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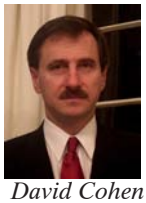
David Cohen

President's Message

I extend New Year's greetings to members of the AAG and hope that you have success in the various challenges that 2008 will present.

I would like to pay tribute to our immediate past-president, Rob Bowell, for his tireless efforts on behalf of the Association over the last two years and also to the executive and council members who have supported him. Rob has dealt with a number of important issues for the Association during that time and I believe that we are in a good position for growth over the next few years.

Following the ballot at the end of 2007, we welcome the return of some very experienced and sagacious AAG members to council in David Garnett, David Lentz, Ray Lett and Cliff Stanley. Mark Arundell joins Council for the first time. I thank the two unsuccessful candidates, Tom Molyneux and Van Price, for being willing to stand for election. In the midst of very hectic professional lives, it is encouraging that members are willing to set aside time to take on various tasks on behalf of the association.

The new year sees no abatement to the mineral exploration and mining industry boom. Coming from a country that traded in its role as a gaol for that of a quarry what more could we ask for in Oz? The analytical labs (our version of the canary down the coal mine) are frantically trying to keep turn-around times down to just a few weeks.

In the review of the last 10 years of advances in exploration geochemistry, Dave Kelley, Ravi Anand, Bill Coker and I concluded that the most serious challenges facing geochemistry are not technical but increasing severity in the shortage of geoscientists coupled to a progressive contraction of geology in the university sector. As governments now view education as another commodity, the laws of supply and demand need to be carefully considered by industry and ways devised to halt the decline in the number of universities able to deliver credible geoscience programs. It is a cold fact; no staff, no graduates/ no graduates, no exploration. Having said this last September, I am now trying desperately to arrange a second laboratory session to cater for the (unexpected) increase in the number of students undertaking the third year geochemistry course at UNSW.

I make the annual appeal for material for EXPLORE, helping Beth in her task as editor. This includes articles and other information of interest to AAG members. I would also encourage academics to lean on your grad and honours students to get papers into GEEA as the student paper competition (2008-2009) is now restricted to papers published in our journal.

Members should also clear space in their diaries for June 2009 when we will assemble at Fredericton, New Brunswick, Canada, for the 24th IAGS and associated field trips. Details will be presented soon by the symposium chair, Dave Lentz.

David Cohen, *President, AAG*

Kimberlite and Base Metal Indicator Minerals in Glacial Sediments of Northern Alberta, Canada

Introduction

Historically, most heavy mineral surveys conducted by Geological Surveys and the Exploration industry primarily focused on either anticipated recovery of gold grains or kimberlite indicator minerals (KIMs). Indicator mineral surveys applied to base metal exploration rely on heavy, coarse-grained and chemically stable, magmatic and metamorphosed oxide and silicate minerals since most sulphide minerals are susceptible to degradation in the near-surface environment (Averill, 2007).

In northwestern Alberta, Canada, the Alberta Geological Survey (AGS) and the Geological Survey of Canada (GSC) conducted reconnaissance-scale sampling of glacial sediments to assess the potential occurrence of KIMs and other indicators of economic minerals (Fig. 1).

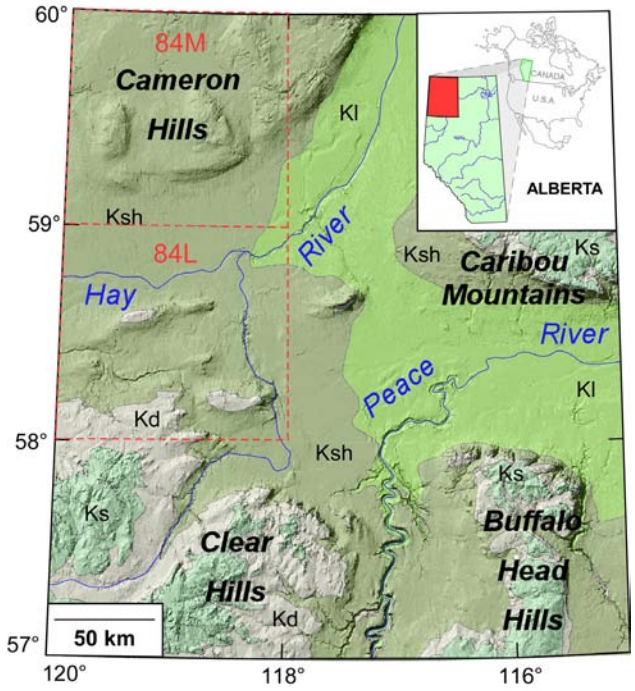

Figure 1: Physiography and bedrock geology of northwest Alberta in which the glacial sediment survey was undertaken. Cretaceous bedrock units listed from oldest to youngest (after Hamilton et al., 1998): Loon River Formation (Kl), Shaftesbury Formation (Ksh), Dunvegan Formation (Kd) and Smoky Group (Ks). The Loon River and Shaftesbury formations occur within the upper part of the Fort St. John Group. The sample survey was conducted in National Topographic System (NTS) sheets 84M and 84L.

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This sampling program represents the first systematic regional geochemical and mineralogical survey of northwestern Alberta to be undertaken by the government. The Cretaceous sedimentary rocks of the Western Canada Sedimentary Basin, renowned for their hydrocarbon resources, are seldom considered to have potential to host base metal mineralization. These sedimentary rocks, deformed in the eastern Cordillera of the Rocky Mountains and Foothills and relatively flat-lying in the Interior Platform of Alberta, have also discouraged those who presumed that the Precambrian rocks of the Canadian Shield are more favourable hosts of base metal mineralization (cf., Edwards, 1988; Macqueen, 1997). Therefore, reconnaissance surveys for heavy minerals and geochemistry of stream and glacial sediments have not been conducted in the northern part of the Western Canada Sedimentary Basin.

Quaternary deposits are the unconsolidated surface materials that blanket virtually all of northern Alberta. Bedrock, occurring as remnant uplands which control the broad elements of the physiography, rarely crops out. Elsewhere, the flat nature of most of the region is a reflectance of the horizontal to gently dipping sedimentary bedrock. The region is poorly drained; secondary streams are not deeply incised and organic deposits in the form of fens and bogs abound. The physiography of northern Alberta consists of a number of uplands including the Buffalo Head Hills, Cameron Hills, Caribou Mountains, and Clear Hills separated by broad lowlands through which the Peace and Hay rivers and their tributaries drain (Pettapiece, 1986). These rivers are part of the Mackenzie River drainage basin which empties northward into the Beaufort Sea.

The underlying bedrock in northwest Alberta are a Cretaceous succession of nearly horizontal and poorly-indurated marine shales of the Fort St. John Group (Loon River and Shaftesbury formations) and Smoky Group, separated by deltaic to marine sandstones of the Dunvegan Formation (Green et al., 1970; Okulitch, 2006). The transition from Lower to Upper Cretaceous strata occurs within the Shaftesbury Formation.

Northwest Alberta is covered by an extensive cover of unconsolidated glacial and nonglacial sediments varying greatly in thickness from 0 to 450 m (Pawlowicz et al., 2005, 2007). These sediments were deposited during glacial and interglacial periods of the Quaternary. For the most part, the surficial materials and present-day landforms are a result of the last glacial event, the Late Wisconsin (25 000 to 10 000 radiocarbon years before present). Ice derived from the Keewatin Sector of the Laurentide Ice Sheet flowed west and southwest across northern Alberta towards the Rocky Mountains. Ice retreated from the study area between 12 000 and 11 000 radiocarbon years before present (Dyke, 2004), at which time extensive glacial lakes developed over the lowland areas as a result of damming of the regional eastward drainage by the retreating glaciers. Thus, fine-grained glacial lake sediments overlie till in the lower portions of the Hay and Peace river drainage basins.

Results of the glacial sediment survey reported here are outputs of a collaborative project between the AGS and the GSC under GSC's Northern Resource Development Program (NRD Project 4450) with additional support through the GSC's Targeted Geoscience Initiative (TGI-2). Heavy mineral and geochemical results released in 2006 (Plouffe et al., 2006) resulted in significant mineral staking and exploration activity. This article outlines the presence of low concentrations of KIMs and high concentrations of sand-sized sphalerite grains in till from northwest Alberta and highlights the potential for the area to contain primary bedrock-hosted deposits of Zn.

Sample Survey and Methods

Bulk sediment samples (~30 kg) of predominantly till (but also including a few glaciofluvial samples) were collected. Samples were collected from the C soil-horizon (>1 m depth) from road exposures, natural bluffs, hand-dug pits, and borrow and sump pits dug for road construction or oil and gas drilling operations. Samples were sent for heavy mineral and gold grain analyses to a commercial laboratory to provide a preliminary overview of the mineral potential for the region. The heavy mineral fraction was isolated in a two step process involving a shaking table and heavy liquids (specific gravity of 3.2). KIMs, gold grains and other heavy indicator minerals were identified in the 0.25 – 2 mm sand-sized fraction under binocular microscopes by staff mineralogists at the laboratory. To monitor the accuracy of the heavy mineral separation and mineral identification procedures, several blank and spiked till samples were inserted by GSC (Plouffe et al. 2006, 2008). Picked KIMs and low Cr-diopside grains were then analyzed by electron microprobe to determine their chemistry.

The silt and clay-sized fraction (<0.063 mm or –250 mesh) was separated by dry sieving at the AGS lab.

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Duplicate and analytical standard samples were introduced into the sample set, which was then submitted to a commercial laboratory for analyses. Analyses were conducted on a 15 g split of the <0.063 mm sized fractions and included an *aqua regia* digestion followed by determination of major elements by ICP-ES and minor elements by ICP-MS, and $LiBO_2$ fusion/dilute nitric acid digestion followed by ICP-MS. Detailed field sampling methods, laboratory procedures for heavy mineral separation and identification, electron microprobe details, and analytical quality control and reproducibility are described in Plouffe et al. (2006).

Results

Approximately 90 glacial sediment samples in northwestern Alberta contained low numbers of KIMs consisting of 1 to 9 indicator grains. KIMs dominantly consist of pyrope, chromite and Cr-diopside with lesser amounts of forsterite and ilmenite (Figure 2) (Plouffe et al. 2006, 2007, 2008). Most of these minerals were detected in the 0.25 to 0.5 mm size fraction but a limited number of grains were found in the 0.5 to 1 mm size range. No potential KIMs were detected in the 1 to 2 mm size fraction. A large percentage of the till samples containing KIMs are located in the region north of Zama and Hay lakes and south the Cameron Hills (Fig. 2). Most noteworthy are two anomalous samples containing 6 and 9 grains respectively.

However, of particular significance, and the focus of recent collaborative research, is the discovery of a significant sphalerite dispersal train in the south-central sector of the Bistcho Lake (NTS 84M) and north central sector of the Zama Lake (NTS 84L) map sheets (Fig. 3). Dark grey to black, angular, brittle grains of sphalerite, with rare grains of orange to honey sphalerite, were found

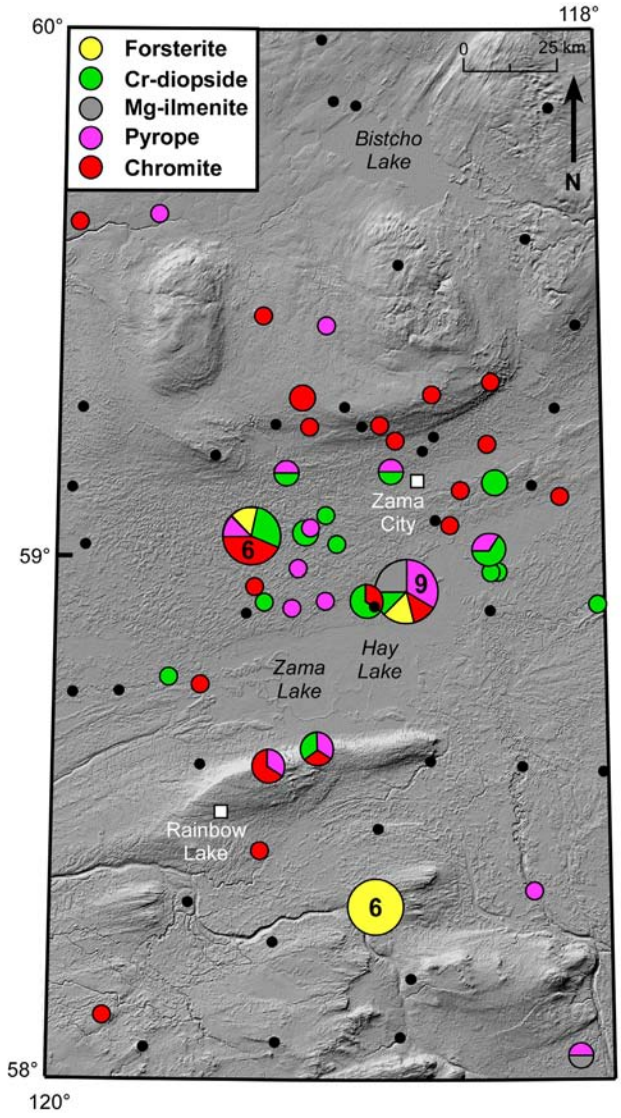

Figure 2: Number of kimberlite indicator mineral grains recovered from glacial sediments, normalized to 30 kg sample weights, plotted on Shuttle Radar Topography Mission (SRTM) generated digital elevation model. The small circles represent a single grain, larger grain counts indicated by number; small solid black circles indicate samples with no recovered KIMs.

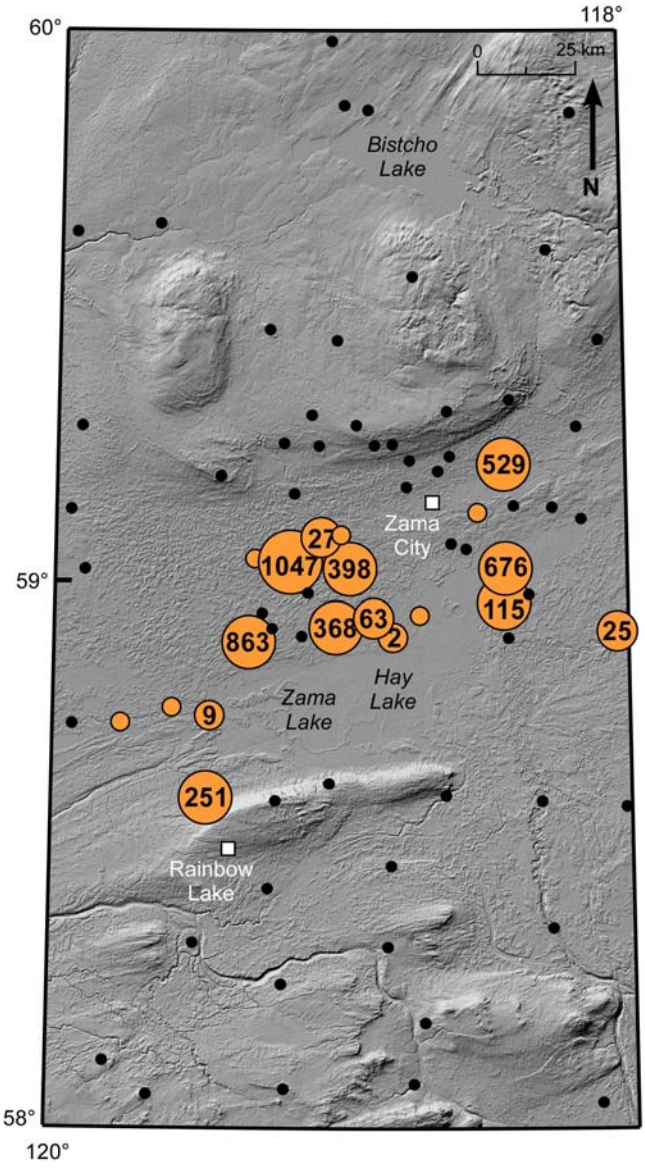

Figure 3: Number of sphalerite grains recovered from glacial sediments, normalized to 30 kg sample weights, plotted on SRTM generated digital elevation model. Small orange circles represent a single grain count; small solid black circles indicate samples with no recovered sphalerite.

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in high concentrations (>100 grains) in nine till samples including the highest concentration of 1047 sphalerite grains (normalized to 30 kg sample weight) in one till sample (Plouffe et al., 2006, 2008). Background concentrations in local till are zero grains. The grains exhibit pristine morphology with angular to sub-angular edges (Fig. 4). The mineralogical anomaly extends over an area of approximately 4000 km^2. One to four grains of galena were reported in eight of the till samples obtained from the anomalous region. The galena grains are also angular to sub-angular.

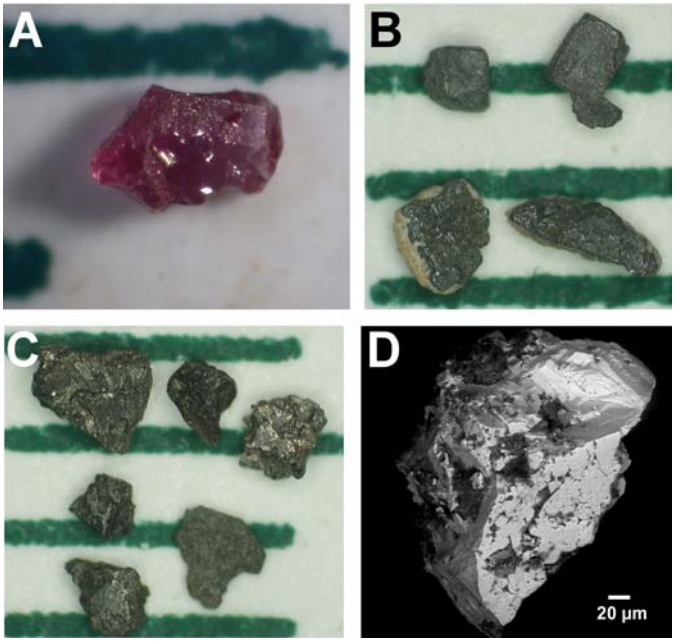

Figure 4: Microphotographs of the various indicator mineral grains recovered from till samples, divisions between green scale bars is 1 mm for images A-C. A) purple Cr-pyrope garnet; B) galena grains exhibiting cubic crystal structure; C) dark grey to black Zn-rich sphalerite, a majority of the grains recovered were of this nature; D) scanning electron microscope image of an angular sphalerite grain.

Fifteen of the dark black sphalerite grains were submitted for electron microprobe analyses to confirm their mineralogy (Plouffe et al., 2007). The average composition of the sphalerite is 33.4 wt % S, 65.4 wt % Zn, 0.7 wt % Fe and 0.43 wt % Cd with traces amounts (0.3 to 0.1 wt %) of Cu, Ag, Se, and In. Compared to the composition of sphalerite at the world class Pine Point Mississippi Valley Type Zn-Pb deposit located 330 km to the northeast (Kyle, 1981), sphalerite from this study contains on average lower levels of Pb and Fe coupled with higher Cd concentrations. Furthermore, sphalerite colour from the Pine Point deposit varies from tan, yellow, light red-brown, dark red-brown to dark brown (Kyle, 1981). In contrast, the majority of sphalerite grains recovered from the northwestern Alberta till samples are dark grey to black (Fig. 4). Geochemistry of the till samples collected in the survey area show that till samples with high sphalerite content in the sand-sized fraction did not yield high anomalously high Zn concentrations in the silt plus clay-sized fraction (<0.063 mm). However, at a regional scale, Zn concentrations in till are slightly elevated (<200 ppm) in a broad band oriented NE-SW extending subparallel to the Great Slave Shear Zone (Fig. 5) (Plouffe et al., 2006). For more detailed information the reader is referred to Plouffe et al. (2006, 2007, 2008).

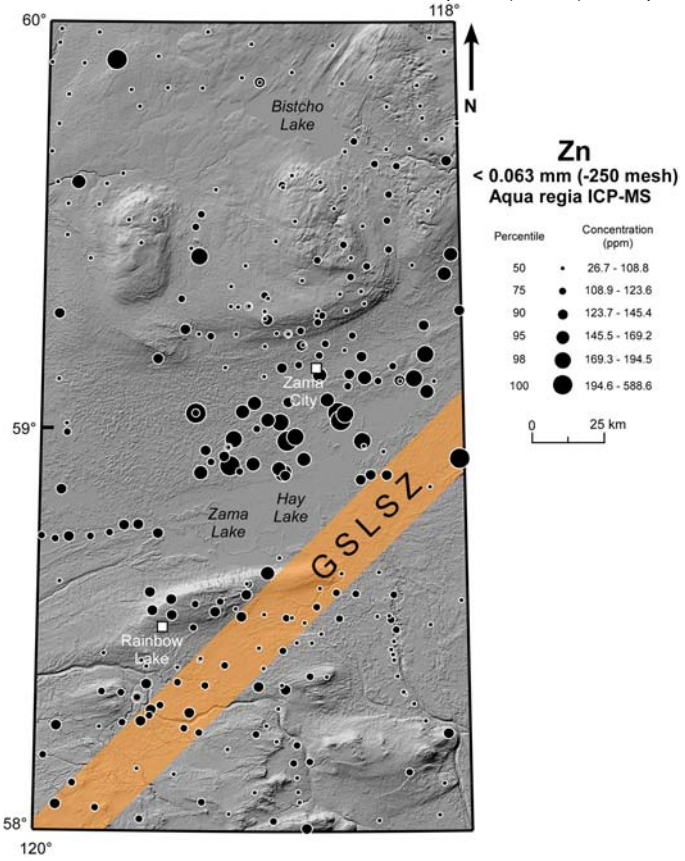

Figure 5: Zn content of the silt plus clay-sized fraction (<0.063 mm or -250 mesh sieve) of till as determined by aqua regia / ICP-MS, plotted on SRTM generated digital elevation model. The orange thick line cutting obliquely across the southeast portion of the study area marks the approximate location of the Great Slave Lake Shear Zone (GSLSZ) projected to surface (from Eaton and Hope, 2003). Modified from Plouffe et al. (2006).

Glacial Dispersal and Ice-flow History

Surficial mapping and ice flow studies in the region indicate that the sphalerite anomaly is not likely derived from the Pine Point Zn-Pb deposit 330 km to the northeast (Fig. 6). The survey area was inundated by ice emanating from the Keewatin Sector of the Laurentide Ice Sheet during Late Wisconsin glaciation (Dyke, 2004). At the onset of glaciation, topographically confined lobes of ice advanced in a general southwestward to westward direction into the region probably in a direction similar to the small arrows on Figure 6. At glacial maximum, ice flowed westward across the region towards the Rocky Mountains where it abutted the Cordilleran Ice Sheet and was deflected north and south along the mountain front. The Zama Lake area lies almost 300 km east of the confluence of both ice sheets. During the full-glacial period, ice-flow trajectories across the Pine Point Pb-Zn deposit were westward (255°) north of the Cameron Hills as indicated by striations observed at the abandoned Pine

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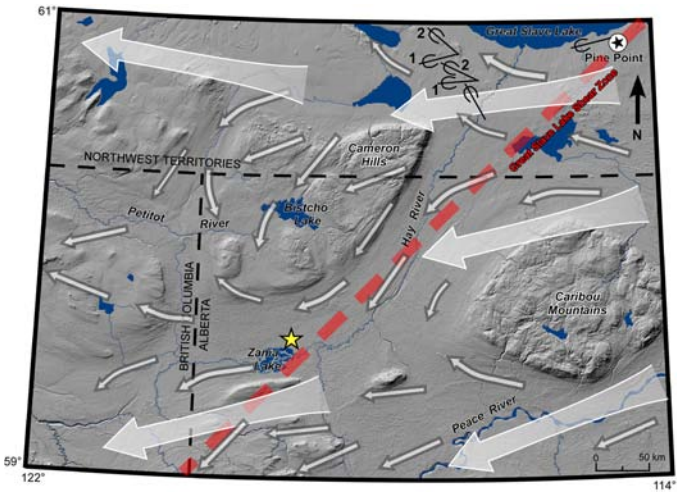

Figure 6: Summary of Late Wisconsin regional ice-flow patterns for northwest Alberta and southwester Northwest Territories depicted on SRTM generated digital elevation model (from Paulen et al., 2007). The large arrows indicate ice flow during maximum extent of the western sector of the Laurentide Ice Sheet and small arrows indicate younger, late glacial ice-flow trajectories. Striation measurements are shown, numbers refer to the relative age of ice flow (1=oldest).The Great Slave Lake Shear Zone (red dashed line) (from Eaton and Hope, 2003) and the Pine Point Pb-Zn mine (black star in white circle) are also indicated.

Point mine, well north of the Zama Lake sphalerite anomaly (yellow star, Figure 6). Extensive fluted and otherwise glacially-sculpted terrain (smaller arrows, Figure 6) exhibit evidence of a number of crosscutting, and at times topographically confined ice flows (Paulen et al., 2007). Many of these streamlined landforms formed during deglaciation when the ice sheet retreated as a series of lobes. Similarly, during initial ice advance, at the onset of the last glaciation, topographically confined lobes advanced across the region. Thus, it is possible that material from the Pine Point region was transported for short distances towards Zama Lake during either early or late stages of the last glaciation. However, sphalerite minerals were recovered from basal till sampled from >3 m depth, suggesting that they were deposited during full glacial, as opposed to deglacial time.

Aside from the regional ice-flow history, there are several factors that argue against the sphalerite anomalies being the product of long-distance glacial transport, comminution, and deposition of erratic material from the Pine Point area, and instead favour a proximal bedrock source. First, the nine sample sites with high sphalerite grain counts (and eleven with lesser concentrations) are situated within a geographically restricted area north of Zama Lake. Second, geochemical analyses of the silt plus clay-sized fraction of the tills does not reveal proportionally elevated concentrations of lead and zinc, suggesting that glacial comminution of sand-sized sphalerite and galena has been limited. Third, close examination of the mineral grains shows that some grains have strong primary crystal structure and sub-angular to angular morphologies which would not have likely survived extensive glacial erosion and transport. Lastly,

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the sphalerite grains have dissimilar optical and chemical properties than the ore studied at Pine Point by Kyle (1981).

Summary

The bedrock source(s) of the KIMs in northwest Alberta is unknown. Plouffe et al. (2007) suggested that samples with 1 or 2 KIMs within the Zama Lake-Zama City region may represent background concentrations for a region located 100's of kilometres southwest of known kimberlites in the Lac de Gras region of the Northwest Territories. On the other hand, samples containing 6 to 9 KIMs are considered anomalous and might reflect the presence of an unknown kimberlitic source closer to this region.

The bedrock source(s) of the sphalerite and galena grains in till in northwest Alberta remain unknown. This mineralogical anomaly in till is not thought to be derived from the Pine Point Mississippi Valley Type Zn-Pb deposit located 330 km northeast in the Northwest Territories, but rather, is interpreted to be the result of glacial erosion of undiscovered proximal sedimentary hosted Zn mineralization, suggesting that we have identified a potential for Zn mineralization in the Cretaceous shale of northwest Alberta. The anomaly is situated in close proximity to the Great Slave Lake Shear Zone (Eaton and Hope, 2003; see also Fig. 6). Recent research on Pb and Zn in northern Alberta formation waters (Hitchon, 2006) concluded that exploration should focus on these shear zones and faults, up which geothermal fluids might have migrated. Future Pb and S isotopic analyses of the galena and sphalerite grains in the till may resolve their provenance and shed further light on mineral potential in the study area, and which may eventually lead to the discovery of one or more Zn-rich base metal deposits hosted within Cretaceous shale of northwestern Alberta.

Acknowledgements

The authors would like to acknowledge M.M. Fenton (AGS) and J.G. Pawlowicz (AGS) for insight into the regional Quaternary geology of northern Alberta. We thank G.J. Prior and D. Goulet for their contribution of sample preparation and rigorous quality control of our indicator mineral and geochemistry samples. Capable field assistance was provided by T. Ahkimnachie, L. Andriashek, H. Campbell, C. Kowalchuk, R. Metchooyeah, R. Peterson, M. Tarplee, M. Trommelen and J. Weiss. A thorough review by M.B. McClenaghan greatly benefited this manuscript.

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Roger C. Paulen
Alberta Geological Survey
Alberta Energy Conservation Board
4th Floor, 4999 – 98 Avenue
Edmonton, AB, Canada, T6B 2X3
roger.paulen@gov.ab.ca 780-427-2851

Alain Plouffe
Geological Survey of Canada
Natural Resources Canada
601 Booth Street,
Ottawa, ON, K1A 0E8
aplouffe@NRCan.gc.ca 613-995-4390

I. Rod Smith
Geological Survey of Canada
Natural Resources Canada
3303 - 33 Street NW,
Calgary, AB, T2L 2A7
rodsmith@NRCan.gc.ca 403-292-7132

Diamond Exploration in Finland

The diamond prospective area in Finland is defined as the area where the rocks are Archean in age, the heat flow is low, less than 40 mW/m^2 and the lithospheric mantle is thick, greater than 200 km. The Finnish part of this Archean area, the Karelian craton, is nearly the same size and has similar geology to the Slave Craton in Canada, where 2 diamond mines are presently operating and with more on the way. The Karelian craton is part of the Karelian-Kola-Kuloi megacraton. It also hosts the Arkhangelsk kimberlite province containing the world-class Lomonosov Diamond Mine, which is currently in production, and the Grib pipe for which plans to mine are well underway (Fig. 1). Other diamond potential rocks in the megacraton include the 1.8 Ga Kemozero layered kimberlite in Russian Karelia and the diamond-bearing lamproites at Kostamuksha, near the Finnish border. The Karelian craton is under-explored given its size and potential and by analogy with other shield areas, and the possibility remains for further and significant diamond discoveries in Finland and European Russia.

Kimberlite was first discovered in Finland in 1964, although it was not identified as kimberlite at the time. Not until 1984, when Ashton Mining of Australia began working with Malmikaivos Oy, a small Finnish mining company and discoverer of Pipe 1, that intensive exploration for diamonds in Finland began. Malmikaivos/ Ashton (M/A) were quite successful, and of the 20 kimberlite-related intrusions they discovered in the Kaavi-Kuopio area (Fig. 1), all are Group 1 kimberlites and nearly all of these are diamondiferous. Diamet, DeBeers and Rio Tinto round out the other big diamond companies operating in Finland before 2000, but none were as successful as M/A.

Figure 1. Location of kimberlites, carbonatites and alkaline rocks in the Fennoscandian Shield. (Map: Google Earth).

One of the main discoveries of M/A was the 2 ha Lahtojoki kimberlite pipe near Kaavi. European Diamonds PLC (EPD) is presently re-evaluating this pipe for diamond grade and has processed 500 tons of a 2500-ton sample taken in the winter of 2004-5. EPD has also sampled extensively in many other parts of the Archean in Finland, having considerable success finding kimberlites, e.g., at Lentiira. Sunrise Diamonds Plc is reassessing some of the other kimberlites in the Kaavi-Kuopio provinces for their diamond content, in a joint venture agreement with Nordic Diamonds Plc. Sunrise Diamonds is also very active in this area and around Kuusamo, exploring for kimberlites based on data from new sampling as well as by access to the Ashton-Diamet database for Finland, through a deal with BHP. Mantle Diamonds Ltd has been sampling extensively in two areas, Kuusamo-Ruka, the Kaavi-Nurmes corridor and is working on a joint project in the claims adjoining Lahtojoki with Gondwana (Investments) SA. Karelian Diamonds Resources Plc (a subsidiary of Conroy Diamonds and Gold Plc) continues to acquire more ground in eastern Finland after recovering encouraging abundances of G9 and G10 pyropes from till samples from the Kuhmo area and is further drilling and sampling the M/A discovered Seitaperä kimberlite north of Kuhmo.

Diamond Exploration Research

The Geological Survey of Finland (GTK) has been conducting R&D work in the field of diamond exploration for well over a decade. The research has focused both on mantle research and regional to local scale heavy mineral surveys. Based on GTK samples and samples provided through collaboration with the diamond exploration companies presently working in Finland, a cross-section of

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the mantle from Kaavi-Kuopio in the SW to Kuhmo to Kuusamo in the NE has been constructed based on the mantle xenocryst record. This cross section shows the thickness of the diamond window over a distance of 600 km across the Karelian Craton. It also shows that the craton edge below Kaavi-Kuopio is structurally different than farther into the craton, with a distinct layered nature to the peridotites as well as a significant component of eclogite. This mantle mapping type of research is essential for diamond explorers working in the area, and the intention is to continue this mapping to the north and east across onto the Russian side of the border.

Studies of diamond indicator mineral dispersion in till have also been carried out in order to contribute to the overall understanding of the Quaternary history in Finland and, more importantly, to provide key information for diamond exploration in Fennoscandia and elsewhere in glaciated terrains.

Diamond Exploration Services

Currently, publicly listed junior companies are the driving force in grass roots diamond exploration worldwide. To implement their working plans, these companies must have promising targets, innovative and skilful management, good funding, and last but not least, access to a competent research facility, preferably located in the same part of the world as their prospect. To facilitate diamond exploration in N. Europe, GTK has built a cutting edge diamond exploration facility, unique inside the E.U.

Since 1994, the Geological Survey of Finland (GTK) has been providing customized, high quality diamond exploration services with complete confidentiality to companies both within Finland and abroad. We specialize in laboratory services and exploration techniques from regional through to prospect scales. To date we have taken and processed over 20,000 quaternary samples for diamond exploration companies including European Diamonds PLC, Karelian Diamond Resources plc., Mantle Diamonds Ltd. and Poplar Resources Ltd.

The GTK Research Laboratory has developed high recovery separation techniques for kimberlite and diamond indicator minerals, including preconcentration by GTK modified Knelson concentrators (3" and 4.5")

Figure 2. GTK has developed high recovery separation techniques for indicator minerals, including duplicated preconcentration with a modified Knelson concentrator. (Photo: GTK).

(Fig. 2), heavy medium removal of light minerals and dry magnetic separation of magnetite from the heavy fraction. The technique allows rapid and routine processing of reconnaissance and regional scale exploration samples, maintaining a constant 90% recovery rate for the critical pyrope garnet and Cpx grains in the 0.25 to 0.50 mm grain size range (Fig. 3). Logistic, quality and efficiency procedures include e.g., mass reduction through pre-concentration in a dedicated plant designed specifically to prevent cross-contamination. For till samples rich in magnetite, low intensity wet magnetic separation is conducted prior to the preconcentration. Microscope observation services conducted by highly experienced skilled pickers are also available.

Our JEOL JSM 5900-LV scanning electron microscope with attached EDS-analyzer (Fig. 4) can be used to confirm the optical recognition of indicators and give a rapid initial estimate of composition without

Figure 3. Kimberlitic indicator minerals and diamonds. (Photo: Jari Väätäinen, GTK).

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Diamond Exploration in Finland...

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Figure 4. All indicator grains are confirmed by an EDS equipped Jeol JSM-5900LV scanning electron microscope. (Photo: Jari Väätäinen, GTK).

coating or preparation of the grains. Thus, it is also an ideal instrument for morphological and textural studies of kimberlite and diamond indicators. An example is the SEM image of an indicator chromite from the Seitaperä kimberlite in eastern Finland shown in Figure 5. The outer rim of the grain exhibits enrichment in TiO_2 compared to the core.

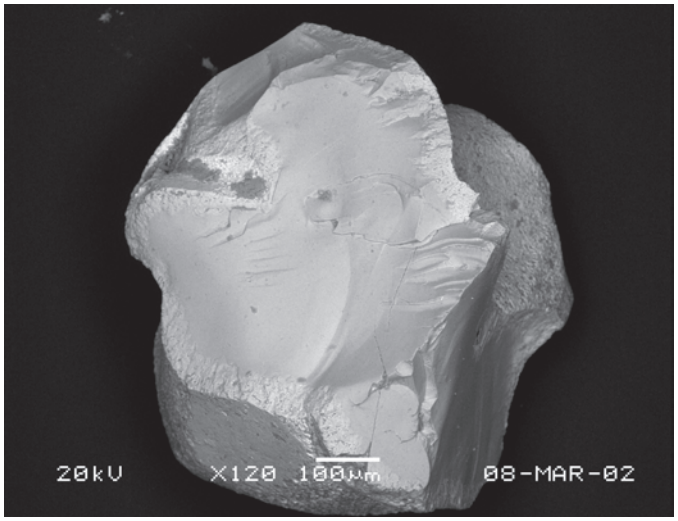

Figure 5. A backscattered electron image of a kimberlitic chromite grain where the outer rim exhibits enrichment in TiO_2 compared to the grain core.

For mineralogical studies our Cameca SX100 microprobe (Fig. 6) offers rapid and cost effective quantitative analysis of indicator minerals. Special software allows trace element analysis, such as Ni in garnets, down to levels of 10 ppm. Routine inexpensive express analysis of chromite and chrome pyrope is a new option.

We offer the following laboratory scale processing services for Quaternary samples. The unit weight of samples to be processed by a 3" Knelson concentrator is 15kg of material finer than 1 mm (or 2 mm). For a 4.5" concentrator the corresponding weight can vary between

Figure 6. Cameca SX50 microprobe offers rapid and cost-effective quantitative analysis of indicator minerals. (Photo: Jari Väätäinen, GTK).

30 and 45 kg. The processing includes:

- Removal of material coarser than 1 mm (or 2 mm) by wet sieving.
- Wet magnetic separation of magnetite.
- Modified Knelson preconcentration.
- Dry magnetic separation of magnetite.
- Dry sieving separation of the 0.25 – 0.50 mm and 0.50 – 1 mm (or 2 mm) fractions.
- Heavy liquid separation (methylene iodide, d 3.3 or less if required) of the 0.25 – 0.50 mm and 0.50 – 1 mm (or 2 mm) fractions.

The sample turn-around-time for the processing described above is 14 days for each delivery of 30 till samples. Or if no preconcentration is needed, we can also start directly from preconcentrates provided by the client. The heavy medium separations and mineral analyses (microprobe and SEM) are done at the GTK laboratories in Espoo, near the city of Helsinki.

Jukka Marmo, Hugh O'Brien, Marja Lehtonen
Geological Survey of Finland
P.O. Box 96
FIN-02151 Espoo Finland
Tel. +358-20-5502445
E-mail: jukka.marmo@gtk.fi
E-mail: hugh.obrien@gtk.fi
E-mail: marja.lehtonen@gtk.fi

Base and Precious Metals Indicator Mineral Research at the Geological Survey of Canada

INTRODUCTION

The application of indicator mineral methods to diamond exploration is well established because much research has focused on the visual recognition of indicator minerals and their chemical characteristics in diamondiferous kimberlites. In Canada, kimberlite indicator mineral methods have been successfully applied to till and stream sediment sampling (McClenaghan & Kjarsgaard 2007) and contributed to the discovery and development of several diamondiferous kimberlites. This method relies, at least at the early exploration stage, on detecting the presence of 10s to 100s of oxide and silicate indicator mineral grains in till or stream sediments that have survived pre- and postglacial weathering as well as glacial transport. In contrast to kimberlites, base and precious metal exploration generally targets much larger mineralized or altered zones which will yield precious and sulphide minerals as well as oxide and silicate indicator minerals. These indicator minerals might not survive pre- or postglacial weathering or glacial transport. Limited research and case studies have been conducted that document the abundance and chemistry of indicator minerals characteristic of base and precious metal deposits and how these minerals survive weathering and glacial transport. The Geological Survey of Canada (GSC) is addressing this knowledge gap through indicator mineral studies of known base metal deposits of various types across Canada, including magmatic Ni-Cu-PGE, Cu-Pb-Zn VHMS, Pb-Zn sedex and Fe-oxide Cu-Au/U (Fig. 1). Additional studies are being carried out on base and precious metal indicator minerals in areas with potential for porphyry, epithermal, volcanic hosted mineralization and sedimentary hosted Zn deposits. The objectives of the GSC research are: 1) to specify the indicator minerals that are indicative of various base and precious metal deposit types and to describe their properties; 2) to establish practical methods for their recovery from glacial and stream sediments and for their identification that can be routinely applied in exploration in glaciated terrain; 3) to apply these methods for establishing the mineralization

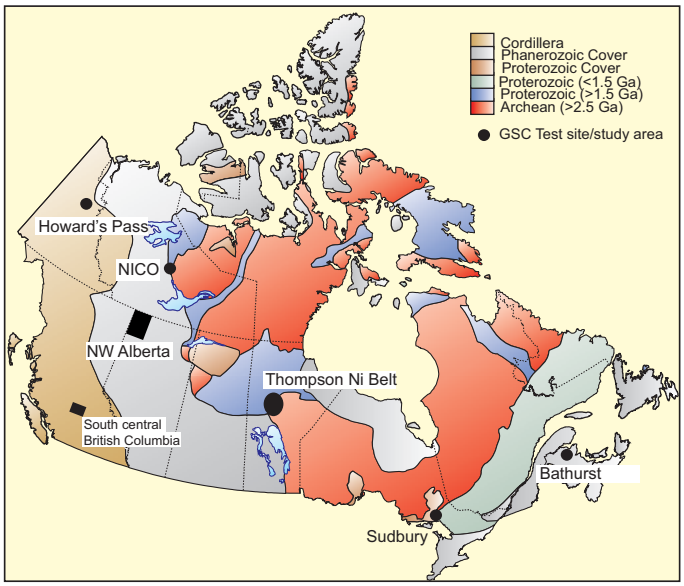

Figure 1. Location of Geological Survey of Canada base and precious metal indicator mineral test sites and study areas in Canada.

potential of regions that are in need of new exploration; and 4) to transfer this knowledge base to the mineral exploration industry. This research is being funded by the GSC's Targeted Geoscience Initiative TGI-3 (2005-2010) in partnership with CAMIRO, and by the Mountain Pine Beetle Project (2007-2009) centered in British Columbia. A study in northern Alberta was funded by the GSC's Northern Resource Development Program (2003-2007). The purpose of this article is to provide an overview of the ongoing base and precious metal indicator mineral research at the GSC.

METHODS

The test sites chosen are known deposits that are accessible, where the ore zones subcrop beneath till, the local area is till covered, and in some cases, previous work indicates there is metal-rich debris in the till. Bedrock samples of ore and host rocks (~5 kg) and till samples (10-30 kg) at varying distances up- and down-ice of several known deposits have been collected at various test sites across Canada (Fig. 1). In addition, regional reconnaissance till sampling was conducted in northwest Alberta and south central British Columbia. In those two areas, till samples were collected at an average spacing of 2 to 5 km. All bedrock and till samples are processed at Overburden Drilling Management Ltd. (ODM), Nepean, Ontario to recover heavy mineral concentrates for counting and selection of potential indicator minerals, some of which have been previously specified by Averill (2001, 2007a, 2007b). Concentrates are prepared using a combination of tabling and heavy liquids (Averill & Huneault 2006) to ensure recovery of the silt (Fig. 2) to sand sized indicator minerals. ODM is working in close collaboration with the GSC on samples from all the test sites to document the indicator mineral suites for the various deposit types. Selected grains are photographed, examined using a scanning electron microscope (SEM),

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Base and Precious Metals Indicator Mineral Research...

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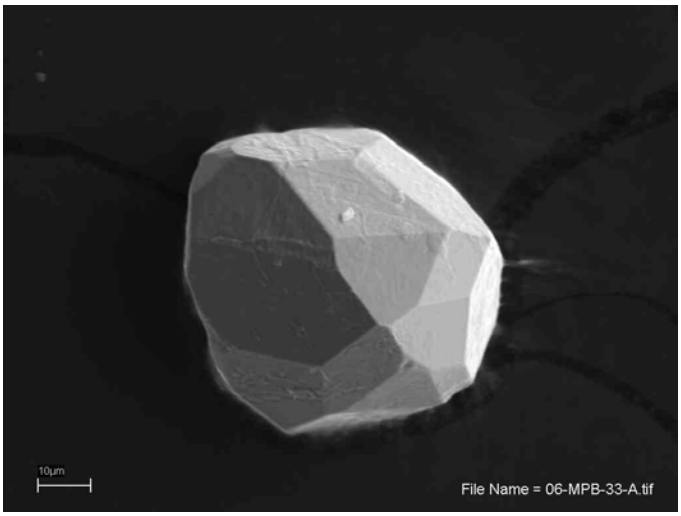

Figure 2. SEM backscattered image of a silt-sized sperrylite ($PtAs_2$) grain from till 250 m down-ice of the Broken Hammer Cu(Ni)-PGE zone, Sudbury.

analyzed by electron microprobe (EMP) to confirm the visual identifications and document their major and trace element signatures, and in some cases, further analyzed by laser ablation-ICP-MS to characterize their trace element signatures.

TEST SITES

Magmatic Ni-Cu-PGE

The world class magmatic Ni-Cu (PGE) deposits in the Thompson Nickel Belt (TNB) in north central Manitoba, Canada, were selected to address knowledge gaps about Ni-Cu-PGE indicator minerals, especially chromite (Fig. 3). This test site is also one of four test sites

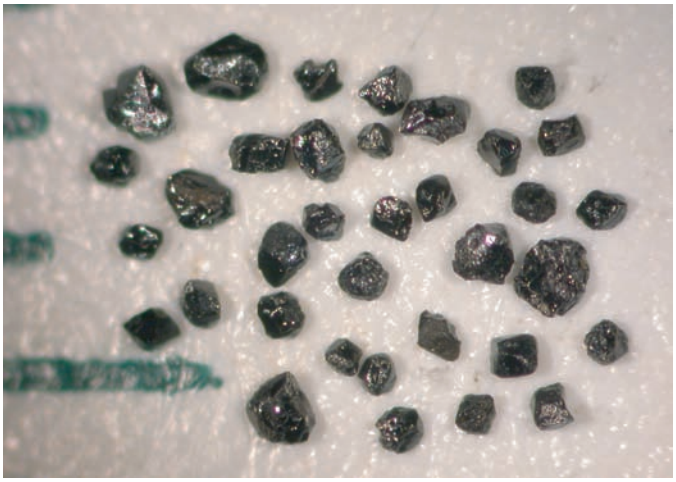

Figure 3. Fresh, angular chromite grains from the 0.25-0.5 mm fraction of till 50 m down-ice of South Pit ore zone, Thompson Ni Mine. Scale bars are spaced 1 mm apart.

for the Canadian Mining Research Organization (CAMIRO) Project 04E01 focused on magmatic Ni-Cu-PGE indicator minerals. The three other test sites included in this CAMIRO project include West Musgraves, Australia, Jinchuan, China and Noril'sk, Russia. Bedrock and till samples were collected across the northern TNB in 2005 and 2006. GSC archived heavy mineral concentrates were also used. This site was selected because a 400 km long Cr-diopside dispersal train in till was known (down-ice) from the TNB (Fig. 4)

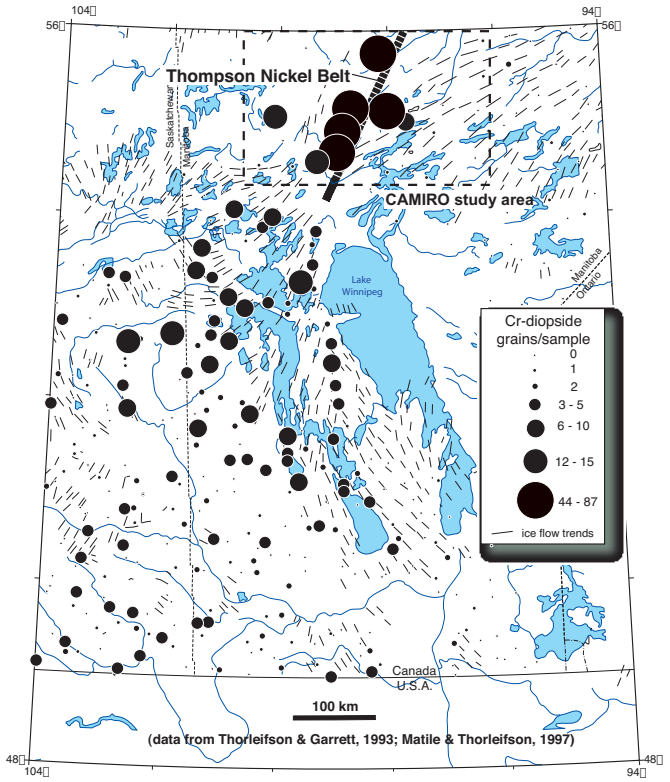

Figure 4. Distribution of low (>0.5 % Cr_2O_3) Cr-diopside in the 0.25-2.0 mm fraction of till from reconnaissance-scale till samples across western Manitoba and eastern Saskatchewan. Data from Thorleifson and Garrett (1993) and Matile and Thorleifson (1997).

suggesting that the ultramafic host rocks have a strong signature in the till and the potential of Cr-diopside to be an indicator mineral of this deposit type. Closely spaced bedrock and till sampling was focused around the open pits at CVRD-INCO's Thompson and Pipe Mines and surface areas around the Birchtree Mine in the north part of the belt. Widely spaced bedrock and till samples were also collected along the NE-SW trending TNB, as well as west (down-ice) and east (up-ice) of the belt. The belt is covered by till which is overlain by thick glaciolacustrine

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Base and Precious Metals Indicator Mineral Research...

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sediments. Thus sampling was carried out using a combination of hand dug holes, till exposed in river sections and backhoe excavation. This study is a collaborative effort by CAMIRO, ODM, B. McClenaghan (GSC), G. Matile (Manitoba Geological Survey), D. Layton-Matthews (Queen's University), W. Griffin (GEMOC), G. Beaudoin (Laval University) and CVRD-INCO.

Magmatic/hydrothermal Cu-(Ni-)-PGE

In 2006, a suite of bedrock and till samples were collected from sites up-ice, overlying and up to 5 km down-ice from Wallbridge Mining Company Ltd.'s magmatic-hydrothermal Broken Hammer Cu-(Ni)-PGE footwall mineralized zone on the North Range of the Sudbury Basin, Ontario. This site was selected because the mineralized zone (Big Boy vein) is well exposed by recent trenching, is known to contain visible sperrylite ($PtAs_2$), and is located on the north side of the Sudbury Basin and thus up-ice of the major Sudbury deposits. The deposit area is covered by thin (<3 m) discontinuous till. This study is a collaborative effort by B. McClenaghan and D. Ames (GSC), G. Budulan (B.Sc. student, University of Ottawa), A. Bajc (Ontario Geological Survey), Wallbridge Mining Company Ltd. and ODM.

Cu-Pb-Zn Volcanogenic hosted massive sulphide

Bedrock and till samples were collected in 2007 from sites up to 2 km down-ice from Xstrata Zinc's volcanogenic hosted Half Mile Lake Zn-Pb-Cu massive sulphide deposit in the Bathurst Mining Camp, New Brunswick. This test site was selected because the deposit was known to have a well defined metal-rich dispersal train characterized by anomalous concentrations of Cu, Pb, Zn, Sn, In, As, Ag, Bi, Au, and Sb in the <0.063 mm sized fraction of till extending at least 500 m down-ice (Parkhill & Doiron 2003). The deposit area is covered by a continuous till blanket that is 1-3 m thick. Collaborators for this test site include B. McClenaghan, G. Budulan (M.Sc. student, Queen's University), M. Parkhill and J. Walker (New Brunswick Dept. Natural Resources), D. Layton-Matthews, Xstrata Zinc and ODM.

Pb-Zn Sedimentary exhalative (SEDEX)

A small suite of till samples was collected in the Howard's Pass area of the Selwyn Basin, Yukon, in the summer of 2007. These samples were collected up-ice, overlying and down-ice of the Zn-Pb-rich XY Zone to document indicator minerals around a Zn-Pb sedimentary exhalative (SEDEX) deposit in a alpine glacial setting with thin, locally derived till and complex ice flow patterns. This research is a collaborative effort by D. Turner (M.Sc. student, Simon Fraser University), B. Ward (Simon Fraser University), B. McClenaghan, Selwyn Resources Ltd. and ODM.

Fe-oxide-Cu-Au/U

The Co-Au-Bi NICO deposit in the Great Bear magmatic zone (central NWT) was selected as a test site to characterize the indicator mineral and alteration geochemical signature of Fe-oxide Cu-Au/U (IOCG/U) deposits in glaciated terrain. IOCG/U deposits can host significant resources in base, precious and strategic metals as well as energy and are under-explored in Canada. This site was selected because the mineralized zones and alkali-altered host rocks are well exposed, ore mineralogy is well known, and active resource evaluation by Fortune Minerals Ltd. provides logistical support in an otherwise remote, poorly-accessible area (Corriveau et al. 2007). In 2007, bedrock and C-horizon till samples were collected over and down-ice from mineralization, host rocks and alteration zones, and up-ice in background terrain. The NICO deposit area is dominated by bedrock and by thin, discontinuous till which is overlain at many sites by veneers of winnowed till and glaciolacustrine sediments. Additional test sites will be selected in the Great Bear magmatic zone for further sampling in 2008. This study is a collaborative effort by I. McMartin and L. Corriveau (GSC), G. Beaudoin, Fortune Minerals Ltd., NWT Geoscience Office and ODM.

Porphyry, epithermal, and volcanic hosted mineralization

A regional till sampling program, including indicator mineral sampling, was completed in 2007 in south-central British Columbia in a region with a high potential to host porphyry, epithermal, and volcanic hosted mineralization. This region was selected because its forest industry is under threat following the recent mountain pine beetle infestation which has destroyed a high percentage of the pine forest. The objective of the till sampling program is to evaluate the mineral potential of this region which ultimately could help diversify its resource economy. The exploration challenges in this region include the thick and nearly continuous glacial sediment cover and thick accumulation of Tertiary flood basalt that overlie prospective rocks. The current hypothesis is that windows through the basalt to underlying mineralized rocks might be concealed by the extensive glacial sediment cover. Surficial geology mapping is conducted in parallel with the till sampling to better define the regional ice-flow history. This research involves the participation of A. Plouffe and J. Bednarski (GSC) and C.A. Huscroft (Thompson Rivers University).

Undiscovered sedimentary hosted Zn mineralization

A surficial geology and regional till sampling project conducted from 2003 to 2007 in northwest Alberta has identified the potential for the area to host sedimentary-hosted Zn mineralization. Plouffe et al. (2006) reported a significant sphalerite (ZnS) anomaly in till in northwest Alberta, including a till sample containing >1000 sphalerite grains in 30 kg (Fig. 5). Galena grains accompany some of the sphalerite grains in till. Current research includes S and Pb isotopic analyses of the sphalerite and galena grains in till, which should provide additional information on the type of mineralization in bedrock and potentially the source of the mineralizing fluids. R. Paulen (Alberta Geological Survey), A. Plouffe, R. Smith and S. Paradis (GSC) have been involved with this project.

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Base and Precious Metals Indicator Mineral Research...

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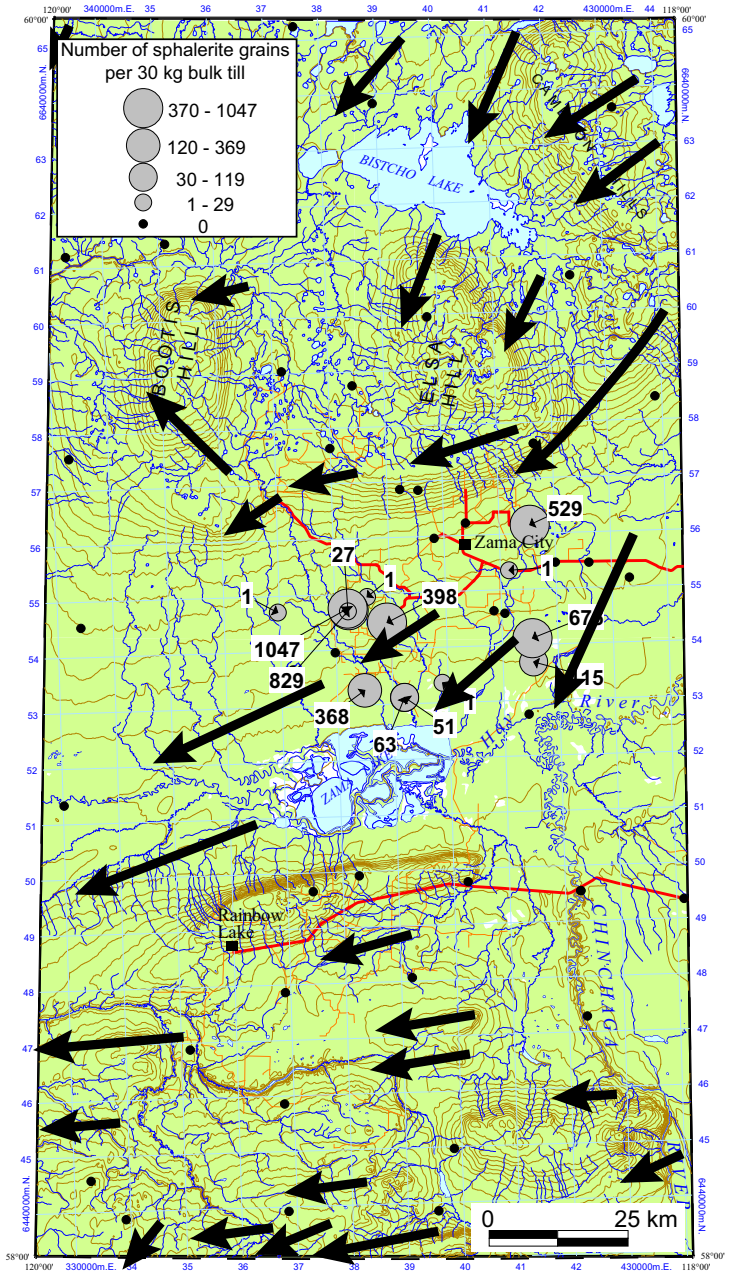

Figure 5. Number of sphalerite grains in till normalized to 30 kg, from northwest Alberta. Ice-flow directions (grey arrows) are from the recent surficial geology maps produced as part of this project.

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Beth McClenaghan, Isabelle McMartin, Alain Plouffe
Geological Survey of Canada
601 Booth Street
Ottawa, ON
CANADA K1A 0E8
Email: bmcclena@nrcan.gc.ca

Exploration 07 Workshop Reports

Two successful exploration geochemistry and mineralogy workshops were held as part of the Exploration 07 Conference in Toronto in September 2007. Both preconference workshops were co-sponsored by Association of Applied Geochemists and generated revenues of $28 k for the AAG. Students were encouraged to attend the workshops and were given a much-discounted rate.

The first workshop on September 8, ***Exploration Geochemistry – Basic Principles & Concepts***, was organized by Bill Coker (BHP Billiton). This workshop provided comprehensive coverage of the basic principles of applied exploration geochemistry aimed at geoscientists who lack training in the principles and practices of exploration geochemistry but are often required to carry out geochemical surveys. The 10 speakers were a group of international geochemists from industry and government who are specialists in various aspects of exploration geochemistry. A total of 83 people registered for the workshop, including 12 students.

The second workshop, ***Indicator Mineral Methods in Mineral Exploration***, was held on September 9 and was organized by Harvey Thorleifson (Minnesota Geological Survey) and Beth McClenaghan (Geological Survey of Canada). This workshop was designed to benefit exploration geologists who wish to obtain an overview of indicator mineral fundamentals, and those seeking insights into recent developments in this important field of mineral exploration. The workshop reviewed basic principles and recent developments in indicator mineral methods, including kimberlite indicator minerals, gold grains, as well as base metal indicators. It included presentations and discussions of indicator mineral methods, survey design, sample processing methods, mineral chemistry, quality assurance/quality control, indicator mineral methods in precious metal, diamond, and base metal exploration, a laboratory case study that addressed sample representatively and integrity, an exploration case study, and a public sector case study dealing with geological survey agency work in systematic mapping. The 10 speakers were experienced and influential indicator mineral specialists from the exploration industry, commercial laboratories, and government agencies. A total of 57 people registered for the workshop, including 4 students.

Some of the speakers in the exploration geochemistry workshop. above: left to right, Dave Lawrie, Beth McClenaghan, Bill Coker, Colin Dunn, Matt Leybourne; and below: Eric Grunsky and Barry Smee (photos by Roger Paulen).

Lists of speakers, pdf versions of the speaker's powerpoint presentations as well as the workshop notes (for both workshops) are available on the AAG website, in the EVENTS section.

Beth McClenaghan
Geological Survey of Canada
601 Booth Street
Ottawa, ON K1A 0E8

William B. Coker
BHP Billiton World Exploration Inc.,
Suite 800, Four Bentall Centre,
1055 Dunsmuir St, Vancouver, BC, Canada. V7X 1L2

Harvey Thorleifson
Minnesota Geological Survey
2642 University Ave W,
St Paul MN 55114 USA

New AAG Councillors 2008-2009

Mark Arundell

Mark Arundell graduated from the University of Melbourne in 1985 with BSc(Hons) in Geochemistry and completed a M Econ Geol at the University of Tasmania (CODES) in 1998. During ten years with Renison Goldfields Consolidated (RGC), he worked as an exploration geologist throughout Australia and an underground and open cut mine geologist at various locations. Mark joined North Ltd in 1995 and worked on a number of projects including Northparkes (Cu/Au), Lake Cowal (Au) and Yakabindie (Ni). Between 2000 and 2005, Mark worked as a Consultant Geologist / Geochemist for various clients including Rio Tinto Exploration, Newcrest, Consolidated Nickel, North Ltd, Luzenac Australia, Peak Gold Mines, PIRSA, ERA and SRK. During this time, Mark (with Simon Gatehouse) presented a number of short courses on "Interactive Geochemical Data Interpretation". Mark was the course leader for the "Interpreting Geochemical Data" workshop at the 2005 IGES in Perth. In 2006 Mark joined Rio Tinto Exploration as Project Leader for Industrial Minerals Exploration. In this role Mark has had the opportunity to apply his geochemical skills to the development of techniques to distinguish talc under cover and in the exploration for potash and trona (soda ash). Mark is a member of SEG and AIG and has been a member of the AAG since 2002.

David Garnett

BSc (Jnt Hons) Botany/Zoology (1968), BSc (Hons) Geology, (1971), University of Wales. PhD in geochemical exploration, with a focus on understanding element dispersion mechanisms in calcretes and associated regolith overlying base-metal deposits in southern Africa (1983, University of Wales). Member of the Exploration Research Unit of JCI, South Africa in the position of geobotanist (1971 - 1974); research geochemist (1974 - 1979); and senior research geochemist (1979 - 1986). General Manager of Becquerel Laboratories, Sydney, Australia, specialising in neutron activation analysis (1987 - 2004); Contracts Manager and now CEO of the Cooperative Research Centre (CRC) for Tropical Savannas Management, Darwin, Australia (2004 – present). Board Member of CRC for Landscape Environments and Mineral Exploration (1995 – present); Chair of their Minerals Advisory Council (2002 – present) and LEME Honorary Fellow (2006). AEG Regional Councillor, Eastern Australia (1992 - 1994); Second and First Vice President (1995,1996); President (1997); ex officio Councillor (1998 - 1999), Councillor (2000 – 2003 and 2006 - 2007). Chaired review which produced the AAG's current By-Laws. Joined the AAG in 1976 and became a Fellow in 1992.

David Lentz

David Lentz (P. Geo.) received his B.Sc. (1983) and M.Sc (1986) degrees in geology from the University of New Brunswick (UNB) in Fredericton, NB (Canada); his B.Sc. honours thesis was on an extension to the Key Lake U deposit, northern Saskatchewan (sponsored by Uranerz) and his M.Sc was on W-Mo-Bi porphyry and Sn-Zn lode mineralization at True Hill, beside the famous Mount Pleasant deposit (sponsored by Billiton) in NB. Afterwards he completed a Ph.D. (1992) on mineralized pegmatite-related skarn systems at the University of Ottawa, before taking up a contract research position in Bathurst (NB) with the Geological Survey of Canada studying the complex Brunswick VMS deposits. In 1994 Dave was hired as the Mineral Deposits geologist for New Brunswick. In 2000, Dave was offered the Economic Geology Chair at UNB where he has been for the past 6 years. For the Geological Society of CIM, Dave served on the executive for 5 very active years and is currently Student Affairs Chair for CIM (2003-2006) and PDAC (2006-2009). He was geoscience representative (2 years) with his professional association (APEGNB). However, Dave is best known for the books and journals he has edited related to ore deposits, conferences and symposiums he has pulled together, as well as the local outreach efforts he is engaged in. Dave won the Geological Association of Canada's Distinguished Service Award in 2007, and was one of CIM's Distinguished Lecturers (2007-2008). He has been a member of AAG since 1994 and an AAG councillor since 2006.

Ray Lett

Gaining a M.Sc. in Mining Geology and Mineral Exploration from the University of Leicester, England in 1969 and a Ph.D. in Applied Geochemistry from University of British Columbia, Vancouver, Canada in 1979, Ray Lett worked as a geochemist for Barringer Research, Mississauga, Ontario, from 1980 to 1990. He has been geochemist for the British Columbia Geological Survey, Victoria, Canada since 1990 where he manages the Survey's geo-analytical services and conducts research aimed at improving geochemical exploration methods. He is a session lecturer at the Centre for Earth and Ocean Sciences, University of Victoria, Canada. He was AAG Secretary from 1980 to 1985 and a Councilor from 1998 to 1999 and from 2005 to present. He was a member of 11th and 19th IGES organizing committees.

Cliff Stanley

Cliff Stanley obtained his bachelors degree in Earth Science from Dartmouth College, and his MSc (applied geochemistry, economic geology) and PhD (mathematical geology) from the University of British Columbia. Dr. Stanley is an associate professor in the Department of Earth and Environmental Science at Acadia University, Wolfville, Nova Scotia, but served seven years with the Mineral Deposit Research Unit at UBC. His present research interests are in the field of lithogeochemistry, hydrothermal alteration, geochemical sampling, partial digestions and glacial dispersion of geochemical signatures. Dr. Stanley has served three terms on the AEG Council (2000-2001, 2002-2003, and 2006-2007), was the AAG distinguished lecturer from 2003-2004, and is eager to continue his commitment to the association by serving on council once again.

AAG Regional Councillor Activities

Theo Davies (AAG Regional Councillor for southern Africa) and Rob Bowell (AAG Past President) met at Heathrow Airport in London, UK to arrange shipment of 230 kg of rocks, fossils, minerals, textbooks and journals for the University in Nigeria- 28 boxes in total. Four boxes include a complete set of the Journal of Geochemical Exploration and Geochemistry: Exploration, Environment, Analysis up to 2005, along with **EXPLORE** newsletters. These four boxes of material were donated by Robert van Tassel, a retired AAG member who offered the journals to AAG in 2005. Rob and Theo completed the paperwork, and organized and arranged transfer of the material. Additional items in the shipment included several textbooks that Rob had collected in the last year and 15 years worth of Journal Geological Society and Quarterly Journal of Engineering Geology. Also in the shipment were some donated XRF standards from Cardiff University.

Rob Bowell
SRK Consulting
Churchill House, Churchill Way
Cardiff CF10 2HH Wales, UK
telephone:+44-2920-348150
email: rbowell@srk.co.uk

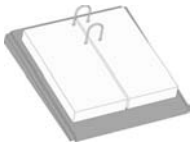
New EXPLORE Business Manager

Many thanks to Dave Seneshen for his volunteer contributions to AAG over the past few years as the **EXPLORE** Business Manager. Dave retired as Manager at the end of 2007. Sarah Lincoln has kindly volunteered to take on the job. Sarah currently works as a geochemist for Barrick Gold Corporation based in Vancouver, Canada where she has been since June 2005. Her work at Barrick is mainly focused on North America. Prior to joining Barrick, she worked for Western Mining Corporation (WMC) before WMC was taken over by BHP Billiton.

Sarah is a graduate of the Colorado School of Mines with a B.Sc. in Geological Engineering as well as a minor in Mathematics. Sarah is the contact person for issues related to advertising in **EXPLORE** and can be contacted at: slincoln@barrick.com

Beth McClenaghan
Editor, **EXPLORE**

Sarah Lincoln, the EXPLORE Business Manager



CALENDAR OF EVENTS

International, national, and regional meetings of interest to colleagues working in exploration, environmental and other areas of applied geochemistry. These events also appear on the AAG web page at: www.appliedgeochemists.org

2008

• March 31-April 3, 2008. **Society of Environmental Geochemistry and Health 26th European Conference - SEGH 2008**
Website: http://conferences.geol.uoa.gr/segh2008/

• May 26 - 28, 2008. **Geological Association of Canada/ Mineralogical Association of Canada Annual Meeting** Quebec City, Canada.
Web site: http://www.quebec2008.net

• June 29 - July 4, 2008. **Geochemistry of Mineral Deposits**, Il Ciocco Lucca (Barga), Italy. http://www.grc.org/programs.aspx?year=2008&program=geochem

• July, 2008. **SEG-GSSA 2008 Resurgence of Economic Geology and the Minerals Industry in Africa,** Joint Conference of the Geological Society of South Africa and SEG Incorporating GEOFORUM 2008. Johannesburg, South Africa. Website: http://www.seg-gssa2008.org/

• July 13 -18, 2008. **Goldschmidt 2008,** Vancouver, BC, Canada. Website: www.goldschmidt2008.org

• July 20-24, 2008. **Australian Earth Sciences Convention (AESC) 2008** Website: www.iceaustralia.com/aesc2008

• August 5-14, 2008. **33rd International Geological Congress**, Oslo, Norway. Website: http://www.33igc.org.

• August 10-15, 2008. **9th International Kimberlite Conference (9IKC)** Frankfurt, Germany. Website: http://www.9ikc.uni-frankfurt.de/

• August 18-22, 2008. **8th Symposium on the Geochemistry of the Earth's Surface**: Joint Meeting of the IAGC, Minsoc and Natural History Museum, London, UK. Contact: M.E. Hodson, m.e.hodson@reading.ac.uk

• October 5-8, 2008. **Geological Society of America Annual Meeting**, Houston, Texas, USA.
Website: www.geoscoiety.org/meetings/index.htm

2009

• May 24 - 27, 2009. **Geological Association of Canada/ Mineralogical Association of Canada Annual Meeting** Toronto, Canada.

• June 1 - 4, 2009. **24th International Applied Geochemistry Symposium,** Fredericton, New Brunswick, Canada
Website: http://www.unb.ca/conferences/IAGS2009

• July 5-10, 2009. **Goldschmidt 2009.** Davos, Switzerland.
Website: http://www.goldschmidt2009.org/

• September 2009. **Geoanalysis 2009**. Drakensberg Region, South Africa.
Website: http://geoanalysis2009.org.za/

Please let this column know of your events by sending details to:

Beth McClenaghan
Geological Survey of Canada
601 Booth Street
Ottawa, Ontario
CANADA K1A 0E8
Email: bmcclena@nrcan.gc.ca
613-992-7805

New AAG Medals Minted

The Gold and Silver medals of the Association have been have re-minted to reflect the change of Association's name to the *Association of Applied Geochemists*. Thank you Dave Kelly for overseeing the medal redesign and minting.

CODES undertakes multidisciplinary research in close association with industry on ore deposit location, formation, discovery and recovery including: igneous petrology; geochemistry; melt/fluid inclusions and magma genesis; hydrothermal systems; volcanology; structure; tectonics geophysics; geometallurgy.

CODES Short Courses in 2008 and 2009

Website: http://fcms.its.utas.edu.au/scieng/codes/index.asp

Volcanology and Mineralisation in Volcanic Terranes
March 30th - April 13th 2008
This course provides an introduction to the processes and products of different eruption styles, contrasts in scale and structure of volcanoes, identification of key volcanic facies associations and interpretation of facies variations. Mineralisation and alteration processes related to hydrothermal systems in subaerial and submarine volcanic environments and implications for mineral exploration are included. This course is a field based unit with trips to the North Island of New Zealand to examine modern volcanic systems and a trip to the West Coast of Tasmania to examine the well mineralised and altered, Cambrian Mt Reid Volcanics.
Course Leader: Prof. Jocelyn McPhie.

Brownfields Exploration
June 2008
The compilation of large datasets that are common in areas of significant previous exploration can present a challenge for any geologist. This course is a lab- and field-based unit that looks at exploration in and around minesites where there is often abundant data. This course will cover GIS applications, and the interpretation of geochemical and geophysical data at various scales. This information will be enhanced by practical exercises involving the integration of multiple datasets from world-class mineralised districts. A field excursion to the west coast of Tasmania will examine real life exploration issues at several minesites.
Course Leader: Dr. Tony Webster.

Ore Deposit Models and Exploration Strategies
November 2008
Ore Deposit Models and Exploration Strategies is an up-to-date synopsis of ore-deposit types and their characteristics. Important features which relate to their genesis and exploration will be discussed and exploration models will be presented for each style. Deposit styles covered include VHMS, Broken Hill Type, Proterozoic Cu-Au, Porhyry Cu-Mo-Au, Skarn Deposits, Sediment Hosted Massive Sulfides and Epithermal Au-Ag. The course is led by Professor Ross Large and a team of Australian and international experts on each deposit style.
Course Leader: Dr. Tony Webster.

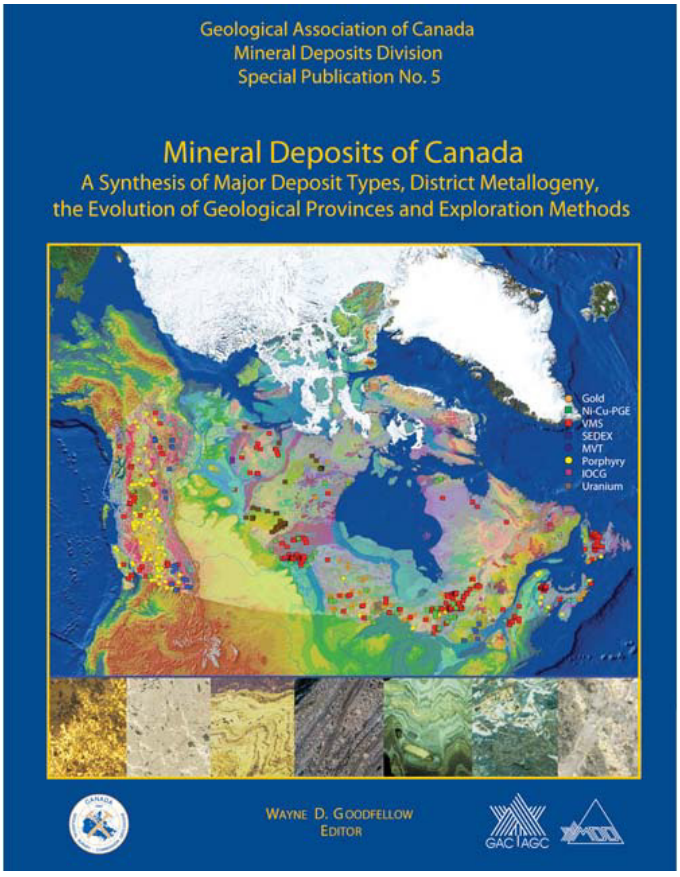
Ore Deposits of South America
March 18 - 31 2009
An exciting field-based course in the Andes covering the major ore deposit styles of South America, deposit types including Porphyry Cu-Mo, High Sulfidation Epithermal Gold and Iron-Oxide Cu-Au. Mines visited include El Teniente (the world's largest underground mine) and Chuquicamata, the world's largest open pit. A series of presentations by researchers and exploration geologists working in South America will address the geology, tectonic-setting and important exploration criteria for each deposit style.
Course Leaders: Ass. Prof. David Cooke, Prof. Bruce Gemmell and Dr. Tony Webster.

Ore Deposit Geochemistry, Hydrology and Geochronology
June 2009
This course covers a variety of geochemical and geochronological techniques used to interpret environments of ore formation and processes of ore genesis, and discusses the implications of these datasets for mineral exploration. Topics include Ar-Ar, U-Pb and Re-Os geochronology, whole rock and trace element chemistry of igneous rocks, sulfide trace element chemistry, stable and radiogenic isotopes, fluid inclusions and hydrothermal geochemistry.
Course Leader: Ass. Prof. David Cooke

Mineral Deposits of Canada
Geological Association of Canada
Special Publication 5

A Synthesis of Major Deposit Types, District Metallogeny, the Evolution of Geological Provinces & Exploration Methods
Edited by Wayne D. Goodfellow.
Price: CDN $80.00
GAC Member Price: CDN $60.00

The Mineral Deposits of Canada (MDC) volume is a collection of 44 papers that have a global perspective but a Canadian focus, and have been grouped under five major headings. Part I is an overview of the economic value of mineral resources in Canada; Part II provides a current synthesis of economically important deposit-types in Canada that include VMS, SEDEX, MVT, IOCG, porphyry, several types of lode gold, magmatic Ni-Cu-PGE, unconformity uranium, and kimberlite diamond deposits; Part III describes the metallogeny of economically important Canadian mining camps; Part IV documents the geological evolution and metallogeny of geological provinces in Canada; and Part V covers geophysical and geochemical exploration methods applied to specific types of mineral deposits. The volume is printed with unrestricted colour to take advantage of the wealth of knowledge and data captured by colour maps and sections, genetic models, images and photographs of representative rocks, ores and minerals. In addition, 4 high-capacity DVDs accompany the volume and contain an ore photo library, ArcGIS databases of major mineral deposits in Canada and the world, PDFs of all papers in the volume, digital files of all diagrams, tables and appendices, and Endnote databases of all papers referred to by volume papers. The book is published by the



Mineral Deposits Division of the GAC in partnership with the Geological Survey of Canada.
http://www.gac.ca/publications/bookstore.php

Hardcover - 1068 pages, unrestricted colour; almost all diagrams and photos are in colour, Geological Association of Canada Mineral Deposits Division; ISBN-13: 978-1-897095-24-9

Digital copies of EXPLORE and the Association newsletter

Thanks to Bob Garrett's excellent archive, pdf versions of paper copies of the Association of Exploration Geochemists newsletters, from its inception in 1971 to 1980, are now available on the AAG website in the NEWSLETTER section. Digital copies of the newsletter from 1980 to 1986 are being scanned by the Geological Survey of Canada and these newsletters will be added to the AAG website in 2008. These old issues are a great source of AEG history and make for some interesting reading. They compliment the digital copies of **EXPLORE** #61 to #137 (1987 to present) that are already posted on the AAG website.

IAGS 2009 Call for Proposals Theme Sessions, Special Sessions and Workshops

24th International Applied Geochemistry Symposium, June 1-4, 2009

Hosted by the University of New Brunswick, Fredericton, New Brunswick (Canada). Contact Dave Lentz with proposals for theme sessions, special sessions, and workshops for the upcoming IAGS 2009. Proposals should include a detailed title, names of 3 co-chairs (with representation from academia, government and industry) and a paragraph describing the session proposed. Please submit by March 31, 2008 by email to: dlentz@unb.ca

Research Opportunity

INNOV-X Systems now offers Academic Research Grants that include the loan of an portable XRF analyzer, technical training and/or support, and sponsorship at a conference. More information about this research opportunity is available at: http://www.innov-x-sys.com/en/company/academic

Kimberley A. Russell
Innov-X Systems, Director of Marketing & Academic Relations, 100 Sylvan Rd, Suite 100, Woburn, MA USA 01801
Phone: 781-938-5005 x 279 • Email: krussell@innovxsys.com • www.innovxsys.com

RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 137. 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**.

Andrews, C.J., et al. (eds.), 2007. Digging Deeper: Proc. 9th Biennial Mtg.; Soc. Geol. Applied to Mineral Deposits (Dublin). Irish Assoc. Econ. Geol. V1: 1-808 and V 2: 809-1633.

Barnicoat, A.C., 2007. Mineral Systems and Exploration Science: Linking fundamental controls on ore deposition with exploration process. in Andrews, C.J., et al. (eds.). Digging Deeper: Proc. 9th Biennial SGA Mtg (Dublin). Irish Assoc. Econ. Geol.

Barrie, C.T, Nielsen, F.W., and Aussant, C.H., 2007. The Bisha Volcanic-Associated Massive Sulfide Deposit, Western Nakfu Terrane, Eritrea. EG 102(4): 717-738.

Batista, M.J., Abreu, M.M., and Pinto, M.S., 2007. Biogeochemistry in Neves Corvo mining region, Iberian pyrite belt, Portugal. J. Geochem. Explor. 92(2/3): 159.

Beaudoin, G., et al., 2007. Mineral chemistry of iron oxides: application to mineral exploration. in Andrews, C.J., et al. (eds.). Digging Deepter: Proc. 9th Biennial SGA Mtg (Dublin). Irish Assoc. Econ. Geol. 497-500.

Breitkreuz, C. and Petford, N. (eds.), 2004. Physical Geology of High-Level Magmatic Systems. Geol. Soc. London. Spec. Pub. 234. 262 p.

Cameron, E.M. and Hattori, K.H., 2005. PGE in Geochemical Exploration. in Mungall, J.E. (ed.). Exploration for Platinum-Group Element Deposits. Min. Assoc. Can. Short Course Series. V. 35: 1-34.

Casiot, C., et al., 2007. Antimony and arsenic mobility in a creek draining an antimony mine abandoned 85 years ago (upper Orb basin, France). Applied Geochem. 22(4): 788-798.

Clayton, R.N., 2007. Isotopes: From earth to the solar system. Annual Rev. Earth Planetary Sci. 35: 1-22.

Davidson, J.P., et al., 2007. Micro sampling and isotopic analysis of igneous rocks: implications for the study of magmatic systems. Annual Rev. Earth Planetary Sci. 35: 273-

de Kemp, E., 2007. 3-D Geological Modelling Supporting Mineral Exploration. in Andrews, C.J., et al. (eds.). Digging Deeper: Proc. 9th Biennial SGA Mtg (Dublin). Irish Assoc. Econ.: 1051-1061.

Dewing, K., 2007. Are Your Data Good Enough: A Checklist for Mining Prospects. Geoscience Can. 34(2): 65-569.

Dube, B., et al., 2007. The LaRonde Penna Au-Rich Volcanogenic Massive Sulfide Deposit, Abitibi Greenston Belt, Quebec: Part II. Lithogeochemistry and Paleotectonic Setting. EG 102(4): 611-631.

Dube, B., et al., 2007. The LaRonde Penna World-Class Au-Rich Volcanogenic Massive Sulfide Deposit, Abitibi, Quebec: Mineralogy and Geochemistry of Alteration and Implications for Genesis and Exploration. EG 102(4): 633-666.

Eckstrand, R., 2005. Ni-Cu-Cr-PGE Mineralization Types: Distribution and Classification. in Mungall, J.E. (ed.). Exploration for Platinum-Group Element Deposits. Min. Assoc. Can. Short Course Series. V. 35: 487-494.

Enders, M.S., Highsmith, R.P., and Simon, G., 2007. Future education trends – what does industry want? in Andrews, C.J., et al. (eds.). Digging Deeper: Proc. 9th Biennial SGA Mtg (Dublin). Irish Assoc. Econ.: 79-82.

Filella, M., Belzile, N., and Lett, M.C., 2007. Antimony in the environment: A review focused on natural waters. III Microbiota relevant interactions. Earth Sci. Rev. 80(3/4): 195-

Goodfellow, W.D., (ed.), 2007. Mineral Deposits of Canada: A Synthesis of Major Deposit Types, District Melallogeny, the Evolution of Geological Provinces and Exploration Methods. Geol. Assoc. Canada. Spec. Pub. No. 5. 1061 p.

Goldberg, I.S., et al., 2007. Depletion and Enrichment zones in the Bendigo Gold Field: A Possible Source of Gold and Implications for Exploration. EG 102(4): 745-753.

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RECENT PAPERS

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Gomez, P., et al., 2006. Modeling of geochemical processes related to uranium mobilization in the groundwater of a uranium mine. Sci. Total Environ. 366(1): 295-

Gorbechev, N.S., 2006. Mineralogy and geochemical zoning and genesis of massive sulfide ores at the Oktyabr'sky deposit. Geol. Ore Deposits 48(6): 473-

Haferburg, G., et al., 2007. Microbes adapted to acid mine drainage as source from strains active in retention of aluminum or uranium. J. Geochem. Explor. 92(2/3): 196-

Hanley, J.J., 2005. The Aqueous Geochemistry of the Platinum Group Elements (PGE) in Surficial, Low-T Hydrothermal and High-T Magmatic-Hydrothermal Environments. in Mungall, J.E., (ed.) Exploration for Platinum-Group Element Deposits. Min. Assoc. Can. Short Course Series. V. 35: 35-56.

Higueras, P., et al., 2006. The Almaden district (Spain): Anatomy of one of the world's largest Hg-contaminated sites. Sci. Total Environ. 356(1/3): 112-

Hilson, G., 2006. Abatement of mercury pollution in the small-scale gold mining industry: Restructuring the policy and research agendas. Sci. Total Environ. 362(1-3): 1-

Kalin, M., Fyson, A., and Wheeler, W.N., 2006. The chemistry of conventional and alternative treatment systems for the neutralization of acid mine drainage. Sci. Total Environ. 366(2/3): 395-

Kelly, J.G., et al., (eds.), 2004. Europe's Major Base Metal Deposits. Irish Assoc. Econ. Geol. 551 p.

Kelley, K.D. and Kelley, D.L., 2007. Future directions in exploration geochemistry research: Pursuit of the far field futures of mineral deposits. in Andrews, C.T., et al. (eds.). Digging Deeper: Proc. 9th Biennial SGA Mtg. (Dublin). Irish Assoc. Econ. Geol.: 63-66.

Kharaka, Y.K. and Otton, J.K., (eds.), 2007. Environmental Issues Related to Oil and Gas Exploration and Production – Special Issue. Applied Geochem. 22(10): 2095-2272.

Kyser, T.K., 2007. Fluids, basin analysis, and mineral deposits. Geofluids 7(2): 238-

Laznicka, P., 2007. Geoscience Literature: Greater Volume – Less Assess or Ignorants in the Sea of Knowledge. Geoscience Can. 34(2): 70-74.

Leybourne, M.I., 2007. Aqueous Geochemistry in Mineral Exploration. in Goodfellow, W.D., (ed.) Mineral Deposits of Canada: A Synthesis of Major Deposit Types, District Metallogeny, the Evolution of Geological Provinces and Exploration Methods. Geol. Assoc. Canada Spec. Pub. No. 5: 1007-1033.

Maier, W.D. and Barnes, S.J., 2005. Lithogeochemical Prospecting. in Mungall, J.E. (ed.) Exploration for Platinum-Group Element Deposits. Min. Assoc. Can. Short Course Series. V. 35: 309-341.

Manaka, M., et al., 2007. Natural attenuation of antimony in mine drainage waters. Geochem. J. 41(1): 17-

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The Association of Applied Geochemists

announces the

2008 AAG Student Paper Competition

SGS

The AAG is calling for nominations for the 17th biennial Student Paper Competition. The paper must address an aspect of exploration geochemistry or environmental geochemistry related to mineral exploration and represent research performed as a student. The student must be the principal author and the paper must have been published in *Geochemistry: Exploration, Environment, Analysis* no more than three years after completion of the degree. A nomination may be made by anyone familiar with the work of the student.

***Deadline* for receipt of nominations is December 31, 2008.**

The winner will receive:

- A cash prize of **$1000**CAD generously donated by **SGS Minerals Services**.
- A 2-year membership of AAG, including the society's journal (GEEA), EXPLORE newsletter, publication of an abstract and CV of the winner, a certificate of recognition and **$500**US towards expenses to attend an AAG-sponsored meeting, courtesy of **AAG**.

Nominations and a digital copy of the paper should be sent to:

Dr David Cohen
Chair, Student Paper Competition
School of BEES
The University of New South Wales
UNSW NSW 2052
Australia
Email: d.cohen@unsw.edu.au

The results of the 2008 competition will be announced at the 24th IAGS in mid 2009.

Further details are available from the chair of the committee or the AAG Students' page at http://www.appliedgeochemists.org/

RECENT PAPERS

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McClenaghan, M.B. and Kjarsgaard, B.A., 2007. Indicator Mineral and Surficial Geochemical Exploration Methods for Kimberlite in Glaciated Terrain: Examples from Canada. in Goodfellow, W.D. (ed.) Mineral Deposits of Canada: A Synthesis of Major Deposit Types, District Metallogeny, the Evolution of Geological Provinces and Exploration Methods. Geol. Assoc. Canada Spec. Pub. No. 5: 983-1006.

McCuaig, T.C., et al., 2007. Fooling Ourselves – Dealing with Model Uncertainty in a Mineral Systesm Approach to Exploration. in Andrews, C.J., et al., (eds.) Digging Deeper: Proc. 9th Biennial SGA Mtg (Dublin). Irish Assoc. Econ. Geol.: 1435-1438.

Mahoney, J., et al., 2007. Control of As and Ni releases from a uranium mill tailings neutralization circuit: Solution chemistry, mineralogy and geochemical modeling of laboratory study results. Applied Geochem. 22(12): 2758-2776.

Mungall, J.E., 2005. Magmatic Geochemistry of the Platinum-Group Elements. in Mungall, J.E. (ed.). Exploration for Platinum-Group Element Deposits. Min. Assoc. Can. Short Course Series. V. 35: 1-34.

Rauch, J.N. and Graedel, T.E., 2007. Earth's anthrobiogeochemical copper cycle. Global Biogeochem. Cycles 21(2):

Richards, J.P. and Kerrich, R., 2007. Special Paper: Adakite-Like Rocks: Their Diverse Origins and Questionable Role in Metallogenesis. EG. 102(4): 537-576.

Schippers, A., et al., 2007. Geomicrobiological and geochemical investigation of a pyrrhotite-containing mine waste tailings dam near Selebi-Phikwe in Botswana. J. Geochem. Explor. 92(2/3): 151-158.

Singh, V. and Rao, S.M., 2006. Application of image processing in mineral industry: A case study of ferruginous manganese ores. Min. Proc. and Extract Met. 115(3): 155-

Siowey, A.J., et al., 2005. Role of organic acids in promoting colloidal transport of mercury from mine tailings. Environ. Sci. and Tech. 39(20): 7869.

Smuda, J., et al., 2007. Mineralogical and geochemical study of elemental mobility at the sulfide-rich Excelsior waste rock dump from the plymetallic Zn-Pb-(Ag-Bi-Cu) deposit, Cerro de Pasco, Peru. J. Geochem. Explor. 92(2/3): 97-110.

Upadhyay, R.K. and Venkatesh, A.S., 2006. Current strategies on exploration, beneficiation and value addition of iron ore resources with emphasis on iron ores from eastern India. Trans. IMM. Section B 115(4): 187-

Walters, S.G., Large, R.R., and Adaire, B., 2007. New Integrated Geometallurgical Research Initiatives and Implications for other Areas of Economic Geology. in Andrews, C.J., et al. (eds.) Digging Deeper: Proc. 9th Biennial SGA Mtg (Dublin). Irish Assoc. Econ. Geol.: 59-62.

Watson, J.H.P. and Beharrell, P.A., 2006. Extracting values from mine dumps and tailing. Min. Eng. 19(15): 1580-

Wilde, A., 2005. Descriptive Ore Deposit Models: Hydrothermal and Supergene Pt & Pd Deposits. in Mungall, J.E., (ed.) Exploration for Platinum-Group Element Deposits. Min. Assoc. Can. Short Course Series. V. 35: 145-161.

Wilson, A. and Chunnett, G., 2006. Trace element and platinum group element distributions and the genesis of the Merensky reef, Western Bushveld Complex, South Africa. J. Petrol. 47(12): 2369-

van Herwijnen, R., et al., 2007. The effect of organic materials on the mobility and toxicity of metals in contaminated soils. Applied Geochem. 22(11): 2422-2434.

Villarrod, L.F., et al., 2007. Lead, zinc, and antimony contamination of the Rio Chileo-Rio Tupize drainage system, Southern Bolivia. Environ. Geol. 51(1): 283-

Yalcin, T., 2007. Geochemical characterization of the Biga Peninsula thermal waters (NW Turkey). Aquatic Geochem. 13(1): 75-

Zientek, M.L., Corson, S.R., and West, R.D., 2005. Discovery of the J.M. Reef, Stillwater Complex, Montana: the role of soil and silt platinum and palladium geochemical surveys. in Mungall, J.E., (ed.) Exploration for Platinum-Group Element Deposits. Min. Assoc. Can. Short Course Series. V. 35: 391-407.

Association of Applied Geochemists web site:
www.appliedgeochemists.org

Association of Applied Geochemists
APPLICATION FOR MEMBERSHIP*

Please complete only the relevant section for membership. See below for mailing instructions.

I, _____, wish to apply for election as a ___Member / ___Student Member of the Association of Applied Geochemists. I have read the Code of Ethics of the Association and in the event of being elected a Member/ Student Member agree to honour and abide by them.

MEMBER: *State Employer and Employee title*
I am actively engaged in scientific or technological work related to applied geochemistry exploration and have been so for the past two years.
_____ as a _____.
(employer) (employment title)

STUDENT MEMBER: *Student status must be verified by a Professor of your institution or a Fellow of the AAG*
I certify that the applicant is a full-time student at _____ in pure or applied science.
(institution)

_____ _____
(Professor/ AAG Fellow Signature) (Printed Name and Title)

Witness my hand this _____ day of_____, 20_____. _____
(Signature of applicant)

NAME AND ADDRESS: PLEASE PRINT (to be completed by applicant)

Name: _____ Telephone bus: _____

Address: _____ fax: _____

_____ home: _____

_____ e-mail: _____

Annual Dues :

All applications must be accompanied by annual dues . All payments must be in US funds. Select one of the four listed below.

1	2008 member dues	US$	100	_____
2	2008 student member dues		10	_____
	- If receipt required, include a self-addressed envelope and add		2	_____
	- If your check is not drawn from a U.S.A. or Canadian bank, add		15	_____
			TOTAL	_____

Payment by check, International Money Order, UNESCO Coupons, International Postal Orders, VISA, American Express and Master Card are acceptable. For credit cards users, minor variations in your billing may reflect currency exchange rate fluctuations at time of bank transaction.

Type: VISA ___ American Express ___ Master Card ___ Credit card account number: _____
Exp. date: _____ Name: _____ Signature: _____

Application for voting membership (Fellow) requires the sponsorship of three voting members. Request a voting member application from the Association office.

Please note: Your application form 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 AAG 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:

Association of Applied Geochemists
P.O. Box 26099, 72 Robertson Road, Ottawa, Ontario, CANADA K2H 9R0
TEL: (613) 828-0199, FAX: (613) 828-9288, email: office@appliedgeochemists.org WEBSITE: http://www.appliedgeochemists.org

ioStipend

In-kind Analytical Research Fund for BSc(Hons), MSc and PhD students

Much has been said and written about the broadening gulf between the demand for qualified explorationists and the supply coming out of our colleges, technical institutes and universities. One merely has to attend any geo-conference and gaze out over the sea of grey to fully grasp the situation our industry faces. This is all the more evident in the field of exploration geochemistry whose members have always been in short supply.

As consultants and service industries, we owe our livelihood to mining and exploration and thus have a vested interest in its development. We believe that any aid to promote fresh faces into our sector is helping to secure our future.

Acme Analytical Laboratories Ltd. and **ioGlobal** are taking the bold initiative of directly aiding students in the geosciences via the **ioStipend**. The **ioStipend** is a grant available to students conducting exploration-related geochemical studies at a recognized educational institution. The grant is in the form of analytical services using any package provided by Acme Analytical Laboratories Ltd. Students and/or their teachers/advisors can apply for the grant by submitting the application to ioGlobal who will vet the proposals.

The grant is intended to promote the collection of high quality, base-line data for comparison with more "esoteric data" (eg, isotopic data, partial digests, non-standard sample media) generated during the course of research, and to promote broad training in fundamental geochemical principals across the geosciences.

The **ioStipend** allows for amounts of approximately $5,000 (AUD, CAD or equivalent) for in-kind analytical work. Successful applicants will also be provided with 3 academic licences of **ioGAS**, the new exploratory data analysis software package available from ioGlobal.

The application form is available at www.ioglobal.net.

It is envisaged that three or four of these awards will be made each year.

Applications are reviewed by an expert group of ioGlobal's geochemists

Eligibility Criteria

Preference will be given to:

- students with no other source of funding
- students working on exploration geochemistry projects
- projects no or very minimal confidentiality requirements

The ioStipend is international. Applications are welcome from qualified institutions globally.

Some technical input may be provided by ioGlobal on request.

Requirements for receiving the ioStipend

Firstly, there are minimal strings attached. Recipients would have to agree to

1. Have their project promoted on the ioGlobal web site in an area devoted to R&D carried out under the program (couple of passport photo shots, brief description)
2. Acknowledge ACME Labs and ioGlobal for support in technical and public presentations of results
3. Write a short article for Explore describing the project outcomes, and allow this to be published on the ioGlobal web site.

David Lawie, John Gravel

EXPLORE

Newsletter No. 138 MARCH 2008

Editor: Beth McClenaghan (bmcclena@nrca.gc.ca)
Assistant Editor:
Elizabeth Bailey (eabailey@usgs.gov)
Business Manager:
Sarah Lincoln, (604) 895-4443 (slincoln@barrick.com)
Back Issues contact: Betty Arseneault (office@appliedgeochemists.org)

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March newsletter: January 15
June newsletter: April 15
September newsletter: July 15
December newsletter: October 15

Manuscripts should be double-spaced and submitted in digital format using WORD. Photos and figures (colour or black and white) should be submitted as separate digital files and as high resolution jpeg or PDF files. Tables should be submitted as separate digital files in EXCEL format. All scientific/technical articles will be reviewed. All contributions may be edited for clarity or brevity.

Formats for headings, abbreviations, scientific notations, references and figures must follow the Guide to Authors for *Geochemistry: Exploration, Environment, Analysis* (GEEA) that are posted on the GEEA website at: http://www.geolsoc.org.uk/template.cfm?name=geea_instructions_for_authors

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THE ASSOCIATION OF APPLIED GEOCHEMISTS

P.O. Box 26099, 72 Robertson Road, Nepean, Ontario K2H 9R0 CANADA • Telephone (613) 828-0199
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COMMITTEES

Betty Arseneault, *Business Manager*
P.O. Box 26099, 72 Robertson Road, Nepean, ON K2H 9R0 CANADA,
TEL: (613) 828-0199 FAX: (613) 828-9288, e-mail:
office@appliedgeochemists.org

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