EXPLORE

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Newsletter for the Association of Applied Geochemists

Paul Morris

President's Message

At the August 2010 AAG Council meeting, amongst the items slated for discussion was a revised committee structure, which was endorsed unanimously by Council. As you can see from the table below, many of the existing committees and their functions have been retained, but in some cases, portfolios have been combined, committee functions have been extended, and a new committee inaugurated. Apart from reinvigorating the AAG committees, I am hopeful that the new structure will also put more emphasis on supporting practitioners of applied geochemistry through subsidized membership, as well as offering some tangible support to applied geochemistry students through the new Education Committee. I have contacted some existing committee members and asked them to stay on in their positions, as well as inviting some AAG fellows to inaugurate the Education Committee. This committee's mandate will be to formulate criteria to identify students who would qualify for AAG support, identify recipients, determine the level and type of support, and approach the private sector for both cash and in-kind support. The committee will report back to Council on selection criteria and recommended level of funding in early 2011, and the program, with any luck, will become active in mid-2011.

Crucial to the success of this program will be the cooperation of the private sector in terms of providing both direct and in-kind support to students, so those of you affiliated with analytical laboratories, software houses, and analytical equipment etc can expect a knock on the door — after all, the students of this year are the clients of the next.

Revised Structure for AAG's Committees

Committee	Function	Comment	Committee size
New Membership	Disseminate information about AAG's objectives in order to increase membership; manages subsidized membership	Mandatory under the By Laws. Added responsibility to monitor subsidized membership	Chairman plus four others, drawn from different countries
Admissions	Reviews the application of every candidate to join AAG.	Mandatory under the By Laws	Chairman and two other fellows
Awards and Medals	Sets up criteria for identifying worthy candidates for AAG medals; seeks nominations for recipients; puts forward nominations to Council for endorsement; identifies and coordinates the activities of the Distinguished Lecturer	Amalgamates Awards and Medals Committee and Distinguished Lecturer Committee	Chairman plus four others, drawn from government, academia and industry.
Education	Administers the Student Participation Program (SPP); identifies and coordinates workshop and short course activities	New Committee, incorporating the Short Course committee	Chairman, plus up to six others
Symposia	Canvasses contributions to host symposia; collates submissions for passing on to Council; monitors the progress of symposia organization; solicits reports and balance sheet after symposia	Existing committee	Chairman plus two committee members

Coordinator	Function	Comment
Student Paper	Promotes the Student Paper Competition; collates and judges submissions	One coordinator who selects referees accordingly to help carry out this task
Website	Coordinates the AAG website in terms of adding/deleting content	Co-opts or employs people accordingly
Geoscience Councils	Acts as liaison between Geosciences Councils and external conferences etc that AAG may be part of	
GEEA	Manages the affairs of AAG's journal.	
Explore	Manages the affairs of AAG's magazine	
Regional Councillors	Coordinates the activities of Regional Councillors, who promote AAG throughout parts of the world. Makes their work available on the website	Traditionally carried out by AAG's vice president.

Related to this increased level of support that will be made available to students is the progress that has been made in attaining charitable status for AAG. By the time you are reading this, AAG should have attained this, making our Association more attractive in terms of financial donations from the private sector.

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Canadian Geochemical Data on the Web

Canada is the second largest country in the world covering approximately 9.9 million square kilometres. Several thousand geochemical surveys have been undertaken across this large landmass since the 1950s, mainly in support of mineral exploration, but also for resource assessment and environmental research (Garrett et al. 2008). These surveys have been conducted by federal and provincial geological agencies as well as exploration companies, universities and consultancies. Surveys have been carried out in many parts of Canada at different scales, ranging from reconnaissance (>10 km sample spacing), to very detailed studies (<100 m spacing).

The composition of the surficial cover in Canada differs in one fundamental aspect from most other parts of the world where soils have developed from the in-situ weathering of bedrock. More than 95% of Canada was covered by glaciers periodically during the last 2,000,000 years and, as a result, the cover of surface sediments consists of materials that were eroded, transported and deposited by glaciers or at glacier margins.

Data for geochemical surveys carried out by the Geological Survey of Canada and provincial geological agencies are available via the Geoscience Data Repository (GDR) web site http://gdr.nrcan.gc.ca/index_e.php . The GDR is a Natural Resources Canada - Earth Sciences Sector initiative which allows discovery, viewing and downloading of information from a collection of geoscience databases. The Canadian Geochemical Surveys (CGS) catalogue on the GDR contains searchable metadata for over 800 geochemical surveys conducted across Canada since the 1950s as well as raw data for over 65 surveys. The catalogue includes data from many different sample media. It is currently biassed towards till and lake and stream sediments. As it continues to grow, other sample media (particularly bedrock) will have a larger presence. The catalogue contains a multitude of cross references to original publications and online data, where available. It is also extensively cross-linked to other databases and geological organizations.

The CGS catalogue has recently been expanded to include raw geochemical data for over 65 till surveys across Canada as well as KML* files of these data that can be viewed with Internet Earth browsers such as Google Earth™. The addition of raw data and creation of KML geochemical layers is on going. (*KML, Keyhole Markup Language, is a data file format optimized for viewing geospatial data).

The catalogue is generated from an underlying relational database. All of the web pages presented via the GDR are derived from this database that stores both the metadata and raw geochemical data for the surveys. The following overview of the contents of the CGS catalogue can be found in more detail in Geological Survey of Canada Open File 5936, "The Canadian Database of Geochemical Surveys: User manual for the metadata website" (Spirito & Adcock 2009). The home page of the Canadian Geochemical Surveys catalogue can be found at: http://gdr.nrcan.gc.ca/geochem/index_e.php. There are four ways to look at the contents of the catalogue, and the home page is the starting point for

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President's Message

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Machinations at Council have also resulted in finding a replacement for our AAG Distinguished Lecturer Kurt Kyser. At the time of writing, the selection is not finalised, but Council will vote on the matter in the next few weeks. I am keen that some or all of the AAG Distinguished Lecturer's talks can be made available digitally on the AAG website, so that everyone may have access, not only those on the Distinguished Lecturer's travel itinerary. I would like to pass on AAG's thanks to Kurt for his DL contributions to AAG — I attended his talk at Fredericton on dendrochemistry, and found it anything but boring (sorry).

2011 will also be the year that the IAGS is hosted in Rovaniemi, Finland, and the LOC has indicated that the second circular would be made available by the end of October, so I guess by now you are all consulting with your travel agents. As well as getting continuous progress reports from Rovaniemi, there are also positive sounds coming out of New Zealand for hosting a IAGS in 2013, which we will no doubt hear about at the August IAGS. I wish you all an enjoyable Holiday Season and a safe and happy 2011.

Paul Morris,
AAG President

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New Members

Fellow
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Canadian Geochemical Data... *continued from page 2*

searching the catalogue by the first three of the four methods listed below:

1. by VIEWING the map-based interface
2. by BROWSING index tables organized by category;
3. by QUERYING a periodic table interface; and
4. by USING Internet search engines e.g. Google™.

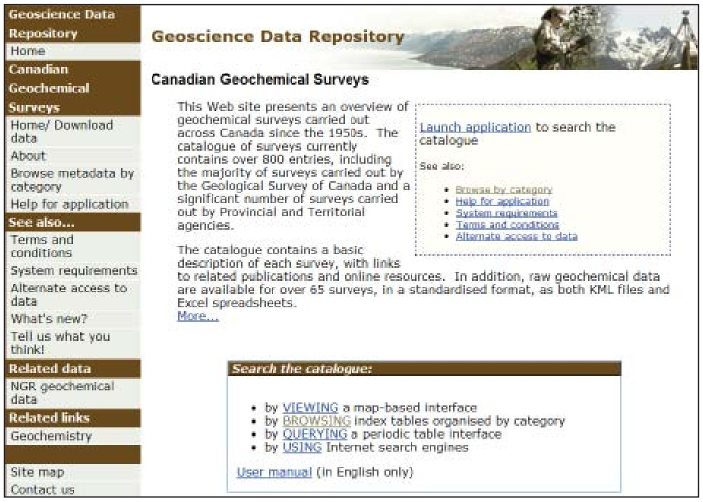

Figure 1. Canadian Geochemical Surveys home page on the GDR.

VIEWING: Map-based Interface

The first way to search the catalogue is by viewing the map-based interface from the home page.

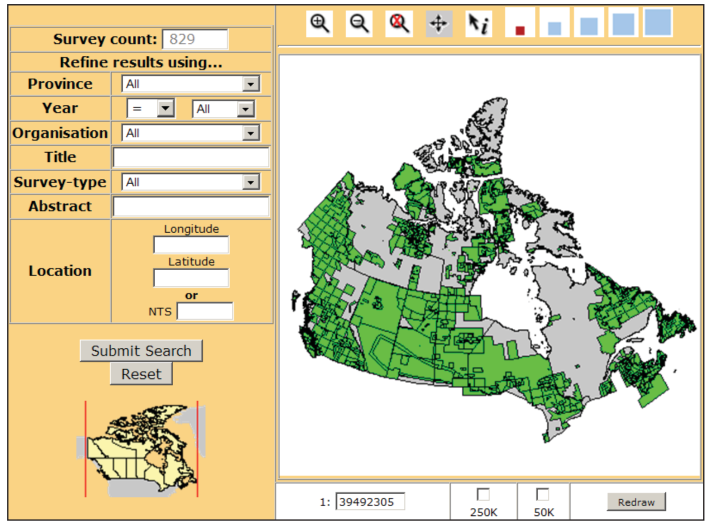

Figure 2. Map-based interface showing 829 geochemical surveys across Canada.

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Using the tools provided with the interface (e.g. zoom, query or search parameters), an area of interest can be chosen and a survey selected. Once a survey (or surveys) is selected by using the query tool ( ), links to the metadata pages ("more") and a KML location map ("KML") are shown in the information grid below the interface map, as shown in Figure 3.

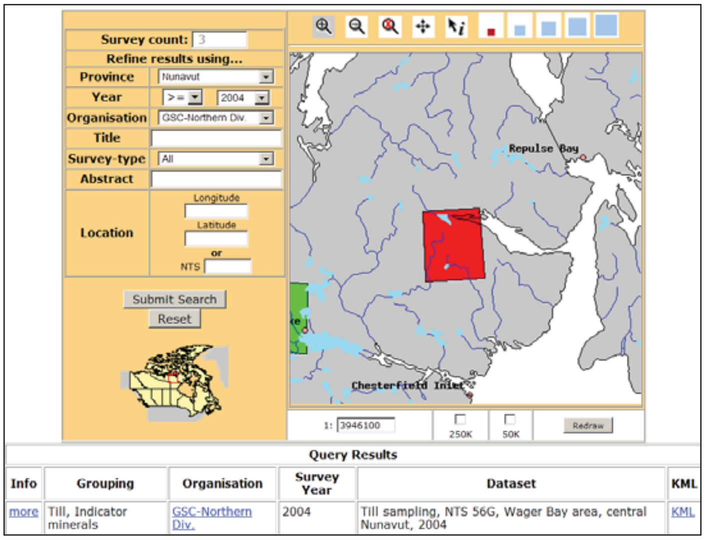

Figure 3. Example of survey selected with the Query tool and corresponding information grid.

Using the "more" link, metadata for the selected survey (shown in red) are available on separate web pages for the survey, as well as associated publications and projects. These three types of pages are highly interconnected and can be accessed from each other. This interconnection allows the related metadata to be viewed independently of where the metadata search began.

BROWSING: Index Tables

The second way metadata can be searched is by browsing index tables organized by category (e.g. Surveys, Projects, Publications). The first three of these index tables display lists which link to metadata pages for survey information, project information and associated publications respectively.

A survey is the principal entity on which the metadata catalogue is based. A survey is carried out in a specific geographic area, over a defined period of time and by a certain organization. A survey can involve the collection of less than ten to several thousand samples from one or more sample media. In most cases, the data and other information related to the survey have been released in one or more publications. The survey metadata page provides a basic description of each survey, with links to related publications and online resources.

A project is an administrative concept and can be defined as a body of work (one or more surveys) related by organization, principal investigator, funding source or any other logical reason why the surveys should be grouped together. Projects are useful in establishing relationships between different surveys. They also capture information related to reanalysis of samples and re-publication of data. The project metadata page provides a description of the project, lists the related surveys and the funding source and also links to the organization responsible for the data.

A publication is a public release of information that results from a specific survey and may or may not include the geochemical data from the survey. It is most often released as a published document, but can be an unpublished thesis or report. A survey may be published in one, many or no publications. The publication metadata page displays: a) the recommended citation; b) the link(s) to its associated survey(s); c) its GeoScan* record and a link to GeoPub**; d) a link to the publication's original GSC Release Notice, if it exists; and, e) a link to download older files that may not be in GeoPub.

**GeoScan – a bibliographic database of GSC publications*
***GeoPub – a database of downloadable GSC publications*

QUERYING: Periodic Table Interface

In addition to metadata for over 800 surveys, the catalogue provides access to raw geochemical data for 65 till surveys across Canada, 39 of which are in the province of New Brunswick. The raw data have been compiled into a standardized format and are available as both KML files and Microsoft® Excel® spreadsheets.

From the Canadian Geochemical Surveys home page, KML index maps of the 65 surveys as well as all 800 surveys are available. The raw data can be viewed as KML files by using the Periodic Table Interface, which is the third way to access the catalogue. KML files can be viewed using Internet Earth browsers such as Google Earth™.

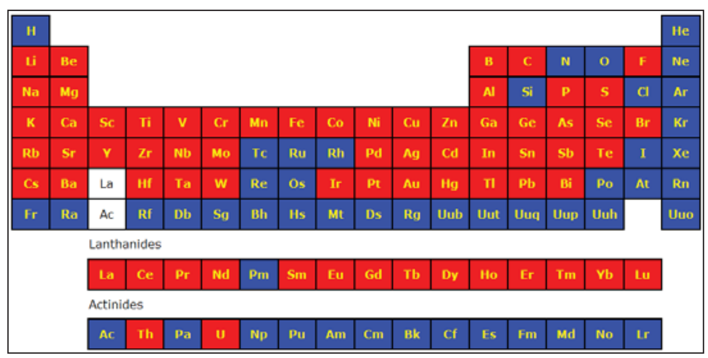

Figure 4. Periodic table interface.

The Periodic Table Interface displays elements in red and blue. The red elements are those for which raw data (from at least one of 65 surveys) are available in a standardized format (KML files or MS-Excel® spreadsheets). The blue elements are those for which no raw data exist. When one of the red elements is selected, for example Cu, a KML index map is displayed showing which surveys include data for Cu. When the KML index map is displayed, the extent of each survey that has data for the selected element is shown. Survey 210008 is one of the surveys for which copper data are available. When the star at the centre of the survey outline

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is clicked, a balloon appears with information about the raw data for that survey.

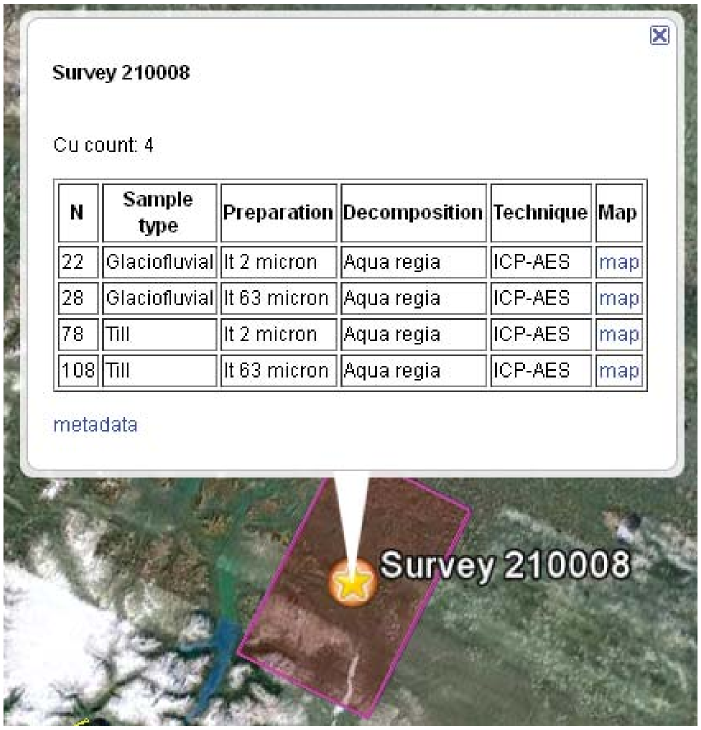

Figure 5. KML map for Cu showing analytical parameters for the survey.

There are four copper (Cu) datasets for Survey 210008, as shown in Figure 5. There are two sample media, glaciofluvial sediments and till, and each sample type has been sieved into two size fractions: <2 µm and <63 µm. The table shows the number of samples (N) of each sample type and sample preparation, and also shows that the samples were digested with aqua regia before being analyzed by ICP-AES.

The "metadata" hyperlink in the bottom left corner of the balloon displays the corresponding Survey Metadata Page on the GDR. The "map" hyperlink in the last column links to a KML map which can display the analytical value for the selected element at each sample site. The cross symbol marking the location of each sample is coloured according to its quartile value: (75 -100th), (50-75th), (25-50th), (0-25th).

In Figure 6, the Cu values for till in the <63 µm fraction are shown. The legend to the left of the map shows the data broken down into 20 percentile groups (0-5th, 5-10th etc.) as well as the number of samples that fall into each group. Each of the four quartile ranges covers five of these percentile groups. On the legend, values in specific percentile ranges can be toggled on or off. For example, only samples with Cu values in the 90th percentile range or higher can be displayed. When the map is first loaded from the "map" link shown in Figure 5, the data are loaded with "Symbols only" by default. At the bottom of the legend, there is an entry "Cu; n=108, Symbols plus value". When this is toggled on, the actual Cu value at each site will be displayed.

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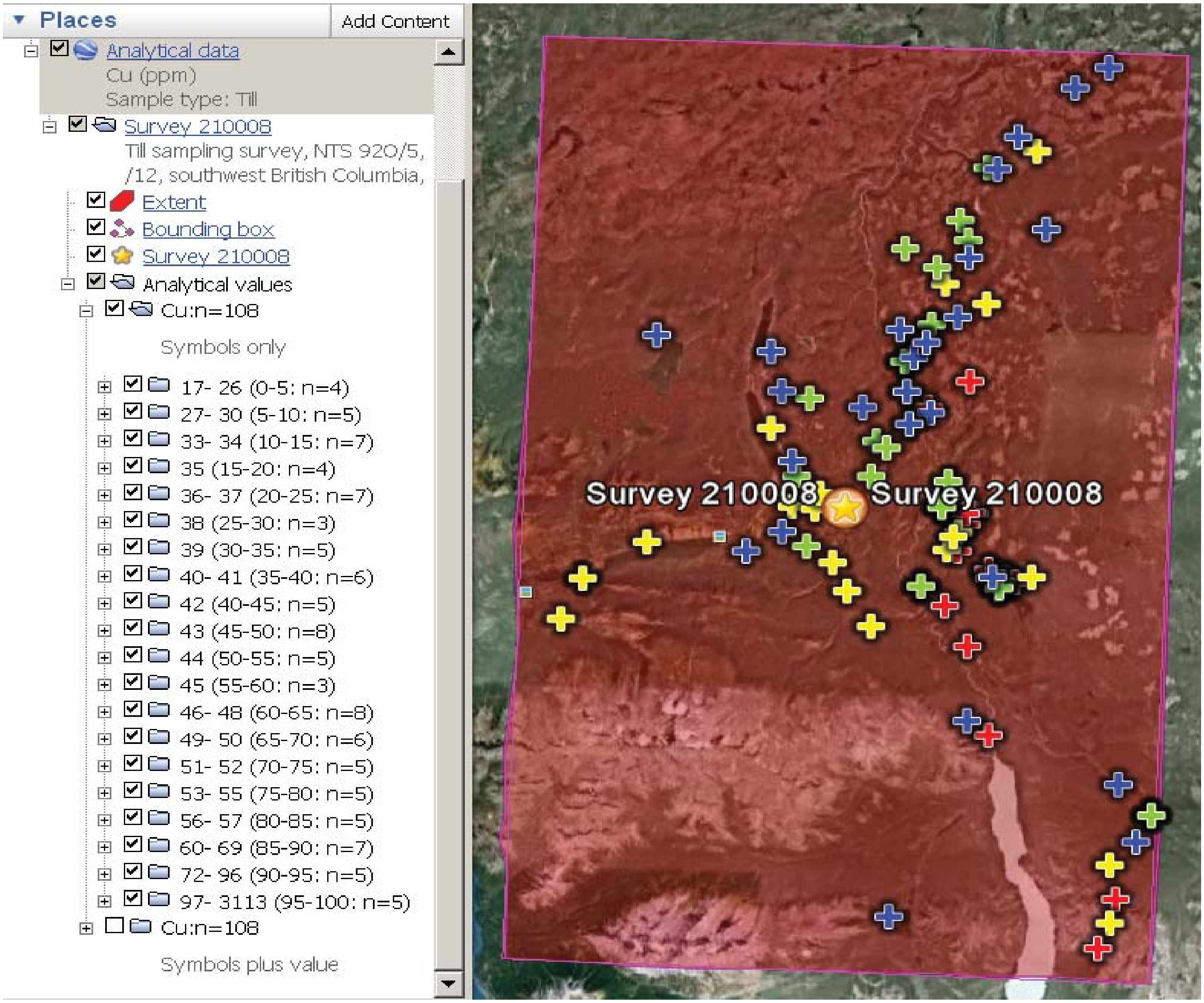

Figure 6. KML map of Cu values, coloured by quartile.

The KML maps described above can also be accessed from the Survey Metadata pages in addition to the Periodic Table interface. These Survey Metadata pages which can be accessed via the map-based interface or the Surveys Index table, provide extra information for the 65 surveys for which the raw data have been compiled. These surveys have *Extended Metadata* sections on the Survey Metadata web pages as shown in Figure 7.

Figure 7. Excerpt from Survey Metadata page showing Extended Metadata section.

This section provides a more complete breakdown of the sample count by map sheet; the number of samples for each type of sample material (if more than one medium was col-

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lected); the way the sample was prepared; and, the Analytical History, including specific details about laboratory packages used to analyze the samples. From the Analytical History section, more details about the types of geochemical analyses can be found and spreadsheets of the raw data, in a standardized format, can be downloaded. This section also provides links to KML maps that display the analytical data for each element that was analyzed in the selected package. The maps are the same as those displayed via the Periodic Table interface.

USING: Internet Search Engines

The final way to view the metadata catalogue is by using Internet search engines, such as Google™. The metadata pages have been indexed by the major Internet search engines. Judicious selection of search terms will often take you directly to a relevant survey, project or publication web page. Hyperlinks within the web page will then direct you to additional information.

For example, if you know the author(s) of a publication, then using their surnames as search terms will often result in a link to the publication metadata page. Alternatively, using the phrase "canadian geochemical surveys" as the first search term, in combination with other search terms (authors' surnames, place names, geochemical terms) should result in several links to pages within the web site, as shown in Figure 8.

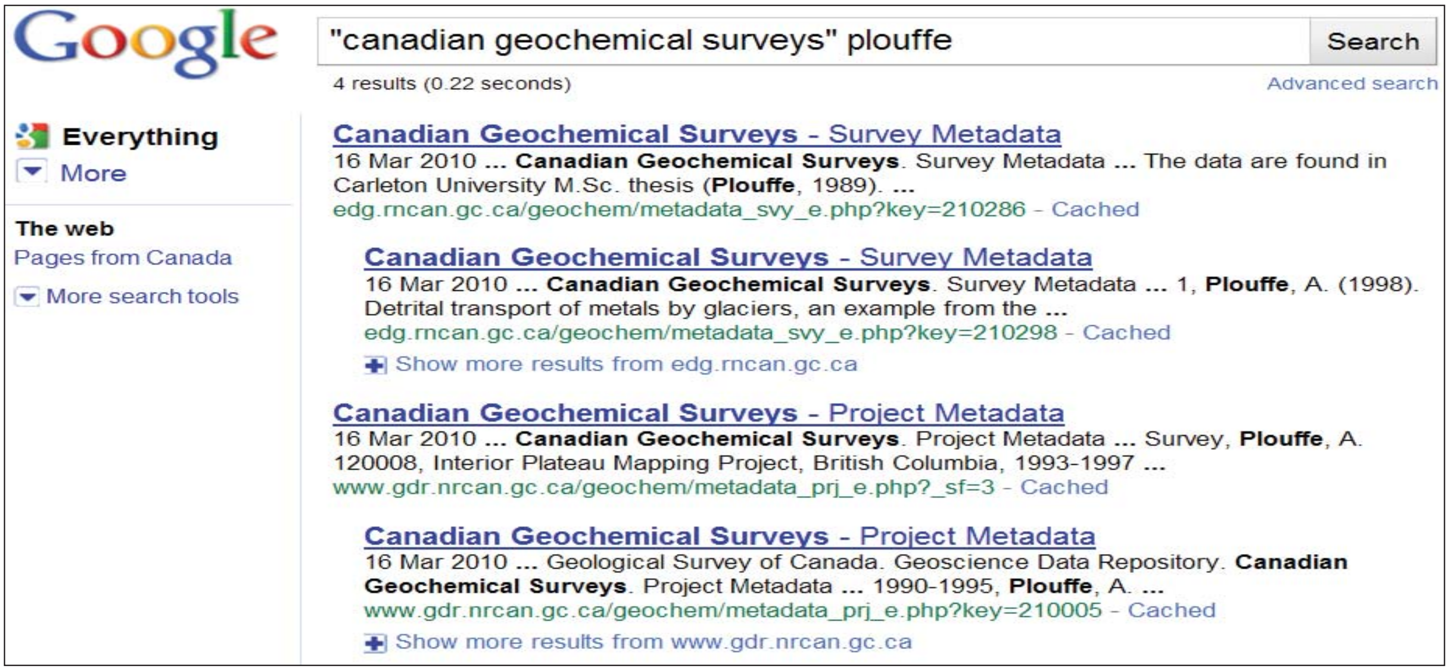

Figure 8. Links to Canadian Geochemical Surveys metadata pages as search results from Google™.

Additional Information

Geological Survey of Canada Open File 5936 (Spirito & Adcock 2009) is a comprehensive user manual for the website and can be viewed directly from the home page (http://gdr.nrcan.gc.ca/geochem/index_e.php). It includes references to additional publications which describe various facets of the catalogue in greater detail.

Acknowledgements

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How Many Samples Are Enough?

Introduction

When Cliff Stanley telephoned me last April and asked me where the '30 samples' came from, I had to admit that I thought I was responsible and that the estimate came from a consideration of the standard error of the mean. I could not remember at the time where I had written it and illustrated the plot of 1/√n versus n; it was not in my first guess, the chapter on sampling in Richard Howarth's Volume 2 of the Handbook of Exploration Geochemistry (Garrett 1983a). Some digging retrieved the 1979 paper (Garrett 1979) that I forwarded to Cliff, and set me thinking as to just why I chose 30.

The choice was not quite as arbitrary as it may appear, what was arbitrary was another number, 120. In the days of statistical tables, the Student-t statistic, used for estimating confidence bounds on means, was only tabled up to 30 (see for example, Mathematical Tables from Handbook of Chemistry and Physics, 11th Edition, 1963), or occasionally 120, as after that it changed only very slowly and slightly up to the value for an infinite sample size. Today the required values of statistics are computed 'on the fly' by the software in the PCs we all use, as are the probabilities associated with hypothesis tests based on those statistics. With reference to the value of 1/√n, by the time n reaches 30 the value of 1/√n has fallen to 90% of that which it attains at 120; and the first derivative, i.e. the rate of change for the function, had fallen to well in excess of 99% of its value for 120.

The choice of the round number 30 did not seem too unreasonable if the objective was to estimate a mean for what was thought to be a homogeneous terrane, rather than set out a network of samples to detect a dispersion halo from a mineral occurrence. In this latter instance a completely different set of guidelines are applicable; primarily to ensure the area of the sampling grid cells is smaller than the area of geochemical dispersion pattern being sought, preferably by a factor of two or more, and that the grid is favourably oriented relative to the expected orientation of the dispersion patterns. Financial costs are always a major concern in designing and executing geochemical surveys, for estimating means, things were not going to change too radically after the sample size reached 30. Unless, of course, the unit or area being sampled was not, in fact, homogeneous, i.e. the issue of 'a specific situation'.

How many samples really are necessary?

We have to thank Cliff for returning to this question in his Explore article (Stanley 2010) and proposing that it needs to be asked within the context of a particular survey in a relative way. Not long before I received his phone call I had been asked the same question in a workshop in Halifax, NS, by an environmental consultant concerned with undertaking risk assessments. I answered in the traditional manner, "30", and was horrified to hear that he thought 3 were sufficient in order to characterize soils in his study areas to compare with the CCME (1997) guideline for As in soils. Granted the size of the areas the consultant was working with were small land parcels, not geological-scale lithozones. However, this in itself can cause problems because of spatial correlation effects, as noted below in the concluding remarks.

Stanley (2010) points out that his derivation of the formula:

$$n \approx \left\{\frac{CV}{rse_{\bar{x}}}\right\}^2$$

is distribution free. True, however, that is not the case for the estimate of CV for the target population being sampled. Estimates of the classical mean and standard deviation (variance) are made with the underlying assumption that the data are normally and independently distributed. Some practitioners rely on the fact that the mean and variance are the most statistically efficient estimators, however, that is only true if the assumptions are met. In most cases regional geochemical data are neither normally distributed, even after some appropriate transformation, e.g., logarithmic, or square root if the underlying true distribution is Poisson, nor independent of one another due to spatial correlation effects.

It is now widely recognized that the estimation of the properties and range of geochemical background benefits from the use of robust estimators, see, for example, Reimann et al. (2005). This recognition is also exemplified by the wide use of the median by practicing geochemists rather than the mean as a measure of central tendency in regional surveys, though it must never be forgotten that background is a range and cannot be suitably defined by a single number (Reimann and Garrett 2005). In general, the adoption of robust estimators by applied geochemists has been slow, although they have been in use for more than 30 years (Garrett 1983b), and physical scientists have been urged to use them by statisticians, see, for example, Rocke et al. (1983). More recently the use of both robust estimators and non-parametric methods, which are resistant to the effects of outliers and distributional assumptions, has become more widespread and tools provided to assist the applied geochemist in their application (Reimann et al. 2008).

The practical problem described by Stanley in Nova Scotia, Canada, an outcome of the North American Soil Geochemical Landscapes project, will occur again. The project was proposed in 2001, and following several workshops a continent-spanning orientation survey was undertaken in 2004 (Smith et al. 2009). Following that, the Canadian and U.S. Geological Surveys commenced full scale sampling in 2007. To address the problem of having a sufficient number of samples to support the estimation of background statistics on a provincial-scale, sampling of the Maritime Provinces was undertaken at a double density of 1 site per 800 km2, i.e. two 20 x 20 km cells sampled in every 40 x 40 km cell. The base sampling density of 1 site per 1600 km2 led to an anticipated suite of approximately 6000 samples across North America. The Geological Survey of Canada withdrew from the tri-national effort in 2009, the U.S. and Mexican surveys are continuing.

Recognizing the high variability of geochemical data and the presence of outliers, for example, the 345.7 ppm As value in the 'Over Meguma Supergroup' data discussed by Cliff (Stanley 2010, Table 1), how can estimates of "how many samples are enough?" be improved. The specific value of

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345.7 ppm As is probably not 'stable', a second soil sample collected a few meters away would likely vary by as much as 50%. The mean, standard deviation and coefficient of variation for the As data are 46.6, 84.8 and 181%, respectively. The act of cutting the high value of 345.7 by a half to 172.8 results in estimates of 35.1, 42.3 and 121%, for the same estimators respectively. The use of robust estimation procedures leads to estimators for the median, Median Absolute Deviation (MAD) and an Inter-Quartile Range (IQR) based estimate of the standard deviation (SD), see Table 1 below, that do not differ between the two data sets. Depending on which of the two analyses was used different estimates of "how many samples are enough?" would be obtained because of the sensitivity of variance and standard deviation estimates to outliers and extreme values. However, if robust estimation procedures were used there would be no difference in the estimates of required sample size, for this example, because robust outlier resistant procedures 'down-weight', reduce the effect of, outliers and extreme values.

Table 1 presents the classical statistical estimators from Stanley's Table 1 and additional robust estimators, medians, and MADs and IQR based estimates for standard deviation (data spreads). Modern statistical packages compute medians and MADs, and an IQR based estimate of the standard deviation (SD) can be obtained by multiplying the IQR, the data range between the first and third quartiles (Q1 and Q3, or 25th and 75th percentiles) by 0.7413, the ratio between the 50% of the data encompassed by the IQR and the data encompassed between mean ± 1 SD for a normal distribution. This leads to the estimation of robust CVs (RCVs).

Table 1.
Estimation of various coefficients of variation for As (ppm) concentration in soils.

Statistic	Over Granite	Over Meguma
Mean	13.35	46.61
SD	7.36	84.77
CV (%)	55.12	181.15
Median	13.80	22.20
MAD	4.45	13.05
RCV_{MAD} (%)	32.23	58.77
Q1	10.8	14.6
Q3	15.9	33.6
IQR	5.1	19.0
SD_{IQR}	3.88	14.46
RCV_{IQR} (%)	28.14	65.16

The new robust estimates may then be used to estimate "how many samples should be enough?". Table 2 presents the results for a 10% tolerance level, as used in Cliff's example.

Table 2.
Number of soil samples required to achieve a 10% tolerance level

	$CV_{Classical}$	CV_{MAD}	CV_{IQR}
Over Granite	30.38	10.39	7.92
Over Meguma	328.15	34.54	42.46

Conservatively, these would be rounded to 31, 11, 8 for 'Over Granite' soils, and 329, 35, 43 for the normal assumption for the 'Over Meguma' soils, respectively. With an appreciation of the natural variability of the geological environment I would not argue that fewer than 30 soil samples should be collected over the South Mountain batholith, it is known to be multi-phase. Furthermore, going back to the original 1979 reasoning, fewer than 30 samples and the confidence bounds around the mean may not be sufficiently tight for the purpose of the survey. However, I would certainly argue against collecting 330 soil samples from the Meguma Supergroup, perhaps 40 would be adequate. The choice ultimately belongs to the geochemist designing the survey, and the financial resources and time constraints for the project.

However, there is a more fundamental question that needs to be addressed, and that is the nature of the statistical distribution of As values in the Meguma Supergroup rocks and their overlying soils. The key issue is whether one is dealing with background data from a normal-like distribution contaminated by outliers, or data from a lognormal distribution that encompasses extreme values. In the former case, normal-like background data have been contaminated by

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outliers from an epigenetic As-Au mineralization process that led to the formation of the gold deposits that have been mined in the Meguma host rocks. In the latter case, the 345.7 ppm As value is simply an extreme value of a continuum of values that vary from very low all the way to extreme values, possibly even greater than 345.7 ppm As. The decision as to the form of the underlying statistical distribution has major implications. For the situation where contamination by an epigenetic process is suspected a robust estimation procedure should be used, not a classical procedure, the results of which are demonstrated in Tables 1 and 2 above. On this basis the calculation would indicate that between 35 and 43 samples should be adequate, assuming the same robust procedure would be applied to the resulting data for presentation, discussion and decision taking. If, however, a lognormal distribution is assumed for the Meguma Supergroup soils, and all relevant calculations are undertaken in logarithms, it would be appropriate to use 'classical' estimators because extreme values are to be expected in a lognormal, or any other strongly positively skewed, statistical distribution.

Table 3 presents the calculations for the soils overlying the Meguma Supergroup, robust estimates are not made as they are inappropriate if one accepts the hypothesis that the data are drawn from a lognormal, or approximately, lognormal distribution.

Table 3.
Summary statistics for the Meguma Supergroup soils assuming a lognormal distribution. Data Log base10 transformed, antilogged values in brackets.

	Mean $_{\text{(Geom. Mean)}}$	Std. Deviation $_{\text{(SD)}}$	CV%
As (ppm) in soil	1.392 (24.66)	0.4218	30.30

This estimate can now be used to estimate the number of samples that might be adequate under the assumption of lognormality. For the normal (arithmetic) examples a 10% tolerance was assumed. For the critical level of the CCME Soil Quality Guideline of 12 ppm, where decision taking is most critical, that results in a ± 1.2 ppm tolerance band. However, for a lognormal distribution the tolerance band converted back to the arithmetic scale the bounds are asymmetric. Thus a 10% tolerance at 12 ppm translates to 9.4 to 15.4 ppm; these could be considered too wide, whereas a 5% tolerance results in bounds of 10.6 and 13.6 ppm. On this basis it would be more appropriate to estimate required sample size for a 5% tolerance level for comparison between the two distributional models. The addition of the result for a 5% tolerance bound for the lognormal model is shown with the classical and robust estimates in Table 4.

From Table 4 it can be argued that a sample size of somewhere between 35 and 43 should be adequate to estimate the statistical properties of the soils overlying the Meguma Supergroup rocks and achieve suitable tolerance levels at the decision-critical CCME Soil Quality Guideline level of 12 ppm As. The selection of a sample size of 40 would satisfy both models, 'epigenetically' contaminated normal-like and lognormal for the As distribution, and lead to reasonable confidence bounds on the estimated mean/median and geometric mean.

Table 4.
Number of soil samples required to achieve a 10% tolerance level for the assumption of a contaminated normal distribution, and a 5% tolerance level for the assumption of lognormality

	$CV_{\text{Classical}}$	CV_{MAD}	CV_{IQR}
Over Meguma (Normal)	328.15	34.54	42.46
Over Meguma (Lognormal)	36.72		

My own bias is to assume that the 'Over Meguma Supergroup' data are drawn from an approximately normal background population that has been contaminated by As from an epigenetic process associated with the formation of the Au-As vein systems in the Meguma host rocks. For that reason I believe the use of a robust statistical procedure is desirable for estimating population statistics, with the median and MAD being the obvious choices.

I argue that Stanley's new procedure can be improved by the application of robust estimators that would better focus on the properties of the background distribution, rather than base a decision on a data set contaminated by outliers from geochemical processes other than background. Clearly the 'outlier' in the sample size estimates, assuming a contaminated normal-like background distribution (Table 2), is that for classical estimation procedures applied to soils overlying Meguma Supergroup rocks. This demonstrates the vulnerability of decisions based on classical statistical procedures when dealing with the reality of natural processes and the presence, in this case, of just one outlier. As Rocke et al. (1982) asked, "Are robust estimators really necessary?", I would answer a loud, "Yes", and think of the amount of time and financial resources that would be saved.

Parting comments

Firstly, the coefficient of variation is a very useful summary statistic, expressing the variability of a data set relative to its central tendency, median or mean, see, for example, the discussion by Koch and Link (1971). During the early days of the National Geochemical Reconnaissance (ca. 1980) it was noted that high non-robustly estimated, i.e. mean and standard deviation based, CVs, >70%, indicated the presence of diverse geochemistry reflecting complex geology and/or the presence of mineral occurrences as the estimates were strongly influenced by positively skewed distributions and outliers. As such, these CVs were useful screening tools for geochemical data subdivided by source lithological unit or some other criterion, identifying areas that deserved additional interpretive attention (Garrett et al. 1980).

Lastly, geochemical data are spatially correlated, samples collected closer together tend to be more geochemically similar than those collected farther apart. Spatial correlation issues fall within the study of regionalized variables and the practice of geostatistics, which I leave to those knowledgable

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How Many Samples Are Enough? continued from page 11

in the art. A recent example of a regional-scale soil study that took regionalized variability into consideration is the work of Grunsky et al. (2010). The impact for those collecting samples from a small area for an environmental study is that the true variance appropriate for the whole extent of a sampled media will likely be underestimated. Therefore, care has to be taken in extrapolating locally generated information to other generally similar areas to estimate just "how many samples should be enough" to satisfactorily sample a larger area. To use a geostatistical term, one should not extrapolate beyond the 'support' that the data in hand provide; which takes us back to where we started, proper sample design planning to meet the objectives of a survey.

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Regional Councillors' Reports

Current Status of Applied Geochemistry Research in Africa

Introduction

Africa hosts about 30% of the planet's mineral reserves, including 40% of Au, 60% of Co and 90% of the world's PGM reserves. Yet, the continent remains grossly underexplored, a fact that can largely be attributed to the lack of analytical capacity as well as a dearth of skilled manpower to effectively run exploration programmes. Efficient application of Applied Geochemistry techniques is also vital in addressing problems of pervasive air-, soil- and water pollution, including solid waste and mine waste water management, and climate change. A few indicators that can be used to assess the status of Africa's analytical capacity as it relates to Applied Geochemistry output, can be given by:

1. The number of research articles appearing in leading Applied Geochemistry journals during the present decade (e.g., Applied Geochemistry; Journal of Geochemical Exploration; Geochemistry: Exploration, Environment, Analysis; Environmental Geochemistry and Health) by authors living and working in Africa (always less than 10% annual turnover);
2. The number of editorial board members of journals such as those referred to in (1) above, who are living and working in Africa (always less than 10% of the total);
3. The number of participants living and working in Africa, who attended key Applied Geochemistry meetings this decade, such as the "AAG Fredericton Conference in June, 2009", "Geoanalysis 2009 in South Africa in September, 2009", and the "Goldschmidt Conferences" (always less than 10%);
4. The number of higher degree graduates in "Applied Geochemistry" from African tertiary institutions (always less than 10% of world total);
5. Participation by African students at international training courses on Applied Geochemistry; and
6. The number of African students who took part in sponsored student paper-prize competitions during this decade.

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Many technicians in African laboratories do not keep abreast with latest analytical techniques and advances in instrumentation owing to poor access- or non-subscription to standard geoanalysis journals such as Spectrochimica Acta, Journal of Analytical Chemistry, Journal of Analytical Atomic Spectroscopy, Analytical Chemistry, that report improvements in these techniques. Few work with internationally certified standard reference materials or take part in proficiency testing schemes such as GeoPT run by the International Association of Geoanalysts, that help keep a check on analytical precision and accuracy, and therefore, often fail to attain the quality assurance level needed for publication of their studies in the more acclaimed analytical journals.

Addressing the Issues

Addressing these issues might involve incorporating compulsory courses on techniques in installation, operation, trouble-shooting and maintenance in all postgraduate courses in Applied Geochemistry and related disciplines.

Note that some high quality Applied Geochemistry activities are not taking place within the region; however, such studies (especially their analytical components) are often pursued with collaborating institutions mainly in Europe and North America. In spite of severe funding constraints and unfavourable national priority considerations, a few African countries (e.g. South Africa, Botswana, Morocco and Nigeria) have made some progress with the African Geochemical Database Project (part of the former IGCP 259 Project); however, little attention is paid by some to adoption of the agreed sampling procedures and analytical protocols set forth in the original recommendations of Darnley et al. (1995).

The Council for Geoscience of South Africa (CGS) has been conducting a high-density regional geochemical mapping programme since 1973. As of 1998, a total area of 295,000 km2 (25% of the surface area of South Africa) had been covered at a sampling density of 1 sample per km2 using helicopter surveys (Lombard et al., 1999). The number of samples has since (by early 2010) risen to 360,000.

Early in 2010, the CGS also reported active involvement in several international geochemical mapping contracts in Africa, with projects in Gabon, Ghana, Madagascar, Morocco and Lesotho (http://www.geoscience.org.za). Helicopter sampling is mainly carried out in the winter months, using helicopter as the main means of transport for sample collection. Follow-up sampling is done by vehicle or foot, with sampling density varying according to specific needs and purposes. The United States Geological Survey is engaged in geological and geochemical mapping in several areas of Morocco (http://international.usgs.gov/regional/).

The Federal Government of Nigeria, on July 22, this year (2010), launched the field proceedings manual for the Geochemical Mapping Technical Assistance Project of Nigeria (GMTAP). The project which actually commenced in 2007, consists of 44 cells in the Global Reference Network (GRN). Preliminary results have been obtained from cell NO6EO4 of southwestern Nigeria (Ogedengbe, 2008). The programme is intended to generate high quality environmental geochemical baseline data from sampling of stream water, stream sediments and residual soil, that would boost mineral exploration efforts as well as find applications in agriculture, public health issues and land use planning.This programme is supported by the World Bank, and is being undertaken by the Nigerian Geological Survey (NGSA), in collaboration with the British Geological Survey (BGS) and the Geological Survey of Finland (GTK).

Some exploration geochemistry is still carried out by major mining companies, but the results are not usually published. These results, though good enough for mineral exploration purposes, often do not meet international quality assurance standards. For these companies, relative variations in element content are (understandably) more important (for detection of anomalous values) than absolute, accurate element concentrations, so important for studies in other applied aspects such as Environmental Geochemistry and Medical Geology. A few reputable international analytical laboratories (e.g., African Minerals Standards (AMIS)) have branches in South Africa, but these laboratories serve mainly explorationists, miners and metallurgists, and not the academic research community.

The University of Western Cape, South Africa is one of very few southern African institutions, tertiary or

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otherwise, that offer a programme in Applied Geology (Exploration Geochemistry). Reasonable research infrastructure and laboratory facilities in the Department of Earth Sciences exist, and include XRF, AAS and GFAAS facilities. However, students seem to be unaware of the existence of, or membership opportunities at, institutions such as the Association of Applied Geochemists, the Geochemical Society, the International Association of Geoanalysts, the International Association of GeoChemistry, the Society for Environmental Geochemistry and Health and the International Medical Geology Association.

The Department of Geological Sciences at the University of Cape Town is more research-oriented, and one of the few departments that maintain a number of world class analytical facilities including ICP-MS, Electron Microprobe and an XRD unit. A Radiogenic Isotope Facility (RIF) has provided a geochronological and tracer capability for the southern Africa Earth Science community since 1988.

Some Recent and Forthcoming Applied Geochemistry Activities

- 27 - 29 July, 2004. In preparation for reconnaissance surveys of the proposed East African Geochemical Mapping Project (www.medicalgeology.org/PDF/news14-p6-10.pdf), a 'Geochemical Workshop and Field Training Course' was convened and conducted by the Geological Survey of Tanzania (GST) under the leadership of Prof. Reijo Salminen of Finland. The 'Workshop and Training Course' was held at the GST Dodoma headquarters and environs; www.iagc.ca/tanz%20.pdf;
- September 10 -14, 2007. The 'Seventh International Symposium on Applied Isotope Geochemistry', University of Stellenbosch, South Africa, examined the use of isotopes to understand a wide variety of problems; www.elementsmagazine.org/archives/e4_2/e4_2_dep_meetingreports.pdf;
- January 19 - 23, 2009. A preparatory workshop on the Geochemical Mapping Project of Nigeria was conducted in Kaduna, northern Nigeria, by the BGS, GTK and NGSA; http://www.bgs.ac.uk/research/highlights/nigeriaGeochemicalMappingWorkshop.html ;
- September 7 - 11, 2009: The 'Triennial Geoanalysis Conference' in the Drakensberg region, KwaZulu Natal, South Africa, had as its core theme, "Earth, Industry and Environment"; http://geoanalysis2009.org.za;
- October 19 - 23, 2009: The 'International Mine Water Conference' in Pretoria, South Africa, was organized by the Water Institution of South Africa and the International Mine Water Association. The Conference looked at significant South African developments in the fields of mine water treatment and management; www.wisa.org.za/minewater2009htm;
- October 11 - 14, 2010: The 'Fourth SAIMM International Platinum Conference', Sun City, South Africa; The conference will cover all aspects, from exploration, feasibility studies, mine development, mining, metallurgy, customers and customer demands, to recycling and interaction with society; www.platinum.org.za/Pt2010/- ;
- November 8 - 9, 2010: The conference on 'Bio- and Hydrometallurgy '10', in Cape Town, South Africa will focus on: Hydrometallurgy (leaching, solvent extraction and ion-exchange); and Biotechnology (development and uses of micro-organisms and other biological agents in hydrometallurgy, flotation, solid-liquid separation, remediation, etc.); www.min-eng.com/biohydromet10/.

Summary

Africa holds perhaps the greatest promise for the successful application of Applied Geochemistry methods and techniques, given that development of its huge mineral resources endowment potential, and solution to the myriad of problems created by the continent's unique geoenvironmental circumstances, rely heavily on the efficient application of such procedures.

The rate of application of modern methods and techniques in Applied Geochemistry has been impeded by the relative unavailability of state-of-the art analytical instrumentation, but even more so, by the virtual non-existence of a sufficient number of highly skilled technical personnel able to install, operate, trouble-shoot and maintain these items of equipment. These problems could in some cases (as in many countries of West Africa) be compounded by the frequent unavailability of basic operating facilities such as, constant electricity supply, clean running water, dust-free environment, and difficulty in acquisition of accessories and spare parts, including analytical reagents and rock and mineral standards (international reference materials) for quality assurance testing.

In order to attain improved analytical protocols and quality assurance levels, it is recommended that all graduate students in Applied Geochemistry or allied disciplines, intending to work in Africa be offered specialised training in installation, operation, trouble-shooting and maintenance of analytical equipment pertinent to their area of study. Graduate students of Applied Geochemistry and their laboratory technicians, mineral explorationists and practitioners of allied disciplines should be encouraged to become active members of the key Applied Geochemistry bodies, which, through their publications expose members to latest innovations and techniques as well as improved opportunities for conference attendance and participation at training courses.

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Regional Councillor Report For Chile

As common knowledge states, "no news is good news". It has been quite a while since this regional councilor has provided an update of happenings in geochemistry in Chile, my apologies to all. As I am sure in most of the world as here, mining exploration activities have been extremely active lately, "time" most likely today is one of the most precious and scarce commodities. The good news is there is no shortage of work around this corner of the world, the problem, barely sufficient time to do it all. Having recently finished project AMIRA P778 Predictive Geochemistry in Areas of Transported Overburden, a joint CSIRO – University of Chile effort, I am happy to mention that results regarding the comprehension of processes of development of geochemical contrast anomalies from buried ore deposits at surface through transported overburden indicate important advancements, in particular on the understanding of ore rock oxidizing processes at source (chemical and microbial), groundwater – ore rock interaction, metal dispersion processes in ground water and mechanisms of transport from source to surface. An important effort was also placed on the understanding of regolith and landscape evolution in northern Chile and the specific geochemical signatures produced by these land forming processes. These studies were aimed at discriminating surface geochemical signatures from those resulting from dispersion processes from ore deposits beneath cover. Results of project AMIRA P778 are currently confidential.

Another AMIRA project in Chile is currently on-going, being carried out by the University of Concepción. Project AMIRA P972 Mineral Chemistry Applied to Exploration of Ore Deposits, is aimed at the development of cost-effective mineral chemistry tools in the understanding of mineralizing systems and how these tools can be applied to determination of hydrothermal vectors to ore zones. This project has collaboration from CSIRO, Aarhus University and University of Oklahoma.

In other topics, major efforts have been placed on geochemistry applied to geothermal exploration and evaluation, a center for geothermal energy research having been formed at the Department of Geology of the University of Chile. In mining, the recent creation of the Advanced Mining Technology Center (AMTC) at the Faculty of Physics and Mathematical Sciences of the University of Chile is among some of the important efforts in mining related research. This center was formed by the departments of Electrical, Mining and Civil engineering, and the departments of Geology and Geophysics, covering research areas in automatization, mineral characterization, ore resource evaluation, geostatistics, hydro resources, sustainable development and mineral exploration. The AMTC is in its first year, funding allocated for a total of 5 years.

Other areas of research and development include environmental geochemistry, carried out at the Catholic University of the North, University of La Serena, University of Concepción and more recently, here at the University of Chile. At the University of Chile three new academics are being hired, aimed at developing research and education in hydro resource topics, including hydrogeochemistry. Research in geochemistry and mineral characterization has also opened new areas in our department, including archaeology, chemical and particulate contamination associated to mining and smelter activity, geomineralmetallurgy, applications to the wine industry, among many other topics.

All in all, earth sciences are currently among the hot topics in Chile. Nature, through unfortunate events, has moved public consciousness to better understand natural events such as the most recent 8.8 Richter scale earthquake of south-central Chile, previous to this, the Chaiten volcano, and most recently, the entrapment of 33 miners at a depth of 700 m in the San José Mine (now successfully rescued), near Copiapó. These events have placed geologists in the public eye, and have had impact in government public policies, research deemed most important in a country that economically depends on its natural resources, and that is naturally exposed to seismic and volcanic risk, among others. Plenty of work and insufficient human resources are the main preoccupation at present. Recent press articles indicate that in the mining industry alone, within the next 5 years, a total deficit of over 12,000 workers is expected. Pressure for more research and education is very high, meeting demand from industry a hard task at present.

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Current Status of Applied Geochemistry Research in Europe

The EuroGeoSurveys Geochemistry Expert Group, which has succeeded the FOREGS Geochemistry Group, is presently carrying out two large projects, the Geochemistry of European Agricultural and Grazing Land Soil (GEMAS) and Urban Geochemistry (URGE) that will keep the group busy for the next 3-year period, and has just completed a project on European groundwater geochemistry using bottled water. The results of this project have been published in 2010 as an Atlas (C. Reimann and μ. Birke (Eds) + 79 others, Geochemistry of European Bottled Water, Borntraeger Science Publishers. Stuttgart. ISBN 978-3-443-01067-6, 268 p.) and country interpretations are in the process of being published in a Special Issue of the Journal of Geochemical Exploration (Mineral waters of Europe, Birke M., Demetrides A. and De Vivo B., Eds). The latter volume will include 15 contributions from national teams of Croatia, Serbia, Slovenia (2), Greece (2), Slovakia, Hungary, Italy (2), Fennoscandia, Germany (2), Portugal and Estonia. At present the Group is setting up its own website that will introduce the projects and activities to the broader public.

Other activities of the EuroGeoSurveys Geochemistry Expert Group for the period 2010-2013, include: (a) publication of a book on urban geochemistry studies in early 2011 (Johnson et al., Mapping the Chemical Environment of Urban Areas – Wiley); (b) data elaboration and publication of GEMAS project results;, and (c) publication of new results of the Geochemical Atlas of Europe project. It is noted, because of industry restrictions, the GEMAS Atlas will be published in 2013.

The URGE project is carried out by a sub-group of the Geochemistry Expert Group led by Rolf Tore Ottesen of NGU. The aim of the URGE project is to carry out urban geochemical mapping of 10 to12 European cities using a common sampling and analytical protocol, so that results are directly comparable across the continent. We expect that sampling can be carried out during 2011 and all analytical results will be available in 2012, which would result in "final reporting" around the end of 2012 or beginning of 2013.

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Regional Councillor report from China

In China research and exploration activities has centred on the following large projects, China Geochemical Baselines, Multi-purpose Geochemical Mapping, Geochemical Exploration and Assessment for Mineral Resources in Remote Landscape Terrains of China, Geochemical Mapping across the Boundary Regions of China and Mongolia.

China Geochemical Baselines

China Geochemical Baselines Networks Project (CGBP) was launched in 2008 and a 5-year term from 2008 to 2012 was designed for covering the whole China mainland. The project is to provide China nationwide geochemical baseline data, spatial distribution and evolution of all elements, and finally to establish a holistic "China Digital Element Earth". Approximately 1500 CGB grids cover the whole China mainland (9.6 millions km2). Each CGB grid is approximately equal to a quarter of one Global Reference Network (GRN) grid. A total of 6000 soil (overbank/floodplain) samples and 10,000 typical rock samples will be collected in the whole China. Nearly all elements except gases in the periodic table will be determined. Half of China has been covered in the past two years. It is expected to publish all data and an atlas in 2013. Prof. Xie Xuejing is the Steering committee Chairman, Professor Xueqiu Wang is the project leader.

Multi-purpose Geochemical Mapping

The RGNR' project, which has bee carried out for 32 years, mainly covered hilly and mountainous regions. The eastern China with urban and developed agricultural regions was not covered by the project. Thus a new project named Multi-purpose Geochemical Mapping project focusing on environmental quality assessment, land use planning and geochemical hazards was jointly initiated since 2002 under the China Geological Survey and provincial governments. Soils are taken as the key sampling media. Lake sediment, water and vegetables (crops) are collected in some regions. Fifty-two elements and organic carbon and pH were determined. It is expected to cover most of the Quaternary plain land of China in ten years. An area of 1.5 millions km2 has been covered till 2009.

Geochemical Exploration and Assessment for Mineral Resources in Remote Landscape Terrains of China

The project is to develop geochemical knowledge and methods for remote landscape regions, which are under-ex-

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plored terrains, such as arid desert terrains, forests and grass land and tundra.

Geochemical Mapping across the Boundary Regions of China and Mongolia

China is cooperating with Mongolia in geochemical mapping at a scale of 1:1 million covering an area of approximately one million km2 across two countries. The project was launched in 2008 under the agreement issued by the China Geological Survey and Mineral Resources and Petroleum Authority of Mongolia. The Institute of Geophysical and Geochemical Exploration will offer help with sampling training and free chemical analysis for the samples from Mongolia. An area of 500 000 km2 have been covered with one sample per 100km2 till September, 2010. Fifty-four elements are determined for each sample. It is expected that the geochemical atlas will be published in 2011.

The 3rd China National Applied Geochemistry Symposium

The 3rd China National Applied Geochemistry Symposium will take place in Guangzhou, southern China, December 2010.

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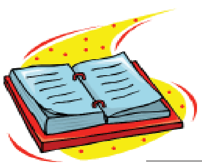

CALENDAR OF EVENTS

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. Please let us know of your events by sending details to:
Steve Amor, Geological Survey of Newfoundland and Labrador, P.O. Box 8700, St. John's NL Canada, A1B 4J6, Email: StephenAmor@gov.nl.ca, phone: 709-729-1161

2010

5- 10 December 2010. Northwest Mining Association 115th Annual Meeting Exposition and Short Courses, Spokane WA USA. Website: www.nwma.orgconvention.asp

8-11 December 2010. 11th European meeting on Environmental Chemistry, Portorož Slovenia. Website: www.ung.si/~emec11

28-30 December 2010. International Conference on Biology, Environment and Chemistry. Hong Kong, China. Website: www.icbec.org

2011

4-8 January 2011. Google Earth: Visualizing the Possibilities for Geoscience Education and Research. Mountain View CA USA. Website: www.geosociety.org/penrose/10google.htm

5-7 January 2011. Ore Giants of Asia (Centre for Russian and Central EurAsian Mineral Studies). London UK. Website: http://tinyurl.com/26lbo8t

8-14 January 2011. 23rd Colloquium of African Geology, Johannesburg South Africa. Website: www.cag23.co.za

24- 27 January 2011. Mineral Exploration Roundup 2011, Vancouver BC Canada. Website: www.amebc.ca/roundup/Roundup-2011.aspx

24-27 January 2011. AGU Chapman Conference on Source to Sink Systems Around the World and Through Time. Oxnard CA USA. Website: www.agu.org/meetings/chapman/2011/acall/

30 January-4 February 2011. Gordon Research Conference: Geobiology. Ventura CA USA. Website: http://tinyurl.com/284x779

6- 9 February 2011. Environmental Health 2011: Resetting Our Priorities. Salvador Brazil. Website: www.environmentalhealthconference.com/

25 February 2011. 4th Annual Washington DC Focused Ion Beam User Group Meeting. Johns Hopkins University MD US. Website: http://tinyurl.com/2bxsad5

6-9 March 2011. Prospectors and Developers Association of Canada. Annual Convention, Toronto ON Canada. Website: www.pdac.ca/pdac/conv

7-11 March 2011. 42nd Lunar and Planetary Science Conference, Woodlands TX USA. Website: www.lpi.usra.edu/meetings/lpsc2011

10-11 March 2011. Linking Geovisualization with Spatial Analysis and Modelling. Hamburg Germany. Website: www.geomatik-hamburg.de/geoviz/

21-24 March 2011. Conference on Mathematical and Computational Issues in the Geosciences. Long Beach CA USA. Website: www.siam.org/meetings/gs11/

3- 8 April 2011. General Assembly of the European Geosciences Union. Vienna Austria. Website: http://meetings.copernicus.org/egu2011

10-13 April 2011. 28th European Conference of the Society for Environmental Geochemistry and Health. Ormskirk UK. Website: www.edgehill.ac.uk/segh2011

13-15 April 2011. Earth Observation of Global Change. Munich Germany. Website: www.eogc2011.tum.de/

2-6 May 2011. Congreso Geologico Argentino, Neuquen Argentina. Website: www.congresogeologico.org.ar

15-19 May 2011. 12th European Workshop on Modern Developments and Applications in Microbeam Analysis. Angers France. Website: http://tinyurl.com/3x6tzzr

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25-27 May 2011. GAC/MAC Annual Meeting, Ottawa ON Canada. Website: www.gacmacottawa2011.ca

29-30 May 2011. GIA Symposium 2011: Advancing the Science and Business of Gems. Carlsbad CA US. Website: www.gia.edu/symposium2011/

5-10 June 2011. Gordon Research Conference: Interior of the Earth, South Hadley MA USA. Website: http://tinyurl.com/2598ze4

20-24 June 2011. Frontiers in Environmental Geoscience 2011, Aberystwyth Wales UK. Website: http://tinyurl.com/yhyxllj

28 June-7 July 2011. XXV IUGG General Assembly: Earth on the Edge: Science for a Sustainable Planet, Melbourne Australia. Website: www.iugg2011.com

4- 9 July 2011. Seventh Hutton Symposium on Granites and Related Rocks, Avila Spain. Website: www.seventh-hutton.org

10-15 July 2011. Catchment Science: Interactions of Hydrology, Biology & Geochemistry. Lewiston ME USA. Website: http://tinyurl.com/35vxvuy

20-27 July 2011. International Union for Quaternary Research (INQUA) XXVIII Congress, Bern Switzerland. Website: www.inqua.tcd.ie/congress.html

24-29 July 2011. 10th International Conference on Mercury as a Global Pollutant, Halifax NS. Website: Canada. http://mercury2011.org

25-27 July 2011. 6th International Conference on the Impact of Environmental Factors on Health, Riga Latvia. Website: http://tinyurl.com/2ayqw2j

1-5 August 2011. 10th ICAM International Congress for Applied Mineralogy, Trondheim Norway. Website: www.icam2011.org

6-9 August 2011. 9th International Eclogite Conference, Tepla Czech Republic. Website: http://tinyurl.com/29oaxrk

14-19 August 2011. Goldschmidt 2011, Prague Czech Republic. Website: www.goldschmidt2011.orgindex

22-26 August 2011. 25th International Applied Geochemistry Symposium, Rovaniemi Finland. Website: www.iags2011.fi

4-7 September 2011. 7th European Conference on Mineralogy and Spectroscopy. Potsdam Germany. Website: http://www.physchemgeo.com/ECMS/

20-24 September 2011. GEOMED2011 - 4th Hemispheric Conference on Medical Geology, Bari Italy. Website: www.geomed2011.it

9-12 October 2011. GSA 2011 Annual Meeting, Minneapolis MN USA. Website: www.geosociety.orgmeetings/2011/index.htm

1-3 November 2011. 8th Fennoscandian Exploration and Mining, Levi Finland. Website: http://fem.lappi.fi/en

21-24 November 2011. Conference on Arsenic in Groundwater in Southern Asia, Hanoi Vietnam. Website: http://tinyurl.com/y3jf9vh

2012

6-11 February 2012. 10th International Kimberlite Conference, Bangalore India. Website: http://10ikcbangalore.com

27-29 May 2012. GAC/MAC Annual Meeting, St. Johns NL Canada. Website: www.stjohns2012.ca

2-8 June 2012. 11th International & 2nd North American Symposium on Landslides. Banff AB Canada. Website: www.isl-nasl2012.ca/

24-29 June 2012. Goldschmidt 2012. Montréal QC Canada. www.goldschmidt2012.org/

5-15 August 2012. 34th International Geological Congress, Brisbane Australia. Website: www.34igc.org

17- 20 September 2012. Geoanalysis 2012, Buzios Brazil. Website: www.ige.unicamp.br/geoanalysis2012

Indicator Mineral Research in the Pine Point Pb-Zn District, Canada

The 24 hours of daylight, the isolation, and the constant buzz of mosquitoes and horseflies quarrelling over the last remaining real estate on my skin, and roaming black bears might be considered nuisances when conducting fieldwork, but to those who are familiar with working in the northern Boreal Forest of Canada, they are part of the charm. This past summer, I grabbed a can of insect repellent and headed north to the Pine Point Mining District, on the southern shore of Great Slave Lake, Northwest Territories, with the Geological Survey of Canada and the University of Alberta to start work on a M.Sc. project under the supervision of Sarah Gleeson, Roger Paulen and Beth McClenaghan. The purpose of this project is to document the indicator mineral and geochemical signatures of the Pine Point Mississippi Valley-Type (MVT) Pb-Zn deposits in glacial sediments down-ice.

During July 2010, we collected 26 till and 54 bedrock samples and measured glacial striations on the shoulders of open pits on the mine property. Waste rock piles and open pits were also scavenged for exceptional crystal specimens. After a reconnaissance of all the open pits, a detailed sampling program was carried out at Pit O-28. This pit was chosen because mineralization sub-cropped, striated outcrops provide detailed ice flow information, till cover was of moderate thickness (~6m) and undisturbed in pit walls, no known ore bodies occur directly up-ice and the sample sites were accessible via an exciting and adventurous ATV trail. Till samples, weighing approximately 18-22 kg each, were collected from exposed sections surrounding the open pit and from undisturbed deposits on the bedrock surface. A second field season is planned for July 2011 to collect additional till samples and to further document the distribution of the surficial sediments. I intend to stock up on insect repellent and bear pepper spray for next summer!

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Here I am (at right) collecting a till sample on the exposed shoulder of Pit O-28 with (left) Dr. Sarah Gleeson (University of Alberta) and (background) Wolf Schleiss (Tamerlane Ventures Limited). Care is taken to observe the texture and properties of the basal till, to avoid anthropogenic contamination.

It is difficult to contain my excitement as I collect giant calcite spar crystals from a waste rock pile.

RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 149. 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**.

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Minutes of the 2010 Annual General Meeting of the Association of Applied Geochemists

held by telephone conference April 22, 2010

I. Call to Order – Establishment of Quorum

President Morris called the Annual General Meeting (AGM) to order at approximately 4:00 PM MDT. Sixteen AAG Fellows were present on the telephone conference and an additional three Fellows had given their proxy to either President Morris or Secretary Smith. The required number of Fellows for an AGM is 15.

II. Discussion and approval of 2009 AGM minutes

The minutes for the 2009 AGM were published in EXPLORE #144 (September 2009). No corrections or additions were noted

It was moved (E. Bailey) and seconded (D. Smith) that the minutes of the 2009 AAG Annual General Meeting be accepted. President Morris asked for a vote on the motion and it was passed unanimously.

III. President's report (P. Morris)

President Morris distributed his report by email prior to the AGM and it is shown below:

I take this opportunity to thank the AAG for the opportunity of presiding over the Association for 2010 and 2011, and also the outgoing President, David Cohen, for his two years of stewardship.

Even though there are biennial changes in the presidency of the AAG, the ongoing running of the Association has been well looked after by a group of applied geochemists who have been long standing members of the association. Looking through the AAG councilors over the past ten years or so, several have had more than one stint. Their ongoing contribution is greatly valued, and it's good to see that late in 2009, some new councilors were added to the Association.

Over the next few months, I'm hoping that AAG can take a more active role in supporting applied geochemistry students. A key part of new proposals in this area is to get industry more involved, and the success of this approach will rely not only on initiatives being driven by Council, but also by contributions from AAG membership in terms of twisting employers' arms to donate either cash or in-kind support to worthy students. After all, applied geochemistry students are the new members of AAG, and the next generation of explorers, environmental scientists and teachers.

For most members, the tangible aspects of AAG are its publications, the website, and the biennial symposia. I'd like to thank the ongoing contribution of Beth McClenaghan (EXPLORE), Gwendy Hall (GEEA) and Bob Eppinger for driving the print and electronic media along, and Pertti Sarala and his group in Finland for organising what looks like an exciting symposium in Rovaniemi in August 2011. Contributions from AAG members keep all these going — papers for EXPLORE and GEEA, news for the website, and attendance at IAGS meetings.

Less visible but as important contributions to AAG are made on almost a daily basis by Betty Arsenault in the AAG office, and Dave Smith, whose encyclopedic knowledge of AEG and AAG comes from a long and committed relationship with the Association.

IV. Secretary's report (D. Smith)

D. Smith pointed out that all the minutes from AAG Council meetings are on the Association's web site in the Members section. Any AAG member who wishes to keep up with the issues being discussed by Council will find this a useful resource.

V. Treasurer's Report (G. Hall)

G. Hall distributed the Treasurer's Report by email prior to the meeting, and it is shown below:

At the end of Dec. 2008 our TD investments account stood at $397,324 and one year later it was an astounding $456,413, thanks to the diligence and financial savvy of Eion Cameron. Eion's focus in 2009 has been on purchasing income-generating stocks and this is now netting the AAG in the order of $1100 per month; his strategy of late has been on capital gains. Eion clearly spends a lot of time regularly adjusting our portfolio and can easily carry out ~ 6 transactions a month, one recently a sell of a garbage company locking in a gain of 65%! Our CIBC current accounts at the end of 2009 were Cdn $27,964 and US $53,646.

Included in our liability/commitment column is $13,507 for Developing Country subscriptions and $19,127 for the Alan Coope/ Scholarship fund. In 2009 we transferred $10,000 US to Finland as seed money for the 25th IAGS.

In the last few months of 2009 we had a 'falling-out' with our auditors, McCay Duff. Essentially the basis was threefold: a lack of clarity in their report items, a 'tone' in their correspondence, and a view of the AAG as if it was a substantially sized company. Mutually we agreed to bring our business to an end. The AAG executive agreed in Jan 2010 to establish an interim measure, for 2009, working with Michael Strauss, an accountant who prepares our US IR statement. He is now reviewing bank statements and supporting information from our internal financial statements as well as from the 2008 audit and will prepare and issue a detailed letter to the Association of his findings. This should fulfill our obligations until we find another auditor. We have still not received a financial report for the 24th IAGS in Fredericton.

It was moved (G. Hall) and seconded (R. Bowell) that AAG use Michael Strauss as an auditor for AAG for the 2009 auditing process. President Morris asked for a vote on this motion and it passed unanimously.

VI. GEEA (G. Hall)

G. Hall submitted the GEEA report by email prior to the meeting and it is shown below:

This has been a year of much change for the journal! We said good bye to two people: Marcia Scrimgeour who ran our GEEA office in Ottawa, Canada; and Sally Oberst, our copy editor at GSPH in Bath, UK. A huge vote of thanks and appreciation for all their work to Marcia and Sally! Marcia kindly stayed on for several months last summer while she handed over the files to me and then we closed the Ottawa office. This coincided with the initiation of our fully electron-

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EXPLORE

Newsletter No. 149 DECEMBER 2010

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EXPLORE Publication Schedule

Quarterly newsletters in March, June, September, December

Deadlines for submission of articles or advertisements:
March newsletter: January 15
June newsletter: April 15
September newsletter: July 15
December newsletter: October 15

Information for Contributors

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

Submissions should be sent to:
Beth McClenaghan, Geological Survey of Canada, 601 Booth Street, Ottawa, ON, CANADA K1A 0E8 Email: bmcclena@nrcan.gc.ca

LIST OF ADVERTISERS

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ic submission and processing system via Allentrack. Though we did endure teething problems for the first few months, and are still experiencing a few hiccups now and then, the transition was certainly worth it. It is so much easier to keep track of the status of each paper and the costs of mailing are negated (I was shocked last summer when I had to send a large marked-up copy after review to Australia: $~65!). Now the GEEA office is a virtual one, run by myself and Sally's replacement in Bath, Jessica Pollitt. There are emails flying back and forth on a daily basis and it is working very well.

More changes are required: our website needs updating and the Editorial Board needs some new blood. These are in the works. Our Impact Factor is still languishing at 0.3; we need some review papers to increase the citations, any volunteers? Our downloads for 2009 are actually quite encouraging: 14,323 full text and 83,587 abstracts.

We had a lot of copy in 2009 and are now decreasing the backlog of papers. The 2009 issues comprised mostly regular papers and those from the 23rd IAGS. Given the number of presentations at the 24th IAGS, the number of papers submitted (barely an issue) was very disappointing. I think a major reason for this was the requirement of extended abstracts at that meeting: many authors, especially since the GEEA format had been requested, were under the impression that these abstracts would be published in GEEA as 'mini-papers' and did not have the time or inclination to write a full paper once the confusion was cleared up.

Thanks to lower operating costs and being sold in bundles via the Lyell Collection and GeoScienceWorld, GEEA has cleared a profit of £16,187!! Half of this is the AAG's.

Many thanks to those who sent in pictures for the front cover of GEEA. This year, 2010, we are using one from Boudewijn de Smeth: a 3D view of a hyperspectral image draped over a dtm of the Rodalquilar epithermal gold deposit, a radical departure from our usual scenic ones.

VII. EXPLORE (B. McClenaghan)

B. McClenaghan submitted her report by email prior to the meeting and it is shown below:

Explore 146 (June issue) is in the final stage of preparation and will be mailed out June 1. It will include a technical article on digital field data capture. Content is booked for the September and December issues of EXPLORE. In addition to the long standing 4 corporate sponsors for EXPLORE (Actlabs, ALS Chemex, SGS and Geosoft), we have a new one for 2010, Innov-X Systems Inc. Thank you to Paul Morris for securing this new sponsor. The EXPLORE Business Manager, Sarah Lincoln, is on maternity leave for 2010. She gave birth to a baby girl in January. While on leave from work, she will continue to look after EXPLORE financial matters.

VIII. Other business

No additional business items were raised.

IX. Adjournment

President Morris thanked all attendees for their participation and declared the 2010 Annual General Meeting adjourned at approxmately 4:23 PM MDT.