EXPLORE
NUMBER 143 JUNE 2009
Newsletter for the Association of Applied Geochemists

President's Message

David Cohen

This edition of **EXPLORE** should be arriving on your desk following a very successful 24th IAGS in Fredericton. Planning is now well under way for the 25th IAGS in Finland in 2011 and for AAG involvement in organisation of the next IGC in Brisbane in 2012.

I congratulate Jorge Benavides on winning the 2007/08 AAG student paper competition, sponsored by SGS, based on his PhD studies at Queen's. I also congratulate Gerry Govett on being awarded the Gold Medal of the AAG and Dave Smith the Silver Medal of the AAG.

Following an extended period of negotiations with Revenue Canada we are still battling to have donors to the Distinguished Applied Geochemist Fund able to claim tax deductibility. The area of contention, and current grounds of rejection, has been whether AAG's purposes extend much beyond education, as we have applied for the AAG to carry the charitable entity status. Education is the essence and the main activity of the AAG, through its conferences, GEEA, **EXPLORE** and support of students. Other options are being considered and the executive is examining minor potential changes to the objectives of the corporation so as to remove the implication that the AAG is also engaged in providing professional benefits to its members beyond education in its broadest legitimate definition. The discipline of applied geochemistry can be fostered but not the profession of applied geochemistry.

Council has approved some reorganisation of the committee structure, involving devolution of much of the roles of the formal committees to convenors and a reduction in the number of committees to provide better alignment with the core areas of activity of the AAG.

One final note about a member of our Association, Mike Leggo has also been elected as the president of the Australian Geoscience Council for a two year term.

David Cohen
President, AAG

The GOPE 25 Kimberlite Discovery, Botswana, Predicated on Four Mg-Ilmenite Grains from Reconnaissance Soil Samples: A Case History

Falconbridge Limited discovered 62 kimberlites in four fields in Botswana between 1978 and 1982 (Fig. 1). Its discovery of the Tsabong and Kokong kimberlite fields in 1978 resulted from follow-up of several regional surface kimberlite indicator mineral ("KIM") anomalies, identified by DeBeers and referenced in a 1976 publication (Baldock et al. 1976). KIM anomalies revealed by Falconbridge's large 1980 Central Kalahari reconnaissance soil sampling program led to Falconbridge's Kikau-Khutse discoveries and to the economically significant Gope 25 kimberlite discovery in 1981. During the Botswana program, the authors were part of Falconbridge's senior Southern African exploration management team. The team was headed by Chris Jennings (Fig. 2), *(see page 2)* who after leaving Falconbridge played a role in the discovery of numerous other kimberlites world-wide, including the Diavik Mine kimberlites in Canada. Chris Jennings was optimistic about Botswana's diamond potential as the Orapa and Jwaneng mines (now owned by Debswana Diamond Company) are two of the largest and most profitable diamond mines in the world, accounting for a quarter of global gem diamond production. Following Falconbridge's initial kimberlite discoveries, John Gurney was retained as a consultant (Gurney et al. 1993) and, inter alia, supervised a landmark collaborative KIM geochemistry research program, involving work on samples

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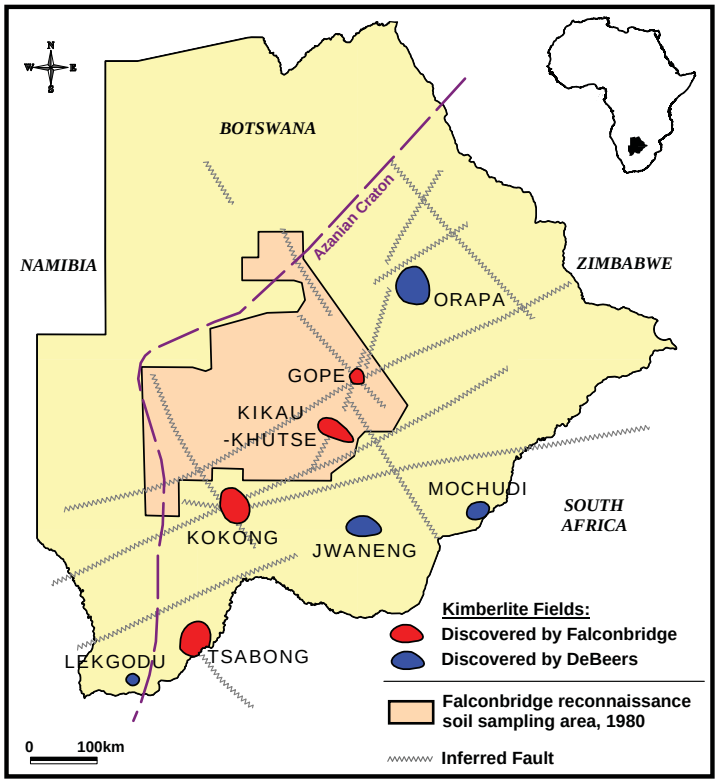

Figure 1. Botswana, 1982. Falconbridge made the first Tsabong and Kokong kimberlite discoveries in 1978. The 1980 Central Kalahari reconnaissance soil sampling program resulted in Falconbridge's Gope and Kikau-Khutse kimberlite discoveries in 1981.

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Figure 2. Botswana Diamond Exploration Meeting, 1978 (Tsabong). Front: Dave Fielding, Mike Waldman, Richard Fynn, Debbie Caskey*, Andy Moore, John Blaine, Ash Clarke (hat), John Gurney# (hat)Back: John Harris, Hugo Dummett*, John Lee, Roger Billington, Chris Jennings (hat), Nick de Bever (All Falconbridge staff, except: *Superior Oil, #Consultant).*

from a large number of barren to highly diamondiferous kimberlites.

The four kimberlite fields discovered by Falconbridge, and the Orapa and Lekgodu kimberlites, are some of the alkaline volcanic pipe concentrations that define a major NE-SW trending lineament extending from South Africa to Zambia (Moore et al. 2008). Kimberlites in central and southern Botswana are covered by Tertiary age Kalahari Group sand, which is sometimes more than 100 m thick. KIM are believed to have been transported to the present flat-lying, semi-arid land surface through the largely unconsolidated sand cover by means of bioturbation, mainly by termites (Lock 1985). Falconbridge conducted the first aeromagnetic surveys over the Tsabong and Kokong kimberlite fields and these surveys detected many of the 55 kimberlites it discovered there. These included the Tsabong M-1 kimberlite pipe (Daniels et al. 1991) that, with an area of 180 hectares, is one of the world's largest known kimberlites. Soil sampling techniques were developed in these areas and soil samples were processed in a dedicated

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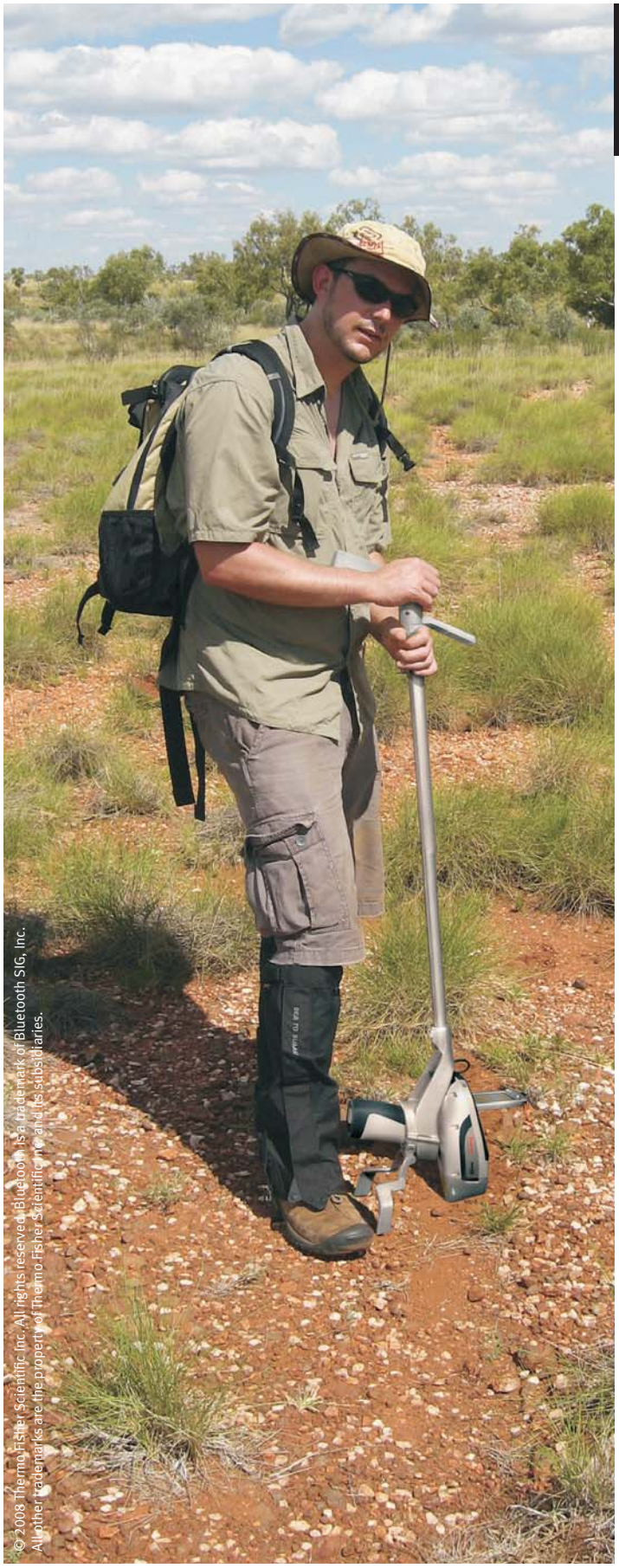
Notes from the Editor

The June issue of **EXPLORE** (No. 143) includes one technical article written by John Lee, Chris Jennings and John Blaine describing Falconbridge's diamond exploration activities in Botswana between 1978 and 1982. Scientific and technical editing assistance for this **EXPLORE** issue was provided by Tom Nowicki, Mineral Services Canada Inc., Steve Amor, Geological Survey of Newfoundland and Labrador and Scott Robinson, Geological Survey of Canada.

Steve Amor has kindly taken on the responsibility for compiling the **EXPLORE** events list. Please send all notices to Steve. Coming in the September (No. 144) issue of **EXPLORE** will be reviews of the 24th IAGS Symposium in Fredericton, Canada. Members are encouraged to submit photos of the Fredericton events, workshops and field trips to **EXPLORE** for this next issue. The deadline for submitting material to the Editor about the IAGS Symposium is July 15, 2009. See you in Fredericton!

Beth McClenaghan



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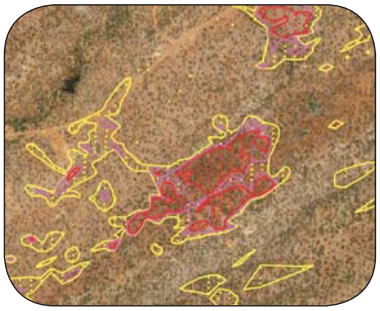

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The GOPE 25 Kimberlite Discovery, Botswana... continued from page 2

Falconbridge heavy mineral laboratory in Gaborone, Botswana. The significance of distinct Mg-ilmenite chemical signatures was soon recognized (Lee 1993) and the relevant exploration techniques, later critical in the discovery of the Gope 25 kimberlite, were developed in-house. The introduction of rotary reverse circulation drilling, conducted by SDS Drilling of Calgary (with Canadian drillers), resulted in much quicker and more effective drill evaluation of kimberlite targets than provided by the traditional cable tool drilling method. KIM grains recovered from soil and drillhole samples in the Gaborone laboratory were forwarded to Mineral Services laboratory in Cape Town, South Africa for electron microprobe analysis. Non-magnetic heavy fractions of kimberlite drillhole samples were sent to the Falconbridge Metallurgical Laboratory in Thornhill, Ontario for what were probably the first large-scale microdiamond analyses conducted in Canada. In essence, the microdiamond recovery technique used by SGS Lakefield today stems from this work. Falconbridge recovered relatively small numbers of microdiamonds from several Tsabong and Kokong kimberlites. These kimberlite fields are currently being investigated by other companies.

Central Kalahari reconnaissance program rationale and sampling method

Having learned much in the preceding two years, Falconbridge decided at the end of 1979 to apply its expertise in the remote, unexplored Central Kalahari region, which included part of the area between the Orapa and Jwaneng mines. The surrounding area had previously been soil sampled, mainly by De Beers. Falconbridge considered the Central Kalahari to have good potential for kimberlite discoveries, partly based on the regional fault/structural pattern (Fig. 1) which was inferred from the 1975-1977 CIDA-sponsored aeromagnetic survey of Botswana (Pretorius 1978). Much of the Central Kalahari is underlain by Late Paleozoic to Jurassic age Karoo sediments, with a generally subdued magnetic background. However, the east-central part, which includes the Gope area, is underlain by Jurassic age Karoo basalt with a very noisy magnetic background, which invariably makes kimberlite detection by magnetic methods difficult. Falconbridge's 1980 helicopter-supported reconnaissance soil sampling program covered an area of 78,500 km^2. Samples were collected at 474 sites on a fairly regular grid, the average sample density being 1 sample per 165 km^2 (Fig. 3). Each sample comprised 20 kg from the surface deflation layer scooped along a 1 km traverse which minimized the effect of landforms such as pans and relict sand dunes. Sampling was completed in 3 stages over a 6 month period. The +0.42 mm sample fraction was processed in the Gaborone laboratory, followed by the 0.25 - 0.42 mm fraction from selected parts of the survey area.

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The GOPE 25 Kimberlite Discovery, Botswana... continued from page 4

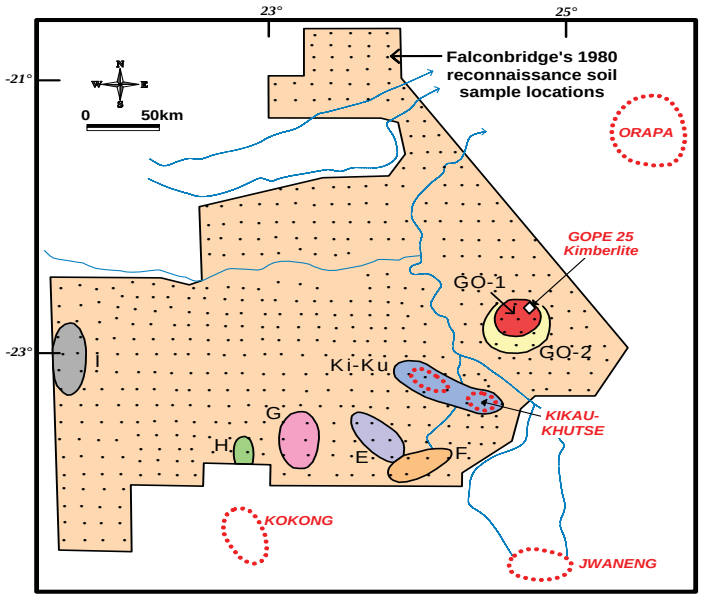

Figure 3. Mg-ilmenite anomalies GO-1, GO-2, Ki-Ku, E, F, G, H and I, identified by Falconbridge during its 1980 Central Kalahari reconnaissance soil sampling program. The Orapa, Jwaneng, Kokong and Kikau-Khutse kimberlite fields and the Gope 25 kimberlite are also shown. Kimberlites in the area are covered by Kalahari Group sands, which are 80 m thick at the Gope 25 kimberlite. (Boundary of area sampled, sampling grid and drainage are from Moore & Dingle 1998).

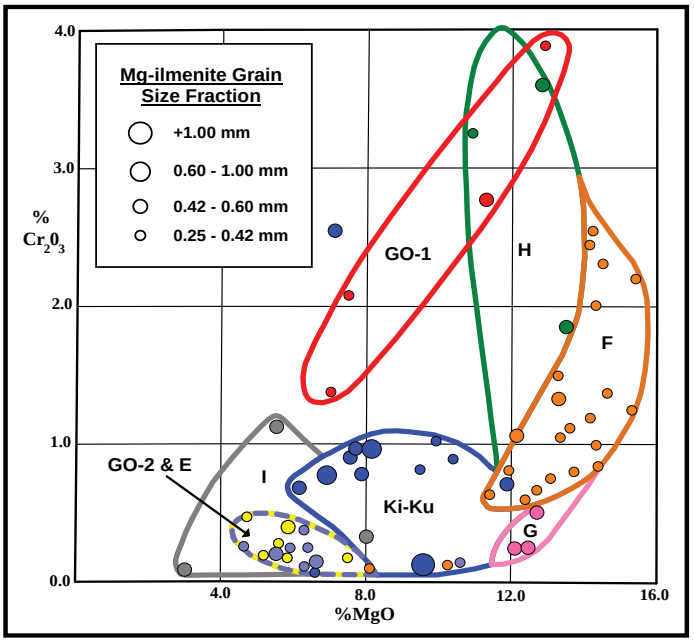

Figure 4. Cr_2O_3/MgO plot for the 65 Mg-ilmenite grains recovered from Falconbridge's 1980 Central Kalahari reconnaissance soil samples. The distinct chemical signatures of the eight Mg-ilmenite anolalies are evident. Anomaly GO-1, which was defined for only four Mg-ilmenite grains, contains the economically significant Gope 25 kimberlite.

Reconnaissance program results

Eight Mg-ilmenite anomalies, namely Anomalies GO-1, GO-2, Ki-Ku, E, F, G, H and I (Fig. 3) were identified in the southern half of the reconnaissance survey area. In Botswana, surficial Mg-ilmenite (specific gravity=4.7) concentrations are often detected proximal to kimberlites. Very few pyrope garnets (specific gravity=3.6) were recovered in the southern part of the area sampled, but (probably fluvially transported) pyropes are plentiful in the northernmost part, where drainages empty into the paleo-Makgadigadi Pan Complex (Moore & Dingle 1998). The Cr_2O_3/MgO plot for the 65 Mg-ilmenite grains recovered from soil samples in the survey area (Fig. 4) shows that each of the anomalies has a distinct chemical signature (given that the signatures of Anomalies GO-2 and E overlap). These chemical signatures suggest a range of diamond preservation potentials in the kimberlite sources, a high Cr_2O_3 / high MgO content of ilmenite suggesting high preservation potential. Anomaly GO-1 was assigned a high priority, despite being represented by only four relatively small Mg-ilmenite grains, because the distinct aggregate chemical signature of these grains (differing from the signatures of the other anomalies) suggested that they were derived from local kimberlites with a reasonably high diamond preservation potential. Anomaly H Mg-ilmenites are probably related to the Kokong kimberlite field and Anomaly F Mg-ilmenites were probably transported from the area with shallow sand cover near Jwaneng. The recovery of relatively coarse-grained Anomaly Ki-Ku Mg-ilmenites, 50 km north of Anomaly F, suggested that these grains were derived from local kimberlites.

Follow-up of reconnaissance program Mg-ilmenite anomalies

Falconbridge quickly acquired prospecting licences over the area covered by Mg-ilmenite anomalies identified in the reconnaissance program and conducted aeromagnetic surveys, followed by ground geophysical surveys, more soil sampling and drilling. Within Anomaly Ki-Ku, the six barren to slightly diamondiferous Kikau-Khutse kimberlites were discovered beneath 40 m of sand. Within Anomaly GO-1 the highly diamondiferous Gope 25 kimberlite (Fig. 3) was discovered beneath 80 m of sand in 1981. A subsequent study (Moore & Dingle 1998) showed that the 20 kg Falconbridge samples SW of Anomaly Ki-Ku contained 2 % to >10 % of +0.42 mm sand-sized material, as did those in the northern part of the area sampled. By contrast, in the intervening area, which approximates to the area underlain by basalt, and includes the Gope area, the samples contained only 2 % to <0.5 % of +0.42 mm sand-sized material. It is not surprising that only four Anomaly GO-1 Mg-ilmenite grains were recovered (three of which were in the finest fraction processed, namely 0.25 - 0.42 mm), given the relatively fine-grained nature and the relative thickness of the sand cover. Had it not been for the recognition of the distinct chemical signature of these four Mg-ilmenite grains, suggesting a local source with a reasonably high diamond preservation potential, Anomaly GO-1 might not have been followed up, in which case the Gope 25 kimberlite would not have been discovered by Falconbridge.

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The Gope kimberlites

The garnet geochemistry (high proportion of G10 garnets) and microdiamond results for Gope 25 kimberlite were much more encouraging than those for the Tsabong, Kokong and Kikau-Khutse kimberlites. In 1982 Falconbridge and its JV partner Superior Oil concluded an agreement with De Beers enabling it to earn a 50% interest in the Botswana properties through expenditure on them. Delineation drilling, underground development and bulk sampling were subsequently conducted at the Gope 25 kimberlite and four additional, smaller diamondiferous kimberlites were discovered. The aggregate Cr_2O_3/MgO chemical signature of Mg-ilmenites from the five Gope kimberlites is consistent with that of the Anomaly GO-1 surficial Mg-ilmenites.

By 1998 De Beers had earned its 50% interest in the property. In 2007 Gem Diamonds Limited acquired 100% of Gope Exploration Company (Pty) Ltd, the owner of the Gope property, from De Beers and Falconbridge (by then a subsidiary of Xstrata PLC) for US$34 million. Gem Diamonds owns diamond mines at Letseng in Lesotho (Southern Africa) and in the Kimberley region of Western Australia. The Gope 25 kimberlite pipe measures 10.3 hectares at 80 m depth (immediately below the sand cover) and 9.1 hectares at 300 m depth. In late 2008, the Gem Diamonds website www.gemdiamonds.com reported a "resource of 105 million tonnes, 78 million tonnes indicated and 26 million tonnes inferred" for the Gope 25 kimberlite, with an average in-situ grade of 19.4 carats per hundred tonnes and an average diamond price of US$131 per carat. It also stated that a Mining Licence Application was submitted in July 2007 and that the company hopes to develop a world-class producing mine at Gope by 2013. Many other companies have conducted further diamond exploration in the Central Kalahari region since the Gope discoveries, but no new potentially economic kimberlite discoveries have been made.

Summary

The Gope 25 kimberlite is the most economically significant of the 62 kimberlites discovered by Falconbridge in four fields in Botswana between 1978 and 1982, in areas where the Tertiary age sand cover thickness sometimes exceeds 100 m.

In 1980 Falconbridge conducted a 78,500 km^2 helicopter-supported reconnaissance soil sampling program at a sample density of one sample per 165 km^2 in the semi-arid Central Kalahari area, part of which is located between Debswana's Jwaneng and Orapa diamond mines. Eight Mg-ilmenite anomalies were detected in soil, each invariably having a distinct chemical signature with respect to Mg-ilmenite grain Cr_2O_3 and MgO content. Anomaly GO-1 was assigned a high priority, despite being represented by only four relatively small Mg-ilmenite grains, because the distinct

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aggregate chemical signature of these grains (differing from the signatures of the other anomalies) suggested that they were derived from local kimberlites with a reasonably high diamond preservation potential. The relatively small number of Mg-ilmenites recovered at Anomaly GO-1, and their generally small grain-size, are partly attributable to the fine grained nature of the soil in the Gope area relative to most of the area sampled.

In 1981, following aeromagnetic and ground geophysical surveys, Falconbridge's drilling within Anomaly GO-1 intersected the 10.3 hectare diamondiferous Gope 25 kimberlite pipe beneath 80 m of sand. The new owner of the property, Gem Diamonds Limited, applied for a Mining Licence in 2007 and hopes to mine the Gope 25 kimberlite by 2013.

It is concluded that recognition of the probable significance of the distinct Mg-ilmenite chemical signature of Central Kalahari reconnaissance soil Anomaly GO-1, which was defined by only four generally small Mg-ilmenite grains in an area with relatively fine grained soil, was crucial in Falconbridge's discovery of the Gope 25 kimberlite.

Acknowledgements

The dedication and skill of Falconbridge's Southern African exploration team (Fig. 2) made the successful five-year Botswana diamond program possible. The Central Kalahari reconnaissance soil sampling program was conceptualized by senior Southern African management (the authors), logistical planning was conducted by Roger Billington and the helicopter-supported sampling and Gope 25 discovery drillhole supervision were conducted by Andy Moore. The efficiently operated company laboratory in Gaborone, managed by Carol Spark, was vital to success. Falconbridge was fortunate to be able to retain John Gurney as a consultant, with particular reference to his KIM chemical criteria for identifying diamondiferous kimberlites. The authors thank Gem Diamonds Ltd. for supporting publication of this paper, Andy Moore for valuable discussions and Stu Averill for suggesting this contribution to EXPLORE.

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Letter to the Editor

In the recent issue (December 2008. No 141) of **EXPLORE** there are two papers presenting information on regional geochemical data sets. The first covers Australia and the second concentrates on North America. I find it quite interesting that the emphasis in Australia is aimed principally at mineral exploration while in North America reference to mineral exploration is minimal.

The concept of regional geochemical mapping was initiated in Canada in 1966 when the GSC published contoured regional trend metal maps derived from stream sediment and steam water data. The maps covered the Keno Hill Area Y.T. and were meant to stimulate mineral exploration in that region and that they did. However they also made it possible to add to the metallogeny of the area by correlating regional geochemistry with regional geology. Similar regional geochemical maps continue to be produced by mineral exploration companies in the late 60s and early 70s in Gaspe, Quebec, in Yukon Territory and in British Columbia. Of course since the 80s multi use regional geochemical maps have become common in industry and in government.

Establishing reliable background levels for trace elements in earth's materials is essential not just for environmental and health purposes but for all aspects of applied geochemistry which also incorporates geological, mineral and petroleum exploration.

C. F. Gleeson

Reply to Letter to the Editor

Dr. Gleeson,

Your letter provides the readership with a broader appreciation of geochemical surveys and their usefulness to provide solutions and answers to environmental as well as exploration issues. The Geological Survey of Canada has been a leader in using geochemical surveys formineral exploration since the mid 1950's and has done systematic regional sampling through the National Geochemical Reconnaisance Program since the 70's. These activities and their contribution to mineral exploration have been widely disseminated throughout the international scientific and industrial communities. The intent of this paper was to highlight the current activities of the GSC and NRCan towards the application of geochemical and other geoscience data for resolving environmental issues, under the Environment and Health Program. The aim of this body of work is to support government wide decisions related to the environment and human health. As you mention, regional geochemical mapping has multi uses and through our work we are expanding the concept of regional geochemical mapping to help resolve environmental issues. Other programs of the GSC will continue to apply regional surveys to mineral exploration and together these programs will use geochemical knowledge to contribute to a sustainable environment. In this context the two applications should be seen as complimentary.

Dr. Andrew Rencz
Program Manager
Environment and Health Program
Earth Science Sector
Natural Resources Canada

The AAG Needs You as a Councilor

Each year the Association of Applied Geochemists needs motivated and energetic AAG Fellows to stand for election to the position of "Ordinary Councilor." Fortunately, each year some of our most outstanding Fellows are ready, willing, and able to meet this challenge. This is the annual article in **EXPLORE** summarizing the job and describing how one goes about getting on the ballot. It is our sincere hope that this might entice more Fellows to step forward for election to this most important position.

Job Description

The AAG By Laws state that "the affairs of the Association shall be managed by its board of directors, to be known as its Council." The affairs managed by Council vary from reviewing and ranking proposals to host our biennial Symposium to approving application for new membership to developing marketing strategies for sustaining and growing our membership. These affairs are discussed and decisions made at Council teleconferences usually held 3-4 times per year. Each teleconference lasts about 90 minutes. In addition, there is often a running email discussion about a selected issue or two between each teleconference. So for a commitment of about 8 hours of your time per year, you can help influence the future of your Association. If you want to spend more than the minimum time required, there is plenty of opportunity to do so through committee assignments and voluntary efforts that greatly benefit the Association.

Qualifications and length of term

The only qualification for serving as Councilor is to be a Fellow in good standing with the Association. Please note the difference between being a Member of AAG and being a Fellow. A Fellow is required to have more training and professional experience than a Member. Consult the AAG web site, Membership section, for further details. If you are not currently a Fellow and have an interest in serving on Council, please go through the relatively painless process of converting to Fellowship status in AAG.

Each Councilor serves a term of two years and can then stand for election to a second two-year term. The By Laws forbid serving more than two consecutive terms, although someone who has served two consecutive terms can stand for election again after sitting out for at least one year. Elections are usually held in the fall of the year for a term covering the following two years. Our next election will be in the fall of 2009 for the term of 2010-2011.

How to get on the ballot

If you are interested in placing your name into consideration for election to AAG Council, simply express your interest to the AAG Secretary (Dave Smith, dsmith@usgs.gov) by August 31, 2009 and include a short (no more than 250 words) summary of your career experience. All that is asked is that you bring energy and ideas to Council and are willing to share in making decisions that will carry the Association forward into a successful future. We look forward to hearing from you.

David B. Smith
Secretary, Association of Applied Geochemists

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

2009

8-19 June 2009. Ore Deposit Geochemistry, Hydrology and Geochronology. Hobart, Tasmania, Australia. Website: http://tinyurl.com/cn2ee2

14-20 June 2009. 14th International Clay Conference. Castellaneta Marina, Italy. Website: www.14icc.org/

21-23 June 2009. Xi'an Ni-Cu Symposium. Xi'an, China. Website: http://2009xani.chd.edu.cn/home1.htm

22-26 June 2009. Goldschmidt 2009. Davos, Switzerland. Website: www.goldschmidt2009.org

23-26 June 2009. 8th International Conference on Acid Rock Drainage. Skellefteå, Sweden. Website: www.securing.skelleftea.se

12-17 July 2009. Gordon Research Conference: Catchment Science. Andover, NH, USA. Website: http://tinyurl.com/d8m2wm

17-20 August 2009. Society for Geology Applied to Mineral Deposits 10th Biennial Meeting. Townsville, Australia. Website: http://sga2009.jcu.edu.au/

7-11 September 2009. Geoanalysis 2009. Champagne Sports Resort, Drakensberg, South Africa. Website: www.geoanalysis2009.org.za

14-18 September 2009. 18th International Symposium on Environmental Biogeochemistry. University of Hamburg, Germany. Website: www.isebiogeochemistry.com/ISEB_10.htm

21-23 September 2009. 7th Iberian Geochemistry Symposium. Soria, Spain. Website: www.congresogeoquimica2009.es

21-26 September 2009. Association of Environmental and Engineering Geologists 52nd Annual Meeting. Lake Tahoe, CA, USA. Website: http://tinyurl.com/dkxdv6

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18-21 October 2009. Geological Society of America Annual Meeting. Portland, OR, USA. Website: www.geosociety.org/meetings/2009/

18-23 October 2009. VIII International Symposium on Environmental Geochemistry. Ouro Preto, MG, Brazil. Website: www.12cbgq.ufop.br/12cbgq/

26-30 October 2009. World Gold 2009. Johannesburg, South Africa. Website: www.worldgold2009.com

9-11 November 2009. Mineral Symposium 2009. Taiping, Perak, Malaysia. Website: http://tinyurl.com/d5q9hd

30 November-4-December 2009. Northwest Mining Association 115th Annual Meeting, Exposition and Short Courses. Reno-Sparks, NV, USA. www.nwma.org/pdf/09cv.pdf

1-3 December 2009. 7th Fennoscandian Exploration & Mining, Lappia Hall, Rovaniemi, Finland, www.lapinliitto.fi/fem2009/index.htm

7-11 December 2009. AGU Fall Meeting. San Francisco, CA, USA. Website: www.agu.org/meetings/fm09/

2010

7-10 March 2010. Prospectors and Developers Association of Canada Annual Convention. Toronto, Canada. Website: www.pdac.ca/pdac/conv/index.html

6- 9 April 2010. 13th Quadrennial IAGOD Symposium "Giant Ore Deposits Down-Under". Adelaide, Australia. Website: http://tinyurl.com/caoys8

10- 13 May 2010. GAC/MAC Annual Meeting. Calgary AB, Canada. Website: www.gac.ca/activities/index.php

13-18 June 2010. Goldschmidt 2010. Knoxville, TN, USA. Website: www.goldschmidt2010.org

21- 24 June 2010. 11th International Platinum Symposium. Sudbury ON. Canada. Website: http://11ips.laurentian.ca

27 June-2 July 2010. 27th Society for Environmental Geochemistry and Health, European Conference. Galway, Ireland. Website: www.nuigalway.ie/segh2010

4-8 July 2010. Australian Earth Sciences Convention (AESC) 2010. Canberra, Australia. Website: www.gsa.org.au/

19-24 September 2010. IWA World Water Congress and Exhibition, Montreal, Canada.
Website: www.iwa2010montreal.org/

2-5 October 2010. SEG 2010 Conference. Keystone, CO, USA. Website: www.seg2010.org

31 October-3 November 2010. Geological Society of America Annual Meeting. Denver, CO, USA.
Website: www.geosociety.org/meetings/index.htm

2011

25-27 May 2011. GAC/MAC Annual Meeting. Ottawa, ON, Canada. Website: www.gac.ca/activities/index.php

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

2012

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

Please let us know of your events by sending details to:
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SGS Minerals Services – AAG Student Paper Competition

Introduction

A prize for the best paper published by a student is awarded by the Association of Applied Geochemists every two years. The purpose of the prize is to reward excellence and encourage prompt publishing of research by students in the fields of exploration geochemistry or environmental geochemistry related to mining activities. The winner is determined by an international panel consisting of a chair and three judges, drawn from our profession but reflecting the perspectives of academia, government and industry. Criteria include excellence and originality in research design, research execution, interpretation, presentation of the science and its practical application to exploration geochemistry. Honours, MSc and PhD students are encouraged to publish their research results and enter this competition. There is no limit to the number of papers considered per individual student.

The Prize

1. From SGS Minerals Services a cash prize of $1000 CAD.
2. From the Association of Applied Geochemists a 2-year membership of the Association, including the AAG's journal (GEEA) and EXPLORE, a certificate of recognition and $500 US towards expenses in attending an AAG-sponsored meeting where the award will be presented.

Rules

1. The paper must substantially address an aspect of exploration geochemistry or environmental geochemistry related to mineral exploration;
2. The paper must represent research performed as a student;
3. The student must be the principal researcher, as attested to by the student's supervisor, head of department/school or a senior scientist who is very familiar with the student's work;
4. The paper must have been published in Geochemistry: Exploration, Environment, Analysis, either during the course of the degree program that generated the research or within three years of the award of the degree.
5. No nomination is required – all eligible papers in GEEA will be assessed. Authors should notify the committee chair, GEEA and the editor when the first author is a student.
6. The decision of the Student Paper Prize Committee is final and no correspondence will be entered into.

Entry

The closing date for the next round is 31st December 2010 and the winner will be announced at the 25th IAGS.

David Cohen
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UNSW NSW 2052
Email: d.cohen@unsw.edu.au

The Association of Applied Geochemists
announces the

2010 AAG

Student Paper Competition

The AAG announces the 8th biennial Student Paper Competition. The paper must address an aspect of exploration geochemistry or environmental geochemistry related to mineral exploration and be based on 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. All eligible papers in 2009 and 2010 volumes of GEEA will be reviewed by the selection panel.

The winner will receive:

A cash prize of $1000CAD 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 $500US towards expenses to attend an AAG-sponsored meeting, courtesy of AAG.

The results of the 2010 competition will be announced at the 25th IAGS in mid 2011. Details are available from the chair of the committee or the AAG Students' page (http://www.appliedgeochemists.org/).

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2008 Student Paper Prize Winner: Jorge Benavides

The Association of Applied Geochemists and SGS are pleased to announce Jorge Benavides as the winner of the 2008 Student Paper Prize. This prize is awarded for the best paper published in GEEA by a student, on work performed as a student and published within three years of graduation, which addresses an aspect of exploration geochemistry or environmental geochemistry related to the mining industry. His winning paper is based on research that Jorge undertook for his PhD at Queen's University, Kingston, Canada.

His award-winning paper is entitled 'Exploration guidelines for copper-rich iron oxidecoppergold deposits in the Mantoverde area, northern Chile: the integration of host-rock molar element ratios and oxygen isotope compositions' which was published in 2008 in Geochemistry: Exploration Environment Analysis, 8:343–367, and was co-authored by Kurt Kyser, Alan Clark, Cliff Stanley & Chris Oates. The abstract of the paper is:

"The Mantoverde area of the III Región of northern Chile hosts numerous copper(-gold) deposits and prospects assigned to the iron oxide–copper–gold (IOCG) clan. These range from sulphide-poor magnetite–apatite–actinolite bodies (e.g. Carmen) to chalcopyrite-rich, hematite-cemented breccias and veins (e.g. Mantoverde, Cerro Negro and Palmira). The most important Cu-rich deposits are associated with the main or, more commonly, subsidiary structures of the plate boundary- parallel Atacama Fault System, and are hosted by Middle to Upper Jurassic andesites and Lower Cretaceous dioritic to quartz dioritic plutons. The rocks in the wider Mantoverde area exhibit a complex evolution involving early sub-seafloor albitization (stage R1), subsequent, very low-grade diastathermal metamorphism (R2), and more local stage I K and Fe metasomatism and stage II hydrolysis, all preceding the emplacement of sulphide-bearing hematitic breccias and veins (i.e. ore-stage III). We develop a lithogeochemical exploration protocol specifically for Cu-rich IOCG-type deposits hosted by calc-alkaline volcano-plutonic terrains, based on the integration of whole-rock molar element ratios and oxygen isotope chemistry. Zirconium, the most conserved (least mobile) element in the volcanic and plutonic rocks of the area, was used as a common denominator for molar element ratios. The molar ratios Na/Zr, K/Zr and Al/Zr indicate that the host rocks proximal to the major deposits were affected by sodium depletion and potassium enrichment. The molar ratio $14Ca+19Na14CO_2/6Si+Al+2Fe+2Mg$, recalculated to a percentage scale, constitutes a modified alteration index which can be used to quantify the degree of hydrothermal alteration in the host rocks. However, although this index differentiates barren from potentially prospective sectors (i.e. strongly altered host rocks), it does not identify the hydrolytically altered rocks that are closely associated with economic copper mineralization. The $d^{18}O$ values of igneous rocks in the Mantoverde area vary widely from +4.2 to +14.1‰. Integrating the modified lithogeochemical alteration index with wholerock $d^{18}O$ values differentiates the least altered volcanic and plutonic rocks (i.e. alteration index <30%), with $d^{18}O$ values close to +7‰, from moderately altered volcanic rocks (alteration index of 30 to 65%) having higher $d^{18}O$ values of +10 to +13.2‰ due to enrichment in ^{18}O during regional metasomatism hydrothermal alteration sub-seafloor related to albitization and metamorphism. A third group comprises strongly K-feldspathized, Fe-metasomatized and chloritized rocks localized in Cu-mineralized centres which have alteration indexes exceeding 65% and $d^{18}O$ values of +4.2 to +14.1‰. The $d^{18}O$ values of paragenetically related minerals indicate that barren, K- and Fe-metasomatized host rocks equilibrated with magmatically derived fluids at temperatures exceeding 420°C. Although no recognizable alteration haloes are associated with the ensuing lower-temperature Cu-(Au) ore stage (III), the genetically related hydrolytic alteration (II) which preceded it generated distinctive alteration indices and Na/Al and K/Al ratios, as well as $d^{18}O$ values averaging +10‰, with chlorite O and H isotope compositions indicating equilibration with non-magmatic fluids. We propose, in combination, that these parameters can be used to vector onto Cu-rich IOCG-type mineralization in Andean, calc-alkaline terrains."

Jorge receives a $1000 cash prize from SGS, a two-year membership of the Association of Applied Geochemists, together with our journal, Geochemistry: Exploration, Environment, Analysis and newsletter, EXPLORE, and a certificate of recognition.

The Association of Applied Geochemists would like to thank SGS for, once again, generously supporting this prize. The 2009-2010 competition is now open. Papers must have been published (or accepted for publication) in GEEA.

D.R. Cohen
Chair, AAG Student Paper Competition Committee

RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in EXPLORE Number 143. 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, lcloss@Mines.edu , not to **EXPLORE**.

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AAG Members at Roundup 2009, Vancouver, Canada, January 26 to 29, 2009

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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)

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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	2009 member dues	US$	100	_____
2	2009 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.

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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
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EXPLORE

Newsletter No. 143 JUNE 2009

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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

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:
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