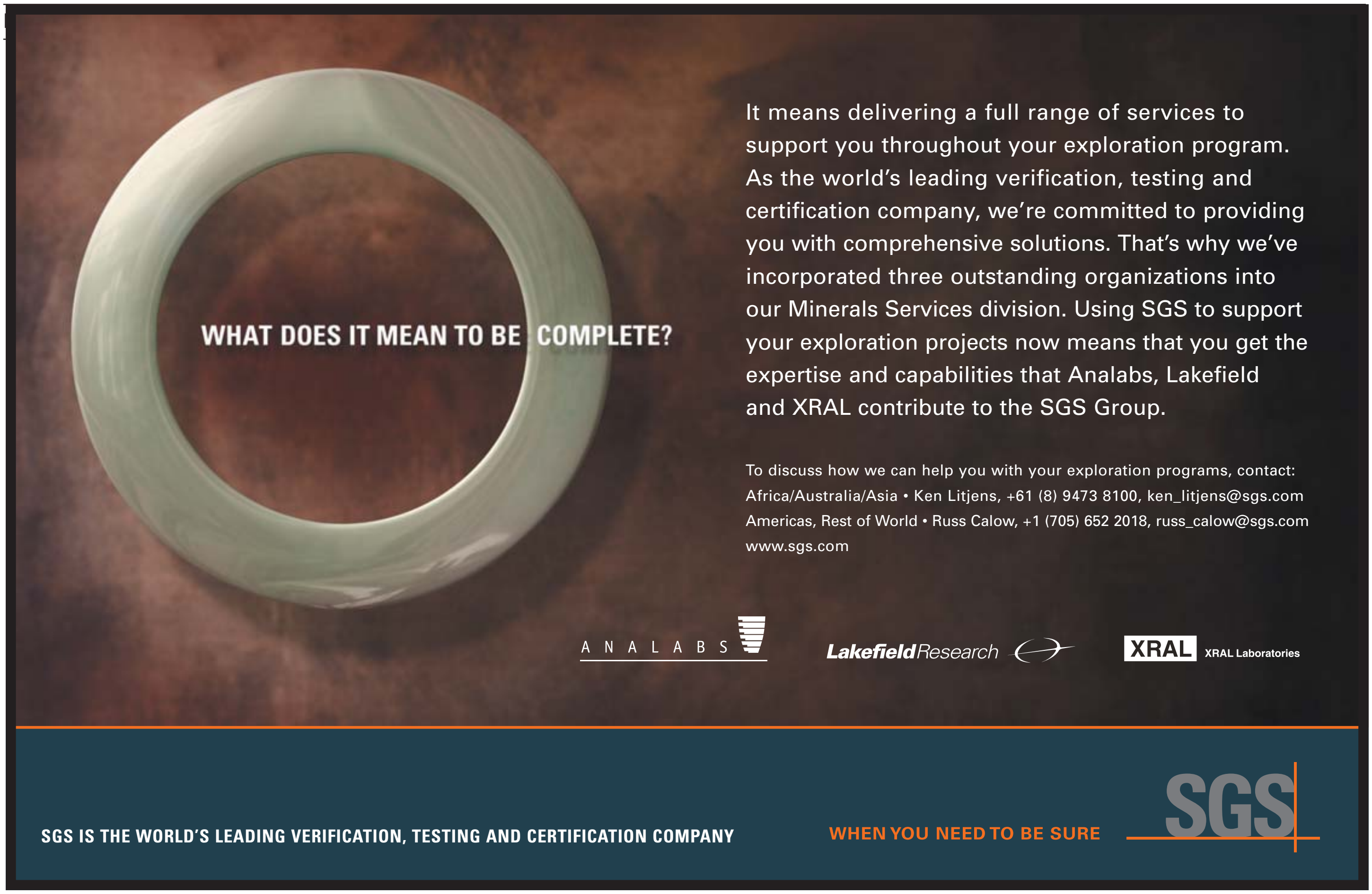

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