The Founders of Economic Geology

Brian J. Skinner (SEG 1960 SF)

In the first issue of the SEG Newsletter for 2005, there were short vignettes of three of the people closely connected with the founding and establishment of the Economic Geology Publishing Company and Economic Geology a century ago. There were 12 people who played key roles in founding the journal and below are short descriptions of three more. These three, Kemp, Leith, and Ries, were academics—the rest of the founders were USGS employees—but each had at some stage been employed by the U.S. Geological Survey or had close connections with the organization. Together with Lindgren, Campbell, and Ransome, the three whose stories follow were the founding associate editors. All were active contributors to the new journal and each played an important role in establishing the peer review system for manuscripts, the critical reviewing of new books, and the encouragement of potential authors to publish in the journal.

Charles Kenneth Leith, 1875–1956

“C.K.,” as he was widely known, was raised and educated in Wisconsin. He first encountered geology when he was hired as a part-time stenographer and typist by Charles Van Hise, professor of geology at the University of Wisconsin. Van Hise was already famous for his studies of the iron ranges; Leith became his student, followed in the footsteps of his mentor with studies in the Lake Superior region, and eventually became Van Hise’s collaborator. Receiving a B.S. degree in 1897, Leith was appointed Assistant Geologist in the U.S. Geological Survey and assigned to work on the Precambrian geology of the Lake Superior region, particularly on the iron formations. For his early work in the region, he received his Ph.D. in 1901 from the University of Wisconsin; in 1902 he joined the Wisconsin faculty, a posting he held until he retired in 1945.

Leith is probably best known among today’s economic geology community for his seminal studies of the Lake Superior banded iron formations. Three publications that stand out are USGS Monograph 43, on The Mesabi Iron-Bearing District of Minnesota, published in 1903; USGS Bulletin 360, co-authored with Van Hise, on The Precambrian Geology of North America, published in 1909, and most famously, also co-authored with Van Hise, USGS Monograph 52, on The Geology of the Lake Superior Region, published in 1911.

Besides his scientific and academic roles, Leith was, for many years, a senior advisor to the federal government on strategic mineral supplies and mineral economics, and an astute business man, being a co-founder of the Ozark Chemical Company, and in the 1930s, the Ozark-Mahoning Company.

Leith was President of the Society of Economic Geologists in 1925, and gave his presidential address on “The Lead and Zinc Deposits of the Mississippi Valley.”

Heinrich Ries, 1871–1951

Ries was the non-metallic minerals expert among the founding associate editors. Born in Brooklyn, N.Y., to a German father and an American mother, he was educated both in the United States and Germany to a high school level, and then received his higher education at Columbia University, where he studied under J.F. Kemp. Being a New York resident, Ries applied to the aged state geologist, James Hall, for a summer job. Hall put him to work on the Hudson River clays, and Ries turned in such a fine report that he attracted as much clay work as he could handle for many years to come. He became the ranking expert of the day on the subject and published many reports on clay and shale resources around the United States. He also became an...
Call For Papers Deadline: June 1, 2005
E-mail queries and abstract submissions to seg2006@segweb.org

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Day 2 Generating and Delivering Wealth
Day 3 Case Histories and Volunteered Presentations

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- Exploration Geologists
- Financial Analysts
- Researchers
- Students

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DEADLINE FOR NEWSLETTER #62: May 31, 2005
Economic Geologists in 1924, and delivered his presidential address on “Pegmatites.”

James Furman Kemp, 1859–1926

Kemp was one of the longest-serving associate editors in the history of Economic Geology— from 1905 until his death in 1926. Kemp was also the eldest member of the twelve founders, being 46 at the time the journal began in 1905.

Educated at Amherst College and graduated with a bachelor’s degree in 1881, Kemp entered the School of Mines of Columbia University later that year for graduate studies, earning his engineering degree in 1884. After two years of further study in Germany, Kemp joined the faculty of Cornell University, and taught there until he was appointed to the faculty of Columbia in 1891. He remained at Columbia University until the end of his life, training many of the economic geologists of the day, including J.D. Irving, founding editor of Economic Geology, and Heinrich Ries, a founding associate editor.

Although Kemp published a number of quadrangle maps, his special interests were centered on metalliferous mineral deposits. In 1893 he published the first comprehensive text and reference volume on the Ore Deposits of the United States and Canada, a work that ran through many editions and was widely studied, both in North America and abroad. It is interesting to read the acknowledgements in the various editions of the text. In the edition of 1893, Professor R.A. Penrose of Chicago is thanked; by the third edition the names of some of the other founders appear— Irving, Weed, and Bain. It seems clear that the community of economic geologists at the close of the 19th century was small and close knit.

Known to his students as “Uncle Jimmy,” Kemp, through his teaching and field studies, had an immense influence on the development of economic geology in North America. He was a stickler for detail, and deplored sloppy thinking. His comments on that score are clear from the first edition of his book: “So much unsound and foolish theorizing has been uttered and believed about ores, that too much care cannot be exercised in basing explanations on reasonable and right foundations.” It was good advice then; it’s still good advice today.

Kemp was President of The Society of Economic Geologists in 1924, and delivered his presidential address on “Pegmatites.”

This year the Society, through its flagship publication, Economic Geology, is celebrating one hundred years of science and discovery. Members are aware of three main initiatives to mark this event: the 100th Anniversary volume of Economic Geology (see inside back cover for announcement and industry sponsors), the centenary symposia and banquet dinner in Salt Lake City during mid-October (see p. 35 for program), and the compilation of a fully searchable digital archive of Economic Geology that will span all issues published since 1905. The archive has been the subject of intense interest and enthusiasm by the membership and current progress suggests that it should debut as early as the middle of the year.

The costs involved in preparing 100 years of Economic Geology for digitization, indexing, and searching are substantial. While the SEG Council took the first bold step in authorizing US$100,000 in expenditure for the project in March last year, the Hugo T. Dummett Mineral Discovery Fund in Canada has become the vehicle for raising the necessary funds. The SEG Canada Foundation has been instrumental in raising major contributions from renowned diamond explorers Stu Blusson and Chuck Fipke, with additional funds from Ivanhoe Mines, Hugo Dummett’s employer at the time of his death in 2002. Funding of this archive is strongly aligned with the intent of the Dummett fund to recognize the development of tools that benefit applied economic geology by providing “information that could lead to discovery of new types of ore deposits, or discoveries in new geological terrains.”

The magnitude and impact of a digital archive of Economic Geology will establish this project as a landmark event in the development of Society publications. The estimated count of print issues being converted to digital format is 752, with an additional 48 issues for years 1999-2004 that are already in digital format. These two sets of data are being integrated into a single set of DVDs (or CDs) that will allow comprehensive searching with linked references. The SEG has worked closely with AGI (the American Geological Institute) to ensure the further integration of GeoRef data in the archive. Given the level of support that has been provided, members can look forward to obtaining the DVD set at a very reasonable price—stay tuned for further details.

The digital archive of Economic Geology will serve SEG members as well as nonmember practitioners of applied economic geology. The DVDs will be portable and accessible, satisfying Hugo Dummett’s own “optimal formula for discovery success” by providing the best available science to resourceful people. In this sense, the Society envisions that the archive of Economic Geology will provide a springboard for “a revolution of ideas as well as technology,” as articulated by Murray Hitzman in his Presidential Perspective column on p. 6. Considering all of the above, there has never been a better time to be a member of the SEG!
A Comparison of Granite-Related Tin, Tungsten, and Gold-Bismuth Deposits: Implications for Exploration


INTRODUCTION
Granite-related Au deposits associated with Sn-W provinces have been the subject of extensive debate over the past five years, since Thompson et al. (1999) defined their broad characteristics. The majority of these arguments have centered upon comparisons between granite-related Au deposits and orogenic Au deposits, and in particular, on how the deposits differ (e.g., Sillitoe and Thompson, 1998; Groves et al., 2003). This discussion is ongoing but there is a growing body of evidence that many of these Au deposits, particularly those with a strong Au-Bi association (herein described as granite-related Au-Bi deposits), are indeed magmatic in origin. Evidence includes the following:

1. Dating of intrusions and ore (e.g., Fort Knox, Dublin Gulch, Pogo, Shotgun, and Timbarra: Hart et al., 2001; Mustard, 2001a; Rombach and Newberry, 2001; Selby et al., 2002), suggesting synchronous magmatic and hydrothermal activity;
2. Geological evidence for an intimate spatial and temporal association and zonation between magma emplacement and hydrothermal activity, including textures characteristic of the magmatic-hydrothermal transition (e.g., Fort Knox, Dublin Gulch, and Timbarra: Bakke, 1995; Maloof et al., 2001; Mustard, 2001a, b);
3. Structural studies that indicate the same structural environment was operative during magma emplacement and vein development (e.g., Pogo, Dublin Gulch, and other Yukon granite-related gold-bismuth occurrences: Rhys et al., 2003; Stephens et al., 2004);
4. Fluid inclusion studies that suggest deeper systems are CO₂ rich, whereas shallow systems contain abundant brines and lesser CO₂, consistent with experimental research on the behavior of H₂O, NaCl, and CO₂ in felsic magmas (Baker, 2002);
5. Fluid and melt inclusions that indicate CO₂-rich fluids were derived from magmatic volatile exsolution and that gold and lithophile metals (Mo, W, Bi, Sn) were enriched in the late-stage fractionated melts (Mustard and Ulrich, 2004; Mustard et al., 2004).

Assuming, then, a magmatic origin for the Au-Bi deposits, important questions still remain, given that the Au-Bi deposits by definition (Thompson et al., 1999) are hosted in provinces characterized by Sn and W mineralization, e.g., what makes a granite-related deposit Au-Bi dominant rather than Sn- and/or W rich, and what criteria can be used in exploration to distinguish these systems? This article explores these issues through comparison of granite-related Au-Bi, Sn, and W systems in different global terranes (Fig. 1). The article does not attempt an exhaustive review of all three deposit types, and the reader is referred to other summaries for a more thorough evaluation of the Sn and W systems (e.g., Taylor, 1979; Strong, 1988; Heinrich, 1990; Linnen, 1998; Wood and Samson, 2000) and Au-Bi deposits (Thompson et al., 1999; Lang et al., 2000; Thompson and Newberry, 2000; Baker, 2002; Hart et al., 2002).

GRANITE-RELATED Au-Bi, Sn, AND W PROVINCES AND DATA SOURCES
We have selected a number of terranes to...
A Wealth of Economic Geology

Why did you become an economic geologist? As illustrated by Brian Skinner in his vignettes of the Society’s founders, many of us became economic geologists because of an excellent professor or as a means to get paid for being outdoors and observing nature. Once we entered the field, we split into a variety of career paths. Some of us work at mines trying to ensure that our companies can realize their quarterly earnings, others explore for the resources needed for the future. A number of us work with the financial community, translating our science and excitement into terms easily understandable by investors, bankers, fund managers, and corporate administrators. Others work in academia or government research groups, attempting to discover the myriad complexity of ore genesis.

The unifying factor is that we all utilize science to better understand where materials of economic value lie hidden in the Earth. Despite how specialized some of us may seem (porphyry experts, rock mechanics specialists, feasibility study whizzes, fluid inclusion gurus), economic geologists are all fundamentally generalists and, in our heart of hearts, many of us still wish to head over the hill and find “the big one.”

As one looks at the vignettes of the Society founders, it is clear that they were individuals of vision with solid scientific credentials. It is also clear that they understood that the new field they were creating was practical. They sought to understand nature, not just for understanding’s sake but to make a difference to society—increasing the available metal, energy, and water resources and creating wealth. When they chose to call the field “economic geology,” they were drawing on two senses of the term economic: both “of or having to do with the satisfaction of the material needs of people,” and “of and having to do with the production, distribution, and consumption of wealth” (Webster’s New World Dictionary). Many of us are drawn to economic geology because it is an applied field that deals directly with society and is associated with the creation of wealth.

We utilize concepts from a broad variety of disciplines to discover and delineate resources that are both useful and of value. The Society of Economic Geologists is returning to its roots with its 2006 meeting at Keystone, Colorado, “Wealth Creation in the Minerals Industry.” Unlike previous SEG-sponsored meetings, this conference will focus on the business of exploration and the need to generate and deliver wealth for society. The relevance of this to industry is obvious, but it is also crucial to the academic sector. With government funding for applied geoscience research falling throughout the world, research in economic geology will increasingly be funded by the private sector. A better appreciation of industry needs and trends is critical for researchers in academia as well as for those conducting more applied research within industry.

The early 21st century is an exciting, and troubling, time for our field. Changes in the geopolitical, corporate, and societal landscape are forcing us to change the ways we do business—from the researcher at the lab bench in search of funding to the CEO deciding how to invest their corporate earnings. These changes require us to move back to our wide-ranging, multidisciplinary roots. As I pointed out in my first presidential perspective, this will require significant changes in how we educate students, requiring the integration of economic geology with mining engineering and mineral processing, including novel areas, such as geomicrobial processing, which will become even more critical in the future. We must also broaden students’ learning to include economics and business as well as geology, geochemistry, geophysics, engineering, metallurgy, and high-level computing skills. We must cover all facets of the “economic” in economic geology.

Perhaps the greatest change, and challenge, for all of us in economic geology in the 21st century will be the necessity for us to internalize the concept of sustainable development. For the minerals industry to be successful, it must make sustainable development a keystone in wealth creation. Moving to this new paradigm will not be easy. How do we inoculate the triple bottom line of business, society, and environment into everything we do, from isotopic studies to planning the next blast round? The SEG 2006 meeting will address these issues with case studies on wealth creation and sustainability.

Change is always hard, but also exciting. The beginnings of revolutions are not always perceived at the time. I am convinced we are in the early stages of a profound revolution in the mining industry. This will be a revolution of ideas as well as technology. The members of SEG are at the forefront of this revolution, whether they wish to be or not. The 2006 meeting on wealth creation in the minerals industry will provide an important forum for us all to simultaneously look backwards and forwards and to help direct change. The 2006 meeting will bring together CEOs and academics, mine geologists and financial analysts. Its aim is to widen our view and to develop strategies for the future; to find the common ground between seeking materials that society needs while respecting environmental and societal limitations on our activities and, at the same time, creating wealth from that endeavor.

Plan on joining us in Keystone for what I expect to be a seminal meeting with significant repercussions for us all. Come to listen and learn or submit a paper to provide your views on how wealth creation influences our field.
The SEG Foundation Student Grants Program: A Growing Success

In 1993, the SEG Foundation (SEGF) awarded five student research grants totaling $6,825. Thus began the SEG Foundation’s Student Research Grants Program (although it was not so-named at that time). Funding for the first five grants was provided by the Hugh Exton McKinstry Endowment Fund, established by Elizabeth McKinstry in 1991 with a gift of 400 shares of Exxon stock valued at $23,000, and followed in 1992 by a second gift of 300 shares of General Electric stock and cash totaling $25,000. The value of the fund at year-end 1992 was $55,185. This was the financial base for the SEGF Student Grants Program. By year-end 2004, funding to support the program had grown to over $2,115,000 in six SEGF funds—led by the McKinstry Fund, with a value of $1,842,981.

Following the initial awards, no grants were made until 1996, in order to allow the financial base of the fund to grow. In 1994, the Hickok-Radford Memorial Fund was established to honor the memory of Bruce Hickok and Geoff Radford, two Alaskan exploration geologists who perished in an avalanche while cross-country skiing. Then, in 1995, the SEGI “Special Grants Committee” was formed to coordinate administration of the McKinstry and Hickok-Radford Funds. The formal beginning of the SEG Foundation Student Research Grants Program occurred in 1996 when four students were selected for McKinstry awards and two for Hickok-Radford awards. When the 2005 grants are awarded this April, the program will have provided a total of $669,000 to more than 400 students worldwide.

$17,450. Newmont awards this year are expected to total $22,550. Under the agreement with Newmont, the funds are “in-and-out,” that is, annual funding provided by Newmont is expected to be awarded entirely in the same or following year (depending on when the funds are received). In other words, the Newmont Fund is not an endowment fund; it is considered a “board-restricted” fund—one that is used for a specific purpose but that can be spent down in its entirety.

Adding the Newmont contributions to the program has significantly increased the annual funding available to students.

The Student Research Grants program is the flagship of the Foundation’s programs and projects to “...fund education, research, publications, student support, public outreach, and other geoscientific programs...” as stated in the Articles of Incorporation of the Foundation. With on-going generous support from the Foundation’s loyal individual contributors and increasingly strong support from corporate benefactors, this vital program will continue to grow. The program provides critical financial resources to students while they are completing their education, and concurrently provides a significant service to our industry, which looks to these students as possible future employees. The first 10 years of the program have seen impressive growth, but we look for even more impressive growth over the next few years—with the challenging goal of doubling the current annual funding available for student grants!

When the 2005 grants are awarded this April, the program will have provided a total of $669,000 to more than 400 students worldwide.

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**GROWTH OF SEG FOUNDATION STUDENT GRANTS PROGRAM, 1996 - 2005**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Total Awarded</th>
<th>Number of Applications</th>
<th>Number of Countries</th>
<th>Number of Awards</th>
<th>Average Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>143,675(^{1})</td>
<td>104</td>
<td>21</td>
<td>Pending</td>
<td>Pending</td>
</tr>
<tr>
<td>2004</td>
<td>82,600</td>
<td>66</td>
<td>12</td>
<td>41</td>
<td>2,014</td>
</tr>
<tr>
<td>2003</td>
<td>66,000</td>
<td>79</td>
<td>17</td>
<td>48</td>
<td>1,375</td>
</tr>
<tr>
<td>2002</td>
<td>68,000</td>
<td>80</td>
<td>19</td>
<td>46</td>
<td>1,478</td>
</tr>
<tr>
<td>2001</td>
<td>75,000</td>
<td>91</td>
<td>20</td>
<td>50</td>
<td>1,500</td>
</tr>
<tr>
<td>2000</td>
<td>86,500</td>
<td>86</td>
<td>9</td>
<td>57</td>
<td>1,518</td>
</tr>
<tr>
<td>1999</td>
<td>59,525</td>
<td>90</td>
<td>11</td>
<td>54</td>
<td>1,102</td>
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<tr>
<td>1998</td>
<td>50,000</td>
<td>67</td>
<td>13</td>
<td>40</td>
<td>1,250</td>
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<tr>
<td>1997</td>
<td>30,700</td>
<td>25</td>
<td>4</td>
<td>20</td>
<td>1,535</td>
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<tr>
<td>1996</td>
<td>7,000</td>
<td>19</td>
<td>2</td>
<td>6</td>
<td>1,167</td>
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<tr>
<td>TOTAL</td>
<td>669,000</td>
<td>706</td>
<td></td>
<td>362</td>
<td></td>
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</tbody>
</table>

\(^{1}\) $133,550 in SEG 2005 budget and US$10,125 (C$ equiv) in the SEGCF budget.
SEG Contributions
12/1/04–2/28/05

FLEMING, ADRIAN W., NEW ZEALAND
GIESCHE, ALBRECHT E., NAMIBIA
GIZE, ANDREW P., GREAT BRITAIN
GULDEN, THOMAS, GERMANY
HAYSTON, PAUL, BRAZIL
HEINRICHS JR., WALTER E., USA
HELKE, ADOF, GERMANY
INNOVEST, USA
KENYON, KEITH B., CANADA
KOSKI, RANDOLPH A., USA
LENEY, GEORGE W., USA
LOGSDON, MARK J., USA
MACKEY JR., EDWARD M., USA
MELANCON, PAUL E., USA
MORE, SYVER W., USA
OLSON, JERRY C., USA
ORKAR, MALCOLM S., GREAT BRITAIN
PERRY, ALBERT J., USA
PLUMLEE, GEOFFREY S., USA
POP, NICOLAE, CANADA
RAMALINGASWAMY, VULIBIRI M., CANADA
REID, JAN W., AUSTRALIA
RODRIGUEZ PENA, LUIS S., SPAIN
RYTIBA, JAMES J., USA
SALAZAR, GUILLERMO, CANADA
SANCHEZ NANNIG, GEOVANNI C., CHILE
SCHMIDT, DWIGHT L., USA
SERGIOIDES, FRANK R., SOUTH AFRICA
SIDDOR, GARY B., USA
SOLOMON, MICHAEL, AUSTRALIA
SUAREZ LLEUTENA, JAIME C., PERU
YALAN, JESUS, PERU

SEG Foundation
12/1/04–2/28/05

CLARK, KENNETH F., USA
COLLINS, WILLIAM D., USA
DILWORTH, KATHI M., USA
EMERSON, MARK, USA
FONTBOTE, LLUIS, SWITZERLAND
HARVEY, BRUCE A., USA
HEINRICHS JR., WALTER E., USA
HILL, LOUIS F., USA
JANECKY, DAVID R., USA
JENNINGS, KEENAN, PERU
JOHNSON, DAVID A., USA
NAKAMURA, KIYOSHI, JAPAN
PATTON, THOMAS C., USA
PRICE, JONATHAN G., USA
RATTE, JAMES C., USA
SANCHEZ NANNIG, GEOVANNI C., CHILE
SHEARER, JOHANN, CANADA
STAUDE, JOHN-MARK G., CANADA
WARIN, OLIVER N., USA
WOLFGRAM, DIANE, USA

SEG Canada Foundation
12/1/04–2/28/05

ARAULOZ, LUIS A., PERU
DEBICKI, EDWARD J., CANADA
PEARSON, WILLIAM N., CANADA
WOODCOCK, JOHN R., CANADA

The Hugo Dummett Mineral Discovery Fund
12/1/04–2/28/05

ARDILA MACIAS, RICARDO J., CHILE
HAYNES, DOUGLAS W., AUSTRALIA
LEMBUX, ERIC B., CANADA
MCDougall, JAMES J., CANADA
MEGAW, PETER K.M., USA
ORTIZ, FRANCISCO J., CHILE
STAUFER, JOHN-MARK G., CANADA
THOMAS, RODNEY N., CANADA
WARIN, OLIVER N., USA

The Alberto Terrones L. Fund
12/1/04–2/28/05

ENRIQUEZ, ERME, MEXICO
LUKE, BARBARA A., USA
OROZCO VILLASENOR, FRANCISCO J., MEXICO

Please note: In the January Newsletter, we neglected to credit the Southern Nevada Section of SME, specifically, for its contribution to this fund.

The Timothy Nutt Memorial Fund
12/1/04–2/28/05

DACEY, ANDREW W., GREAT BRITAIN
KARPE, WLADYSLAW P., SOUTH AFRICA
MILLER, GRAHAM C., AUSTRALIA
MOODY, IAN W., AUSTRALIA
MOORE, JOHN M., SOUTH AFRICA
POHL, DEMETRIUS C., USA


FROM THE TREASURER

Year-End Summary

Once again the Society and the Foundation finished the year in excellent financial condition. Compared to the initial 2004 budget, both achieved higher revenues and lower expenditures while accomplishing an extensive array of programs as planned. Additionally, the investment portfolio had a return of approximately 11.6%, growing to $10.5 million.

Noteworthy areas of revenue in excess of what had been budgeted include increased contributions, increased dues, increased institutional subscriptions, increased page charges, and generous support for the 100th Anniversary Volume. These clearly reflect recognition by members, institutions, and industry for the value of Society publications and services. Overall, operating expenses were below budget, reflecting successful efforts by the full-time staff and volunteers to carefully manage the business while concurrently expanding member benefits.

Program support expenditures by the Foundation were up about 15% compared to 2003, reflecting the increased opportunities meriting Foundation support. Especially noteworthy is the increase in student research grants, up about 30% from 2003, indicative of renewed interest by graduate students in economic geology.

The investment portfolio finished the year at $10,536,708. This is a growth of $777,128 from the 2003 year-end value of $9,759,580. In addition to this growth, the portfolio also provided approximately $440,000 for operational activities of the Society during 2004. The portfolio continues to be managed under the direction of the Investment Committee with the guidance of Innovest Portfolio Solutions LLC, a Colorado investment advisory firm. Quarterly meetings of the Investment Committee and Innovest provide the opportunity to rebalance the investments, largely domestic and international bond and equity funds, for optimum growth and security for Society objectives.

As we enter 2005, the Society has a balanced budget providing even greater services while drawing less from the portfolio. The Society enters 2005 in a very strong financial position.

<table>
<thead>
<tr>
<th>Year End 2004</th>
<th>SEG Inc.</th>
<th>SEG Foundation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenues, total</td>
<td>$1,462,714</td>
<td>$460,248</td>
<td>$1,922,962</td>
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<tr>
<td>Expenses, total</td>
<td>$1,128,301</td>
<td>$289,253</td>
<td>$1,417,554</td>
</tr>
<tr>
<td>Contributions</td>
<td>$98,287</td>
<td>$115,868</td>
<td>$214,155</td>
</tr>
<tr>
<td>Capital Gains</td>
<td>$423,486</td>
<td>$340,494</td>
<td>$763,980</td>
</tr>
<tr>
<td>Portfolio Value</td>
<td>$5,981,414</td>
<td>$4,555,294</td>
<td>$10,536,708</td>
</tr>
</tbody>
</table>

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compare and contrast granite-related 
Sn, W, and Au-Bi deposits (Tables 1 and 
2; Fig. 1). The Tintina gold province in 
Yukon and Alaska contains some of the 
best documented and most significant 
granite-related Au-Bi deposits, includ-
ing Fort Knox, Dublin Gulch, Pogo, and 
Shotgun (Table 1), in addition to other 
Bi-poor Au deposits such as Brewery 
Creek and Donlin Creek (excluded from 
this analysis; see Hart et al., 2002). The 
Au deposits are spatially and tempo-
rally related to mid- to late-Cretaceous 
intrusions. Sources for whole-rock gran-
ite geochemistry used in this evaluation 
include data from Lang et al. (2000) on 
the central Yukon subalkalic Tombstone 
plutonic suite granites, which are asso-
ciated with sheeted Au-Bi deposits (e.g., 
Dublin Gulch) and smaller prospects in 
the area (e.g., Clear Creek and Scheele 
Dome). All three of these systems are 
also associated with W skarn deposits, 
the most significant being Ray Gulch 
(5.4 Mt @ 0.82% WO3; Lennan, 1983), 
which lies adjacent to the Dublin Gulch 
Au-Bi deposit (Maloof et al., 2001).

Bakke (1995) published data on the 
granites that host the Fort Knox Au-Bi 
deposit and W skarn mineralization.

| TABLE 1. Selected Granite-Related Gold-Bismuth Deposits |
|---------------------------------|-----------|------|-------|---------|---------------|
| Region                          | Au-Bi     | Au/  | Au grade | Au total | Reference     |
|  | deposits | Bi | Size (Mt) | (g/t) | (Moz.) |        |
| Tintina gold province                  | Fort Knox | 0.86 | 169.0    | 0.9    | 5.1   | Bakke, 1995   |
|                                  | Pogo       | 0.89 | 10.0     | 1.6    | 5.1   | Smith et al., 1999 |
|                                  | Dublin Gulch | 0.89 | 50.3     | 0.9    | 1.5   | Maloof et al., 2001 |
|                                  | Shotgun    | 0.73 | 1.0      | 0.9    | 1.0   | Rombach and Newberry, 2001 |
| Tasman fold belt                  | Kidston    | 0.65 | 94.0     | 1.5    | 4.5   | Baker and Andrew, 1991 |
|                                  | Timbarra   | 0.65 | 13.0     | 1.0    | 0.4   | Mustard, 2001   |
| Altaid orogenic belt  | Jilau       | 0.65 | 54.0     | 1.1    | 1.9   | Cole et al., 2000 |

| TABLE 2. Classification and Characterization of Granites Associated with Sn, W, and Au-Bi Deposits |
|---------------------------------|-----------|-------|---------|--------------|----------------|----------------|---------------|
| Metallogenic association Region/deposit | Country | Granite | SiO2 | Granitoid | Alumina | Accessory minerals | References |
| Sn-W-Bi                          | Cornwall | S     | 71-74 | Peraluminous | Ilmenite, monazite, andalusite, topaz, fluorite | Manning and Hill, 1990 |
| Sn-W-Bi                          | Herberton | I     | 73-77 | Peraluminous | Ilmenite, monazite, topaz, fluorite | Pollard, 1988; Champion and Chappell, 1992 |
| Sn-W-Bi                          | Fairbanks-Circle | USA | I | 71-77 | Peraluminous | Ilmenite, titanite, monazite, tourmaline, topaz | Newberry et al., 1990 |
| Sn-W                             | Western | I/S  | 70-74 | Peraluminous | Ilmenite, andalusite, pyrhotite | Ishihara et al., 1980; Linnen, 1998 |
| W-Sn-Mo                          | Jiangxi | S     | 66-76 | Peraluminous | Magnetite, monazite, garnet, monazite, tourmaline, fluorite | Yan et al., 1980 |
| W-Cu-Mo                          | E Yukon | I     | 67-77 | Peraluminous | Ilmenite, monazite, garnet, andalusite, allanite, tourmaline | Gordey and Anderson, 1993 |
| W-Mo-Sn-Bi                       | Altoid orogenic belt | Kazakhstan | I | 63-77 | Peraluminous | Magnetite, titanite, monazite, allanite, ilmenite, tourmaline | Heinhost et al., 1996; Serykh, 1996 |
| W-Mo-Bi-Sn                       | Herberton | I     | 56-72 | Peraluminous | Allanite, fluorite, ilmenite, | Champion and Chappell, 1992 |
| W-Sn-Au                          | Iberia | I/S  | 62-76 | Peraluminous | Cordierite, garnet, titanite, andalusite, sillimanite, tourmaline, topaz | Neiva and Gomes, 1991; Fernandez-Suarez, 1998 |
| Au-Bi-W                          | Tintina gold province | USA and Canada | I | 50-74 | Peraluminous | Magnetite, monazite, allanite, titanite, tourmaline | Lang et al., 1999; 2000 |
| Au-Bi-W                          | Jilau | I     | 57-72 | Peraluminous | Magnetite, monazite, allanite, titanite, tourmaline | Cole et al., 2000; Cole, 2000 |
| Au-Bi-Mo                         | Timbarra | I     | 49-78 | Peraluminous | Magnetite, ilmenite, titanite, fluorite | Mustard, 2001; Mustard 2004 |
| Au-Bi-Cu-Mo-W                    | Kidston | I     | 50-76 | Peraluminous | Titanite, fluorite, magnetite, ilmenite, xenotime | Baker and Andrew, 1991; Blevin, 2004 |

Bold = principal commodity(ies)  *
In addition to zircon and apatite

... from 5
Dilworth et al. (2002), Dilworth (2003), and Ebert (2003) described the petrology of intrusions in the region of the Pogo Au-Bi deposit. Mid-Cretaceous intrusions of eastern Yukon are also associated with major W skarn deposits, including Mactung (30 Mt @ 0.82% WO$_3$; Dick and Hodgson, 1982) and Cantung (4.2 Mt @ 1.6% WO$_3$; Mathieson and Clark, 1984). No significant gold deposits are known from this region of the Yukon. Gordey and Anderson (1993) addressed the geology and geochemistry of intrusions that are associated with the W deposits. In the Fairbanks-Circle region of Alaska, significant Sn and W deposits also occur with mid- to Late Cretaceous intrusions, and data from Newberry et al. (1990) are used to discriminate granites associated with the Sn and W systems.

The Tasman fold belt of eastern Australia also contains well-documented granite-related Au-Bi and W-Sn deposits. The major examples are Carboniferous to Permian in age, and we include data from Timbarra in northern New South Wales (Mustard, 2001a, b; Mustard, 2004). Timbarra contains disseminated Au mineralization in a multiphase, zoned intrusive complex, where Au is associated with Bi, Te, As, and Mo. A summary of the intrusion characteristics at the recently mined out Kidston deposit has also been included in Table 2 (Blevin, 2004, pers. commun.); however, no whole-rock data are available, in part due to the extensive alteration associated with the Au-bearing breccia pipe. The Herberton region of far north Queensland is well known for its Sn deposits (Pollard, 1988; Blevin, 1990; Champion, 1991; Champion and Chappell, 1992). We utilize data from Champion (1991), who described Kennedy Igneous Province granites from the region associated with Sn (O’Briens Creek supersuite) and W deposits (Ootann supersuite).

The Jilau sheeted vein- and skarn-hosted Au-Bi-W deposit in Tajikistan is associated with granodiorite to granite and has been described by Cole et al. (2000). The deposit formed during the late Paleozoic part of the Altai orogen, a province known for world-class orogenic Au deposits (e.g., Muruntau) in addition to significant granite-related W and Mo deposits (e.g., Late Paleozoic granites of central Kazakhstan: Heinhorst et al., 1996; Yakubchuk et al., 2002).

Additionally, we have compiled data from regions that contain significant Sn and/or W deposits, but which are apparently devoid of granite-related Au-Bi deposits. These include Cornwall, England, a region renowned for its Sn deposits (Manning and Hill, 1990), the Jiangxi province, southeast China, which contains some of the largest W mines in the world (Yan et al., 1980), and granite-related Sn and W deposits of Thailand (Ishihara et al., 1980).

For a comprehensive assessment of the quality of the geochemical data used, the reader is referred to the source references (Table 2). The major oxides (Fe$_2$O$_3$, FeO, Na$_2$O, K$_2$O, and CaO) and trace elements (Rb and Sn) used in the plots are subject to modification through weathering and/or alteration. However, the majority of studies referenced have focused on the least altered samples in order to address the primary igneous chemistry rather than alteration effects; nonetheless, some of the scatter in Figures 2, 3, and 4 may reflect varying degrees of alteration. Data from deposits such as Kidston and Shotgun have not been included owing to the extensive alteration associated with the breccia pipes (Blevin, 2004; Rombach and Newberry, 2001).
Blevin and Chappel (1992, 1995). These authors studied granites from eastern Australia and showed that granite-related Cu deposits are associated with less fractionated (Rb/Sr ≈ 0.01 to 0.1), oxidized intrusions (Fe₂O₃/FeO ≈ 0.5 to 5). In comparison, Mo deposits occur with more fractionated granites (Rb/Sr ≈ 0.1 to 10) of similar oxidation state, whereas granites related to W deposits are associated with fractionated intrusions (Rb/Sr = 0.1 to 10) of intermediate oxidation state (Fe₂O₃/FeO ≈ 0.1 to 2.0). Tin deposits, however, are associated with the most fractionated (Rb/Sr = 1 to 100) and reduced (Fe₂O₃/FeO = 0.01 to 0.5) granite types. Granite-related Cu and Mo deposits are associated with I-type intrusions, whereas W and Sn deposits are associated with both S- and I-type granites.

Table 2 summarizes the granite types associated with Sn, W, and Au deposits in the terranes selected for this study. Granites that are associated with Sn-dominant districts such as Cornwall, Herberton (O’Brien’s Creek supersuite), and the Sn-rich granites of Alaska are SiO₂ rich (> 70 wt %) and highly fractionated (Figs. 2 and 4). The intrusive rocks are subalkaline, peraluminous, and are both S- and I-type in origin (Fig. 3 and Table 2). The granites commonly contain biotite ± muscovite, but lack calcium-bearing silicates such as amphibole, pyroxene, and sphene (Ishihara, 1977). A wide range of accessory minerals is also present, including ilmenite (rather than magnetite—consistent with the typically reduced oxidation state), monazite, andalusite, topaz, tourmaline, fluorite, and garnet, in addition to zircon and apatite. Terranes that contain major Sn and W deposits (e.g., western Thailand) have granites with similar characteristics, whereas regions that are better known for their W mineral deposits such as the eastern Yukon, Jiangxi province in southeast China, central Kazakhstan, and Herberton (Ootan supersuite) are subtly different. S-type granites occur in some districts, but I-type granites are more common and show a range from metaluminous to peraluminous compositions (the latter being dominant; Figure 3). The granites are subalkaline, but show a greater range in SiO₂ (mostly from ~ 63 to 77 wt %; Fig. 2). Differences are also noted in the Rb/Sr ratios, which suggest that W-associated granites are less fractionated than Sn-related granites (Fig. 4). These granites are both magnetite- and ilmenite-bearing, consistent with a moderate oxidation state, as indicated by Fe₂O₃/FeO = 0.1 to 2.0.

The global comparison of Sn and W granite characteristics is consistent with previous studies (e.g., Blevin and Chappel, 1992, 1995); however, we are now able to place granites associated with the Au-Bi deposits within this context (Table 2 and Figs. 2, 3, and 4). The associated intrusions show a greater range in SiO₂ than Sn- and W-related granites in all three selected areas (Tintina gold province, Timbarra, and Jilau; Fig. 2 and Table 2). The bulk of the data ranges between 62 and 73 wt % SiO₂, consistent with the common association with granodiorite to granite compositions, but all three regions contain intrusive rocks that range between 50 and 60 wt percent SiO₂. The granites have Rb/Sr ratios that mostly lie between 0.1 and 1 (Fig. 4), are all I-type and dominantly metaluminous with localized peraluminous phases (Fig. 3). They are commonly biotite- and hornblende-bearing, and mostly contain ilmenite rather than magnetite, consistent with Fe₂O₃/FeO = 0.1 to 0.6. The range of accessory minerals is limited (titane, allanite, monazite, and rarely, garnet) compared to granites associated with Sn deposits. Timbarra, one of the smallest deposits of this type, differs in that it contains more magnetite than ilmenite (although both are present at trace levels only), and has undergone the highest degree of fractionation (Mustard, 2001a, b; 2004). Interestingly, there is no W mineralization at Timbarra, unlike most other significant Au-Bi deposits, but Mo is abundant, consistent with a more fractionated and oxidized granite (Blevin and Chappel, 1992, 1995; Mustard, 2001b).

**Sn, W, AND Au-Bi DEPOSIT CHARACTERISTICS**

A feature of granite-related Sn and W deposits is the range of deposit styles that occurs in and around the intrusions (Fig. 5 and Table 3). The deposits include vein (stockwork, sheeted, flat, or single large veins), breccia, disseminated, greisen, pegmatite, and skarn types (Taylor, 1979). The range in deposit styles in part reflects the wide range in emplacement depths, from shallow level breccia systems in volcanic environments (e.g., Bolivia Sn deposits), through subvolcanic- and plutonic-hosted breccia, stockwork, and sheeted vein systems (Cornwall and Herberton), to plutonic disseminated, greisen, flat vein, and pegmatite deposits (e.g., Thailand, Jiangxi, and Panasqueira). A similar range in deposit styles has been described for granite-related Au-Bi systems, including potential shallow level volcanic systems encountered at Kori Kollo in Bolivia, subvolcanic to plutonic breccia.
and vein systems at Kidston, plutonic sheeted and flat vein deposits in the Tintina gold province, and disseminated Au at Timbarra. Pegmatite-hosted deposits are not recognized, but both Fort Knox and Timbarra locally contain Au in pegmatite and vein dike (hydrothermal veins with aplite margins) features (Bakke, 1995; Mustard, 2001b).

A distinctive feature of most Sn systems, and to a lesser extent W deposits, is the common occurrence of tourmaline, although not uncommon in veins hosted by granites in granite-Au regions, is rare to absent in the mineralization. Tin and W deposits are commonly characterized by well-developed magmatic-hydrothermal transition textures (e.g., miarolitic cavities, pegmatites, vein dikes, and unidirectional solidification textures). Early high temperature alteration includes feldspathization (both potassic and sodic) followed by pervasive or vein-related greisen comprising muscovite-quartz ± biotite or chlorite ± topaz ± fluorite (Heinrich, 1990). Alteration in many vein systems is commonly confined to narrow envelopes (Heinrich, 1990). Cassiterite, wolframite, and scheelite commonly occur with muscovite, quartz, fluorite, and minor arsenopyrite and pyrite. The main sulfide stage is typically late and minor, and is characterized by chalcopyrite, sphalerite, stannite, and pyrrhotite.

Granite-related Au-Bi deposits share some parallels with the paragenesis of Sn and W deposits, including early magmatic-hydrothermal transition textures. In many of the deposits, scheelite and/or molybdenite appear to be precipitated in the early stages and are associated with feldspathic alteration. The main Au stage appears immediately to postdate this event and is associated with lower temperature sericite-carbonate-quartz (± pyrrhotite-arsenopyrite-pyrite) veins and alteration. Bismuth (e.g., native bismuth, maldonite, bismuthinite) and Te (Bi-Te-S

### TABLE 3. Comparative Summary of Selected Sn, W, and Au Deposit Characteristics

<table>
<thead>
<tr>
<th>Metals</th>
<th>Region/ deposit</th>
<th>Main alteration minerals*</th>
<th>Deposit types</th>
<th>Emplacement depth/ pressure</th>
<th>Fluids</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sn, W, Bi, Pb, Zn, Ag</td>
<td>Bolivia</td>
<td>Tourmaline, sericite, fluorite</td>
<td>Breccia, vein, disseminated</td>
<td>&lt;2 km/ 0.5 kbars</td>
<td>Early high T, hypersaline; late low salinity, low T; CO₂ rare</td>
<td>Linnen, 1998</td>
</tr>
<tr>
<td>Sn, W, As, Mo, Bi, Cu, Pb, Zn</td>
<td>Herberton</td>
<td>Albite, K-feldspar, muscovite, quartz</td>
<td>Veins, pipes, intrusive breccias</td>
<td>1–3 km/ 1 kbars</td>
<td>Early high T, hypersaline; late low salinity, low T; CO₂ rare</td>
<td>Linnen, 1998</td>
</tr>
<tr>
<td>Sn, W, As, Cu, Pb, Zn</td>
<td>Cornwall</td>
<td>K-feldspar, tourmaline, muscovite, calcite, fluorite</td>
<td>Veins, sheeted veins, greisen</td>
<td>3–6 km/1-2 kbars</td>
<td>Early high T moderate salinity ± hypersaline; late low salinity and Ca-Mg-rich fluids; CO₂ rare</td>
<td>Linnen, 1998</td>
</tr>
<tr>
<td>Sn, W, Cu, Zn, Ta, Nb</td>
<td>Thailand</td>
<td>Fluorite, muscovite, tourmaline, calc-silicate</td>
<td>Pegmatite, vein, disseminated, greisen, skarn</td>
<td>3–12 km/1-3 kbars</td>
<td>Moderate T, low salinity H₂O-CO₂-CH₄</td>
<td>Linnen, 1998</td>
</tr>
<tr>
<td>Sn, W, Cu, Ag</td>
<td>Iberia</td>
<td>Muscovite, tourmaline</td>
<td>Vein (flat), greisen</td>
<td>0.1 to 3 kbars</td>
<td>High to moderate T, low salinity H₂O-CO₂-CH₄</td>
<td>Linnen, 1998</td>
</tr>
<tr>
<td>W, Mo, Bi, Sn</td>
<td>Herberton</td>
<td>Muscovite</td>
<td>Veins, pipes, massive greisen</td>
<td>&lt;5 km/ 2 kbars</td>
<td>Early high T, high salinity; late low to moderate salinity, moderate T and variable CO₂</td>
<td>Charoy and Pollard, 1989</td>
</tr>
<tr>
<td>W, Cu, Zn, Pb, Sn, As</td>
<td>E Yukon</td>
<td>Calc-silicate</td>
<td>Skarn</td>
<td>3–6 km/1-2 kbars</td>
<td>Moderate T, low salinity CH₄ bearing</td>
<td>Gerstner et al., 1989</td>
</tr>
<tr>
<td>W, Sn, Nb, Ta, Mo</td>
<td>Jiangxi</td>
<td>K-feldspar, biotite, muscovite, calcite, chlorite, topaz, tourmaline, fluorite, calc-silicate</td>
<td>Disseminated, greisen, vein, breccia, skarn</td>
<td>3–6 km?</td>
<td>Moderate T, low salinity H₂O-CO₂</td>
<td>Jiaqi, 1992</td>
</tr>
<tr>
<td>Au, Bi, W, As, Mo, Te, Sb</td>
<td>Tintina gold province</td>
<td>Muscovite, chlorite, calcite, albite, K-feldspar, biotite</td>
<td>Sheeted veins, vein (flat; stockwork), breccia</td>
<td>2–5 km/ 0.5–1.7 kbars</td>
<td>Moderate T, low salinity H₂O-CO₂-CH₄, locally hypersaline</td>
<td>Baker, 2002</td>
</tr>
<tr>
<td>Au, Bi, Ag, Te, Mo, Sb, As</td>
<td>Timbarra</td>
<td>Chlorite, sericite, albite, fluorite, calcite</td>
<td>Disseminated</td>
<td>≈7 km/ 2 kbars</td>
<td>Moderate T, low salinity H₂O-CO₂</td>
<td>Mustard, 2001a</td>
</tr>
<tr>
<td>Au, Bi, Te, W, As, Cu</td>
<td>Jilau</td>
<td>Calcite, sericite, feldspar</td>
<td>Vein, skarn</td>
<td>≈8 km/ 2.2 kbars</td>
<td>Moderate T, low salinity H₂O-CO₂-CH₄</td>
<td>Cole et al., 2000</td>
</tr>
<tr>
<td>Au, Bi, Mo, W, As, Te, Zn, Cu, Pb</td>
<td>Kidston</td>
<td>Sericite, carbonate</td>
<td>Breccia, sheeted vein</td>
<td>3 km/0.8 kbars</td>
<td>High to moderate T, hypersaline, and moderate T, moderate salinity CO₂</td>
<td>Baker and Andrew, 1991</td>
</tr>
</tbody>
</table>

*In addition to quartz
minerals) also occur during this stage and show a strong correlation with Au. Later base-metal veins (Pb, Zn ± Cu sulfide) and carbonate-rich veins locally postdate the main Au stage. In general, all three deposit types typically contain low amounts of sulfide (compared with porphyry Cu deposits, for example), but the sulfide content may be higher in country rock-hosted deposits.

Sn, W, AND Au-Bi FLUID CHARACTERISTICS

Linnen (1998), Heinrich (1990), and Wood and Samson (2000) reviewed fluid inclusions in Sn and W deposits from different regions, including shallow Sn-W systems associated with subvolcanic porphyry stocks and domes (e.g., Bolivia; Herberton, Australia); and deeper plutonic veins and greisen systems (e.g., western Tasmania; southeast Asia; Hercynian, Europe). The shallow systems (<1 kbar) commonly contain high-temperature coexisting brine and vapor inclusions, whereas the deeper systems (0.5–3 kbars) contain abundant low-salinity, CO₂-bearing aqueous inclusions. Chloride complexes were interpreted by Wood and Samson (2000) to be unimportant for W transport, with tungstate (WO₄²⁻) being the main solute species. Heinrich (1990), however, suggested that in Sn systems the chief ligand was Cl⁻ even in the low-salinity ore fluids. Baker (2002) reviewed fluid inclusion variations in granite-related Au deposits from shallow crustal settings (<~5 km) and deeper plutonic environments (>5 km), and found that Au deposits exhibit variations similar to those observed in Sn-W systems. Deposits in shallow environments contain high-temperature (>350°C) immiscible brine (>30 wt % NaCl equiv) and low-salinity (<5 wt % NaCl equiv) vapor that commonly contains CO₂. Deposits in deeper environments contain abundant low-salinity, CO₂-rich aqueous fluids (<10 wt % NaCl equiv). Baker (2002) suggested that the contrasting fluid types were likely due to the behavior of CO₂ in felsic magmas, with deeper systems rich in CO₂ due to its low solubility at higher pressures in the melt. He suggested that in the deeper deposits, Au (and Bi?) is likely to be transported as a bisulfide complex owing to the reduced conditions and low salinity of the fluids, and that in the shallower systems chloride complexes may be important, but that bisulfide complexes were likely to occur in the vapor phase.

FIGURE 5. Schematic diagram illustrating the different mineralization styles and their relationships to different granite types in Au-Bi and Sn-W deposits, with selected examples.

IMPLICATIONS FOR THE GENESIS OF Au-Bi DEPOSITS AND THEIR EXPLORATION IN Sn-W TERRANES

A comparison of the granite geochemistry associated with Sn, W, and Au-Bi deposits clearly shows that there are distinct differences between the groups (Figs. 2, 3, and 4). Tin deposits are associated with the most fractionated, peraluminous granite types and are typically the most reduced. Tungsten granites show significant overlap with the Sn granites, but are typically less fractionated and have more intermediate oxidation states. Tungsten granites share many similarities with granites associated with Au-Bi deposits and, indeed, the two mineralization types are common within the same mineral camp (e.g., Tintina gold province). However, the granite suites associated with Au-Bi deposits invariably show a greater range of SiO₂ and on average are less fractionated. These findings have significant implications for exploration for Au-Bi systems in Sn-W terranes. Tin-W terranes that are dominantly associated with S-type and peraluminous granites appear to be significantly less favorable (e.g., Cornwall) than Sn-W regions that contain I-type, metaluminous to peraluminous granite compositions. Furthermore, districts within I-type granite belts that contain a greater SiO₂ range are considered more prospective. For example, in the Yukon there are major W deposits (e.g., Mactung and Cantung) at the eastern end of the Tintina gold province that are related to granites that have 67 to 77 wt percent SiO₂ but do not have any significant known Au association (Table 2). Farther west in the Yukon and into central Alaska, numerous Au-Bi occurrences and deposits are associated with granites that show a much greater range in SiO₂ (50–74 wt %). This relationship appears to be consistent in other terranes where granite-metal association data can be reliably discriminated, such as in the Tasman fold belt (e.g., Kidston and Timbarra; Table 2). There are indications in other terranes that this is a consistent association. The Iberian peninsula of Spain and Portugal contains significant Sn and W mineralization, but also numerous Au occurrences of possible magmatic origin (e.g., Salave and Jales).
The data available from this region do not allow us to discriminate between specific granite-metal associations, but it is interesting to note that the compositional range in the region is greater than that of granite-related Sn-W terranes elsewhere that lack Au (Table 2).

There are also important genetic implications. Tin-W deposits occur in a variety of tectonic environments, including continental arc, back-arc, continent-continent collision, and intra-continental settings (Taylor, 1979). The Sn-W terranes with significant Au appear to have formed primarily in continental margin settings, distal from the arc to back arc in some instances, and during late to postorogenic compression (Thompson et al., 1999). Within this environment the deposits are associated with granite regions that contain a range from mafic-intermediate to felsic compositions. Nonetheless, several workers have documented that the more fractionated granite phases are closely associated with Au and Bi at the site of deposition (e.g.: Kidston: Baker and Andrews, 1991; Fort Knox: Bakke, 1995; McCoy et al., 1997; Timbarra: Mustard, 2001b). These observations, therefore, may imply a role for more primitive magmas and/or mantle in supplying certain components to the deposits (Au and CO2), but fractionation and volatile exsolution processes were important in concentrating the ore.

The relationship between Au and Bi may provide some insights into source and depositional processes. Bismuth is an abundant element in many highly fractionated Sn-W ore systems that lack Au (Strong, 1988), whereas Au deposits in Au-bearing Sn-W terranes have a very strong Bi correlation (Table 1). This indicates that either the ultimate sources of Bi and Au are different, or that they only coprecipitate under certain conditions. One possible explanation is that the Au was sourced from primitive magmas (explaining the absence of Au in Sn-W-Bi deposits of restricted, high-silica granite composition) but is concentrated by the late fractionation process that also concentrates Bi (Mustard and Ulrich, 2004). Furthermore, Douglas et al. (2000) have shown that Bi may play an important role in partitioning Au from a hydrothermal fluid through their liquid-bismuth collector model. Thus, if Au is present in reduced, granite-derived fluids, it will likely be associated with Bi. There is less information on Te from the Au-Bi deposits, but the available data suggest it also has a close association with Au. This relationship is worth further investigation because Te is typically absent from Sn-W systems, and may therefore be a useful pathway, in addition to Bi, for exploration for granite-Au systems.

**CONCLUSIONS**

Exploration for granite-related Au-Bi deposits in Sn-W terranes should consider the following outcomes of this research:

1. Tin-W terranes associated with S-type granites are less favorable than I-type granite regions.
2. Within Sn-W terranes associated with I-type granites, regions that contain a wide range of SiO2 compositions are more favorable.
3. Tin-W deposits may contain pathfinder elements that overlap with the Au-Bi deposits (e.g., Bi, As, Mo, Ag, Sb). Tellurium may help further distinguish Au-Bi systems.
4. Gold-Bi deposits occur in a variety of deposit styles (in part controlled by host rock, proximity to granite, and depth of emplacement) and exploration geologists need to be aware of the variety of target types in and around the intrusive environment.
5. Tin-W systems also exhibit this range in style, but vein and alteration minerals such as F-bearing minerals and tourmaline appear to be more abundant in these deposits.

**ACKNOWLEDGMENTS**

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Lightening the Heart of Darkness: The Rebirth of Gold Mining in SubSaharan Africa

Michael Martineau spoke on the topic of gold mining in SubSaharan Africa as 2004 SEG Distinguished Lecturer. He can be contacted at AXMIN Inc, Suite 107, Kent House, 81 Station Road, Ashford TN23 1PP, United Kingdom; e-mail, michael.martineau@btinternet.com

INTRODUCTION

SubSaharan Africa, that group of 36 countries lying south of the Sahara and north of the Limpopo River, has experienced a boom in the development of commercial gold mining over the past 18 years that has passed almost unnoticed. Yet since 1990 it has consistently produced more discoveries at a lower cost than any other area in the world (Fig. 1a). It is a record of hope and success, in an area often associated with tragedy, that has been created by a small group of civil servants, geologists, and entrepreneurs who were willing to stake their reputations against the ruling dogmas of despair and what was presumed a poor endowment. Since 1986, over 25 new mines have been developed (Fig. 1b) based on 140 million newly discovered ounces of gold (4,500 tonnes) in measured and indicated resources (Fig. 2a). Commercial production has grown from 25 loss-making tonnes of commercially produced gold per annum to approximately 250 t of low-cost production. Eleven new mines are either under construction or at the feasibility decision stage and commercial production is on course to exceed 300 t per year by 2007. The record of discovery and development continues as major companies, encouraged to invest by the success of their junior predecessors, explore around the initial discoveries that they have purchased from them or farmed into, and junior companies identify and explore in new areas (Fig 2b).

This is a story, above all, about the individual’s ability to change perceptions and the ruling investment criteria through patient negotiation in both government and financial offices, coupled with a willingness to get his or her own hands dirty in the field on potential prospects. It is a classic demonstration of why a short line of communication from the field operator to the ultimate decision maker and the delegation of responsibility to the field operator for negotiation as well as exploration-related decisions are essential for successful grassroots exploration or mine development in new areas.

HISTORICAL PERSPECTIVE

Gold mining has existed in SubSaharan Africa for over 1,700 years (Fig. 3a). Traces are most evident in the former Malian, Ghanaian, and Zimbabwe empires that in the 1300s extended far beyond the limits of their present namesakes. Trade across and around the margins of the Sahara desert was extensive, peaking in the fourteenth century with the arrival in Mecca of Mansa Mousa, the “king” of Mali, carrying 13 t of gold on 100 camels. However, the power and legacy of these prehistoric cultures had disappeared under the pressure of Arab and Portuguese conquests of the trading cen-
ters long prior to colonial settlement, at which time a new mining era began.

The British, Germans, and Belgians treated their colonies as an important source of raw materials, introduced systematic geological mapping of high quality, and encouraged the development of privately owned mines. Records are good and extensive, although not always easily accessible. Many of the new mines or prospects in Tanzania, Ghana, Sierra Leone, and the Democratic Republic of Congo (DRC) have been (re)-discovered through careful field review based on these historical records.

The French, by contrast, treated their colonies as an extension of France, most suitable for agricultural development, trade, and settlement. French West Africa, comprising almost a third of Sub-Saharan Africa, featured only one or two small hard-rock gold prospects plus a small number of alluvial gold operations. The development in former French areas has therefore relied to a much greater extent on the follow-up of prehistoric workings, and on regional scale geochemical surveys carried out as aid programs since 1970.

Following independence, exploration and development largely ceased, partly because of the threat or reality of nationalization, but to the greatest extent because an increasing misalignment of exchange rates precluded profitable operation. As known reserves were exhausted, mines closed without replacement. In 1967, operations at Geita, the largest of Tanzania’s gold mines, ceased with reserves still in place; in Ghana the intervention of Tiny Rowland at Obuasi, on behalf of Lonrho, allowed production to increase briefly throughout the 1970s, but by 1980 Prestea, Obuasi, and Tarkwa, all formerly substantial mines, were in terminal decline sustained only by state funding. Only in newly independent Zimbabwe did mining continue to flourish (ironically, now to follow the same destructive course of economic mismanagement under Robert Mugabe).

REGIONAL AID AND SMALL-SCALE MINING

The fear of a world shortage of minerals coupled with the pressure to locate reserves of uranium after 1970 drove a worldwide minerals boom. In Africa this provided an incentive for aid-funded regional aeromagnetic, geochemical, and radiometric surveys. In the former British colonies and Guinea these were mostly conducted by Geosurvey. In French West Africa, the BRGM, that curious combination of geological survey, mine developer, and extension of the French political influence, conducted regional geochemical and mapping surveys, generating a data base from which many discoveries would be made in Cote d’Ivoire, Senegal, and Central Mali. With funding from the German Government, the European Development Fund and the United Nations, Klockner and others conducted regional geochemical and aeromagnetic surveys across large parts of Mali, Niger, and Burkina Faso, identifying the anomalies and ancient workings that were to provide the base for, among others, the major mines of Sadiola, Syama, and Morila in Mali and Samira Hill in Niger. No new mines resulted from this work at that time (with the possible exceptions of Ity in Cote D’Ivoire and Ariab in Sudan, which were both small, high grade, and developed by...
the BRGM), owing to the unacceptable investment climate at the time, but by the late 1980s an important database had been created.

At the same time a rise in the gold price, coupled with the collapsing economies and a misalignment of currencies, stimulated a new phase of mining by artisans. Massive gold rushes involving the migration of tens of thousands of rural people erupted across Tanzania, Ghana, and DRC; on a much smaller scale rushes also occurred in French West Africa. These rushes followed a similar pattern to those over 100 years earlier in Canada, the United States, and Australia, resulting in disease, crime, social disruption, and a high death rate through unsafe practices. After a short life of typically one to five years, they equally rapidly collapsed following the exhaustion of the shallow resources. However, at least 50 percent of the recent discoveries, including Bulyanhulu, Golden Pride, and North Mara in Tanzania, and several mines in Ghana, are based on the follow-up of the remnants of their activity.

GEOLGY

All the major new mines are located either in the greenstones and granites of the Archean cratons (3.5–2.4 Ga) of Zimbabwe, Tanzania, DRC, Central African Republic (CAR), Sierra Leone, and Mauritania, or in the Proterozoic sedimentary and volcanic rocks of the Birrimian (2.2–1.95 Ga) in Ghana, Guinea, Mali, and Senegal (Fig. 3b). The younger Proterozoic (850–650 Ma) volcanic belts of the Sudan, Ethiopia, Eritrea, and Egypt host important deposits as yet undeveloped because of the absence of suitable mining codes and the threat of insurgency. It is likely that, in the future, new types and ages of deposits will be located, such as iron oxide associated copper-gold-uranium deposits in Zambia, DRC, or CAR, or younger sediment-hosted gold deposits in mobile belts of Togo, Cameroon, Gabon, Sudan, and DRC, for which prospects are already under investigation.

Strong structural control of regional extent is particularly evident in the localization of the Birrimian deposits, most of which are associated with transverse and thrust faults at the margins of northeast-trending volcanic belts associated with the collision into the African proto-continent of the Archean block centered on Sierra Leone, Liberia, and southwestern Guinea (Fig. 4a). In contrast, the Malian deposits Yatela, Sadiola, Loulou, and Tabokoto, occur along splays from the northwest-trending Malian shear, which largely separates the northeast-trending island arc-basin terranes mentioned above from the continental margin limestones and sandstones of a cratonic block to the northeast. In the Archean, strong structural control is likewise evident. For instance, the major Tanzanian mines Geita, Bulyanhulu, and Golden Pride lie along a northwest-trending fracture.
zone, evident from satellite photography and from aeromagnetic surveys, and also evident in the alignment of shears within the deposits themselves (Fig. 4b).

Many of the Archean deposits (e.g., Geita) occur in iron formations. Others occur in sheared basic or intermediate volcanic rocks (e.g., Golden Pride), as quartz veins (e.g., Bulyanhulu), or as sheeted vein swarms in the apex of granodiorites (e.g., Freda-Rebecca). In the Birrimian, most deposits occur at the contacts between basic volcanic rocks, interpreted as island arc remnants, and black shale-graywacke sedimentary rocks interpreted as having formed in back-arc basins (e.g., Obuasi, Prestea). However, especially in Mali and Cote d’Ivoire, they also occur associated with diorite dikes and sills in brittle quartzite and marble (e.g., Loulou, Sadiola, Ity).

In Ghana, an important group of deposits (including the largest Tarkwa) occurs in a later sequence of fluvial conglomerates and quartzites of Witwatersrand type lying at the center of several of the greenstone-black shale belts that may fill intracratonic rifts. Tourmaline and albitic alteration are common in deposits of both ages. Deep tropical weathering has been a major factor in making certain deposits amenable to mining and processing. Enrichment in the oxide zone is locally but not universally of importance.

**INITIATING THE RECOVERY**

1981 saw two events critical to the recovery: firstly, the formation of a committee in Ghana (under the revolutionary President Rawlings, who was determined to break the cycle of socialist mismanagement and corruption), which was charged with the development of a modern mining act; and secondly, the formation of the first of the junior explorers in Africa, Cluff Mineral Exploration Limited. Ghana was still struggling under the worst famine and financial crisis in its history, and because the committee needed to persuade many disparate and often hostile “interested parties”—not least, the World Bank—and vested nationalist and socialist interests, the new Mining Act was not agreed upon and published until 1986. Likewise, the Cluff group took time to establish its mining team around its early small production, and the first large discovery was not made until 1985. Nevertheless, the seeds of the recovery, as yet unrecognized, had been sown.

**ZIMBABWE AND THE FIRST OF THE PANAFRICAN JUNIOR EXPLORATION COMPANIES**

The 1980s saw the creation of many junior gold exploration and development companies on all continents, driven by a high gold price, layoffs by major companies of many of their most talented explorers, the availability of finance, and above all, the development, especially in Australia, of new low-cost high-recovery mill, CIP/CIL, and gold-stripping technologies. Africa barely participated in this first wave of that global recovery: in South Africa, because the major mining companies and financiers discouraged competition from new entrants; and in the remainder of Africa, because of the adverse
Lightening the Heart of Darkness (Continued)

economic/political climate. The newly independent Zimbabwe stood out as a remarkable exception with its long history of small miners, high education level, a supportive government of reconciliation, and an operating mining and exploration legislative environment.

John (Algy) Cluff, an entrepreneur with a history of successful oil exploration in the UK’s North Sea, recognized the potential and accepted the challenge laid down to him by a participant in Zimbabwe’s independence negotiations to invest in and back a (then) freely democratic government. By 1982, Cluff’s geologists had discovered and were developing their first mine, the Royal Family, around former colonial workings. Of itself, the Royal Family mine was an insignificant 5,000-oz/yr producer using conventional technology, but it supported a team that was to introduce revolutionary changes to the Sub-Saharan gold industry over the next decade.

In 1985 this team discovered two new deposits with multimillion-ounce potential adjacent to another former colonial mine. The development of the Freda and Rebecca mines demonstrated, for the first time, that the best modern technology and operating practices could be applied in Sub-Saharan Africa, including contract mining, fixed price turnkey construction, non-recourse debt finance, and operation by locals without significant expatriate involvement.

Freda, the first large-scale open-pit gold mine in Africa, entered production in 1988. It introduced heap leaching on plastic and was 100 percent non-recourse financed. It mined at a head grade of 0.9 g/t Au, which was scathingly described by the CEO of the then leading producer in Zimbabwe as “substantially below his tails grade.” The mine, brought into production only 18 months from its discovery drill hole, proved a resounding success because the “sanded” granite host required minimal breakage before mining and was amenable to high recoveries with a quick leach time without agglomeration on heaps with several lifts. During Freda’s construction, the second and adjacent hard-rock open-pit mine, Rebecca, with a head grade of approx 3 g/t Au, was developed using a standard Australian fixed-price turnkey construction contract for a nearly off-the-shelf semi-autogenous mill to CIL plant supplied by Minproc. The introduction to Africa of operating and financing practices, which by that time were standard in Australia and the United States, but which had previously been thought to be inapplicable on this continent, led to greatly reduced capital and operating cost requirements. In turn, this led across Africa to the move away from small and high-cost underground operations to the low-cost, low-grade, high-throughput open-pit operations that characterized the rebirth.

In a further widely copied move, Cluff developed programs to train Africans to the highest technical and management levels both locally and through international secondment, removing the need for the large number of high-cost expatriates that had characterized previous developments. (Ashanti, under its African CEO Sam Jonah, was training its African employees to a high technical level but was yet to cut expatriate numbers.)

Cluff’s success in Zimbabwe did not lead to a minerals boom in that country, in large part because of the subsequent restrictions on capital repatriation and the subsequent exchange rate misalignment, but in a move that spread its philosophy, it turned its attention to Ghana where the new minerals act was now effective, and to Tanzania where the new president was introducing an economic reform program. As part of a planned joint venture, Cluff approached Ashanti to develop open pits above the underground mines at Obuasi in Ghana, taking Ashanti staff to Australia to study the Kalgoorlie superpit and arranging for the training secondment of an Ashanti engineer at its own Freda-Rebecca operations. Although no joint venture eventuated, the principle of mutual cooperation and exchange of ideas between the many British, Canadian, Australian, and African participants in the Sub-Saharan redevelopment, which has so uniquely characterized and driven the rebirth of gold mining in this region, was clearly established and two years later Ashanti developed its own major open-pit heap leach operation alone.

GHANA

While Cluff explored, the Ghana committee deliberated. The committee, which included Kofi Ansah (later Minerals Commissioner throughout the expansionary period from 1986 to 1999) and Sam Jonah from Ashanti Goldfields (who was later to become CEO), comprised members from the government, industry, and an international advisory
group. With much patience over five years, they overcame the obstacles and developed what has become the model for all new mining legislation across Sub-Saharan Africa. The new legislation addressed both mining and fiscal issues, and built on international experience in developing new codes for New Guinea and Guyana. It provided for security of title, limited government participation (10% free carried plus the right to purchase and fund a further 10% equity interest at market rate), the exclusive right to proceed to development based on former exploration licences subject only to described conditions, a 3% royalty on gold sales, relief from import and other duties, and the right to repatriate an agreed level of earnings. A Minerals Commission, charged with the granting and recording of title and promoting the industry, was established with initial dedicated external funding.

The new Ghanaian legislation, together with the introduction of a realistic and free floating exchange rate and the promotion of specific investment opportunities around prospective targets by the Minerals Commission, had the immediate effect of bringing in new investors alert to the changing situation. Golden Shamrock, Glencar, and Cluff, forming part of the first 1986-1987 wave of investment, were all introduced by the Minerals Commission to prospects on which they defined reserves and developed successful mines that were in production by the early 1990s. The realization by Golden Shamrock and Glencar that the thick, low-grade but shallowly dipping conglomerate horizons in the Tarkwaian series would be amenable to large-scale open-pit mining, in contrast to traditional seam mining underground, led to early development of the Iduapriem and Teberebie deposits. Some years later, Goldfields of South Africa took over the old Tarkwa gold mine from the state and redeveloped it as a million ounces of newly discovered resources.

New investment at Obuasi by Ashanti Goldfields and its subsequent public listing on the London stock exchange led to its temporarily increasing production from 250,000 oz/yr to 1 Moz/yr Au (now 500,000 oz/yr) in large part through the development of open-pit mining in the stockworks bordering the historic high grade vein deposits. Unfortunately, under pressure from the financial advisors, Ashanti Goldfields developments were on a scale that needlessly increased both capital and operating costs, a mistake that also led to the demise of the new Teberebie and Bogosu mine developments during the 1990s.

By 2003 Ghanaian gold production had increased to over 2 Moz/yr through the development of nine new mines. Further increases to an estimated 3 Moz/yr by 2008 are predicted as new discoveries at the margins of the volcanic belts by Newmont and Golden Star and planned expansions are brought to fruition.

**TANZANIA**

Although Tanzania is now recognized as one of the leading African gold mining nations, its transition to favored nation status was not as smooth as Ghana’s. In 1986 Tanzania’s “Great Leader” President Nyerere, publicly acknowledged the economic failure of his socialist policies and voluntarily stepped aside to institute a democratic government with a mixed economy. Unfortunately, in a move that was to delay the influx of minerals explorers for at least four years, the rights to essentially all the Lake Victoria greenstone belts that host the best commercial gold potential were granted to an Egyptian-run company Dar Tadine Trading (DTT). DTT assembled a highly talented team of western explorers, commissioned the reprocessing of all preexisting data including the Geosurvey aeromagnetic survey, and purchased extensive exploration equipment. Whether DTT ever intended to explore seriously is uncertain, for their activities rapidly degenerated into an opaque gold-buying operation while the explorers and their equipment languished unfunded.

In 1990, SAMAX (established by Cluff’s former managers), having reviewed prospects lying outside the DTT territory, successfully negotiated the granting of Tanzania’s first four “new order” exploration licences. In a further illustration of the cooperative relationship between the pioneering explorers the area selection was partly based on an exchange of data with Kenor, another junior explorer best known for its discoveries in Guinea. On two of these licences SAMAX were to discover the multimillion-ounce Golden Pride, Kukuluma, and Matandani deposits. These deposits were to form the basis for the development of Tanzania’s first two commercial mines.

In 1992, Cluff finally obtained access to the former Geita mine (800,000 oz Au historic production), based on an application made four years previously and to adjacent ground previously granted to the UN (whose intervention had effectively delayed meaningful exploration on this prime ground for four years). Within months Cluff had defined resources amenable to open-pit mining. Publication of the early successes by SAMAX and Cluff, coupled with the final cancellation of DTT’s licences, encouraged other juniors, including Sutton Resources (Bulyanhulu) and East African Gold Mines (North Mara), to enter the country. However, it was only in 1998, with clarification of the conditions for the partly constructed Golden Pride mine critical to profitable operation and financing, that the Ghana-style fiscal conditions and the new Mining Code were finally gazetted. It had taken 10 years of patient discussion, negotiation, and company-sponsored trips to Ghanaian, Australian, and Canadian mines by government representatives to view the operation of modern mining acts to bring about what is now acknowledged to be Africa’s fairest minerals legislation.

By the end of 2004, five new mines were in production with a combined output of 1.5 Moz Au and measured plus indicated resources containing 1,200 t of gold.

**MALI, GUINEA, AND FRENCH WEST AFRICA**

In contrast to the former British colonies of Zimbabwe, Ghana, and Tanzania, where most new prospects were located by exploration around former mines, the identification of the mineral potential of French West Africa grew out of the regional geochemical surveys of Klockner, the UN, and the BRGM conducted during the mid 1980s, and changes to the mining acts starting in 1986. The first minerals conventions based on the results of these surveys were applied for and obtained, almost accidentally, by entrepreneurs who were active in the countries for other purposes: shipping (Kenor), trading (Iamgold), or charitable ventures (SEMAFO).

In 1987, Kenor was awarded one of the first
minerals concessions in Guinea around the small former underground Banora mine. Kenor brought in the BRGM to conduct exploration, and after an initial evaluation of alluvial resources, initiated feasibility studies for an open-pit, heap leach operation based on their discovery of the Lero deposit in 1990. In 1990, Golden Shamrock obtained rights to the Siguiiri area also in Guinea, on which by 1994 they had completed feasibility studies for a heap leach operation based on extensive gold-bearing laterites.

In 1990 Iamgold, following up on the legend of Mansa Mousa’s source of gold in the 1300s, was granted the first Malian exploration permit over the Sadiola concession, where Klockner had defined a strong gold-in-soil anomaly around prehistoric artisanal workings. Iamgold initially employed Klockner to continue the detailed exploration, but by 1992, with a small near-surface resource already defined, had brought in Anglogold to continue the development. The 500,000 oz/yr Au mine that entered production in 1996 thereby initiated the pattern of partnership between junior and major companies that has characterized and accelerated the more recent Sub-Saharan African developments. BHP developed the Syama deposit discovered by the BRGM, but like Bilton at Bogosu (Ghana), Pioneer at Teberebie, and Ashanti at Obuasi open pit, overcapitalized the operation, used too many expatriates, and developed on too large a scale with too elaborate technology. As part of a world-wide retrenchment of its gold assets, BHP sold all its Malian interests, including the Loulo and Morila discoveries, to Randgold, which has since capitalized on and greatly expanded these resources.

Parallel but smaller discoveries were made in Cote d’Ivoire, Burkina Faso, and Niger.

Development of the discoveries in this part of Africa required the negotiation of individual conventions to give security of title and to ameliorate the otherwise extremely high taxation, social costs, and government-retained interests (up to 50%). Throughout the 1990s, and up to the present time, there has been a progressive move by the former French colonies to introduce legislation closer to the Ghana-Tanzania model, with Niger, Cameroon, Burkina Faso, and the CAR providing recent examples, but it is generally true to say that development has been slower, more costly, more complicated, and more bureaucratic than in Anglophone Africa.

By the end of 2004, six new gold mines had been developed in Francophone Africa with a capacity of 1.7 Moz/yr, and four new mines were under construction that are predicted to increase production to over 2.4 million by 2006.

NEW AREAS

With the new millennium, a revival in the gold price and the junior market, a new phase of exploration by junior companies has begun. The emphasis has shifted from Tanzania and Mali (where no new greenfields discoveries have been made since 1998) to Sierra Leone and Liberia (Mano River), Central African Republic (AXMIN), Eritrea (Nevsun et al), DRC (Moto and Banro), and Mauritania (Rio Narcea). Discoveries likely to be capable of development have been made in each country and the major companies have followed, but it remains to be seen whether necessary changes to minerals and fiscal legislation and the stability of these governments will permit the same type of successful industry development that has been achieved in Ghana, Tanzania, and Mali. Emphasis is also moving toward base metals, diamonds, and iron ore, resources for which new discoveries and developments, also led by junior companies, are being made.

THE MAJOR COMPANIES AND RISK ASSESSMENT

Control of the major gold deposits has progressively passed to the world’s major gold-mining companies through joint venture and acquisition. The price paid by the major companies for this participation appeared relatively high at the time (US$30–$40 per resource ounce, US$70–$100 per undeveloped reserve ounce); however, the initial price paid has typically been justified, with the benefit of hindsight, through the subsequent expansion of reserves and resources discovered through brownfield exploration. For example, at Geita, acquired by Ashanti through the purchase of Cluff Resources, where measured and indicated resources at the time of acquisition were about 2 Moz, subsequent exploration has increased this to about 12 Moz, with further exploration targets to be tested. At Sadiola, Anglogold’s farm-in to Iamgold’s property resulted in an increase of resources from 2.5 to over 12 Moz.

In the face of such obvious success in their brownfield exploration and the successful operation of the resulting new mines, it may seem puzzling why most major companies have consistently failed to achieve success through either grassroots exploration or through the development of their own directly acquired deposits (with the notable exception in mine development of Goldfields at Tarkwa in Ghana and Newmont at Ahafo and Akyem also in Ghana, both of whom rapidly adopted junior company-type decision-making). It is not true to say that the juniors succeeded because they came in first and had acquired the key properties: by the early 1990s, BHP, Gencor, JCI, Goldfields, Barrick, Placer, AngloAmerican, and others held large tracts of highly prospective ground with established anomalies in the same areas as the junior companies, and Billiton (at Bogosu) and BHP (at Syama) had developed highly sophisticated but failing new plants on major deposits. The fundamental reason for the failure appears to be that, in contrast to the junior companies, the majors retained decision-making at remote locations in the hands of discipline-oriented specialists. Typically, such experts had little appreciation of the time or “give and take” required to meet local requirements, had no opportunity to develop the personal trust and relationships that were a requirement for resolving differences between government and industry expectations, and had very limited understanding of risk management. Negotiating teams tended to arrive fresh from head office with a fixed departure date and preconceived and inflexible sets of terms for their involvement. Project designers tended to be dictated minimum production requirements for a new mine by head office/financiers, regardless of the orebody parameters. Opinions on political risk tended to be derived from
externally purchased surveys, with the result that early efforts by majors concentrated on the DRC. Exploration results tended to be judged on the basis of external criteria, with the result that anomalies attractive in the local context, and which were later proved to host economic orebodies, were inadequately tested. Above all, the majors appeared to have entered SubSaharan Africa with no consistent strategy or objective and none of the patience required to achieve early success.

The alliance with, or acquisition of, the junior companies that followed these early failures provided the required local staff and experience as an incidental but critical adjunct to the acquisition of the gold resources. The symbiotic relationship that developed from this has now become the preferred modus operandi for both groups.

SUMMARY AND CONCLUSIONS

The resurgence of the gold mining industry is one of the major success stories of Africa. It grew out of the efforts of a small group of African civil servants, working with external advisors and the junior exploration companies at the direction of new governments, to develop mining and fiscal legislation acceptable both in a local context and to the international mining industry. This group had the courage and persistence to see off forceful and arrogant leaders of the gold mining industry, who demanded exclusive rights, zero royalties, and extended tax-free periods, and World Bank economic advisors who opposed alleviation of crippling VAT, import tax, and fuel levies. The result has been that SubSaharan Africa now has a truly diversified new industry (initially gold, but more recently spread into copper, heavy minerals, platinum, and diamonds), which is providing genuine benefits in terms of tax generation, employment, infrastructure, education, healthcare and markets for local produce. The role of the junior companies and that of the major companies has been complementary, with the former providing the consistent in-country patience needed to develop the legislative framework and the exploration persistence needed to demonstrate the existence of major deposits, and the latter providing the finance and the operational skills once the foundations had been laid. In Ghana, Tanzania, and Mali, mining now comprises a substantial fraction of GDP and a far higher proportion of foreign exchange. Similar levels are expected to be obtained in Burkina Faso, Niger, and Sierra Leone through new discoveries and mine developments. Although the rule of law tends to be strong in the developed areas, poverty continues to bring its problems: at the corporate level the reimbursement of VAT, collected at source but reimbursable on mine consumption, is a persistent problem; at the mine level AIDS, malaria, and malnutrition require mine-supported training and medication. The development of the mines has brought infrastructure, particularly good transport, training, water, and a local market for produce, to literally hundreds of thousands of people in rural areas. The challenge now is to ensure that these benefits outlive the mines themselves on a site-by-site basis.

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The information in this paper derives from the personal observation of those of us involved in the field across Africa, dialogue at conferences, company press releases, published maps (themselves compilations), and compilation of data from diverse unpublished sources, including the Metals Economics Group. Acknowledging each as references would be impractical. I am particularly indebted to colleagues and to former colleagues at Cluff Resources, SAMAX Gold, and AXMIN, who have supplied so much of the information, experience, and ideas described in this paper and also several of the discoveries. Also to the principals and geologists of many of the other pioneering explorers who have worked so constructively to develop an exploration and legislative infrastructure where none was present before, most particularly those of Ashanti, BHP, East African Mines, Golden Shamrock, IAMGOLD, Kenor, Resolute Resources, SEMAFO, and Sutton Resources. Finally I would express my appreciation of the role of Sir Sam Jonah, a founder member of the 1981 Ghana legislative committee and CEO of Ashanti Goldfields, who more than anyone else has been responsible for encouraging mining in Africa and Africans in mining and to the SEG for its support of the SEG Distinguished Lecturer Program.

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As the 2004 SEG Regional Vice President lecturer, I attempted to include tectonic and geologic considerations applicable to mineral deposit exploration in each of my topics, because a metallic minerals exploration boom has revived in Asia, the area of the world in which I reside and where I planned to give talks. I prepared four topics: (1) Currently evolving epithermal gold provinces in Kyushu, Japan, (2) Plate tectonic settings for porphyry copper deposits, (3) The Muine-Toyoha magmatic hydrothermal system, northern Japan, and (4) Hydrothermal alteration patterns over the El Salvador porphyry copper deposit, Chile.

For the first and second topics, I presented modern, contrasting examples of evolving metallogenic provinces of low-sulfidation epithermal gold deposits and porphyry copper deposits and emphasized that these type of deposits formed during specific tectonic events, rather than during steady oceanic plate subduction. The third topic was the description of a mineralized magmatic hydrothermal system in a calc-alkaline volcanic field and a discussion of how to differentiate mineralized systems from barren ones in slightly eroded volcanic fields. In the fourth topic, I showed lateral and vertical hydrothermal mineral zoning as well as the temporal relationship among hydrothermal minerals in the phyllic alteration zone above the El Salvador porphyry copper deposit. This model can be employed to determine the center of a hydrothermal system.

I started my tours at Korea Institute of Geoscience and Mineral Resources in April 2004, followed by the visits to Peking University (Fig. 1) and Institute of Mineral Resources, CAGS, in China, and Hanoi University of Mining and Geology, Research Institute of Geology and Mineral Resources, and Department of Geology and Mineral Resources of Vietnam in May. In June, the Society of Resource Geology organized a workshop on porphyry copper deposits at Kawasaki, Japan, in which I was involved, and then I visited Mongolia, where economic geologists were excited with the successful exploration of porphyry copper-gold deposits at Oyu Tolgoi by Ivanhoe Mines (Fig. 2). I finished my lecture tours in the Philippines, visiting University of the Philippines (Fig. 3) and the Mineral and Geoscience Bureau in December 2004.

I benefited greatly from these lecture tours; they were a good opportunity to revise my ideas through discussions, to visit world-class deposits such as Oyu Tolgoi and Nui Phao, and to see my friends in each country. The toughest job I had during the tours was a special request to give a lecture to undergraduate students at the Faculty of Economy of Peking University. I was supposed to talk on the topic of mineral economics, a subject with which I am not familiar. Despite the difficulty, I struggled to explain why I am a geologist and why I am interested in the genesis and exploration of mineral deposits.

Finally, I would like to express my sincere thanks to Drs. Sang Mo Koh, Yongfeng Zhu, Tran Thanh Hai, Sereenen Jargalan, Jun Yumul, and Carla Dimalanta, who kindly invited me and arranged my lectures in individual countries, and to Christine Horrigan, SEG Traveling Lecturer Secretary, who organized my lecture tours successfully.

† Mineral Resources Research Group, Institute for Geo-Resources and Environment, AIST; e-mail, y-watanabe@aist.go.jp
Chihuahua Mines Excursion
November 30 – December 3, 2004

Kenneth F. Clark (SEG 1970 SF)

Fifteen SEG and prospecive members participated in a four-day mine and field trip excursion November 30 to December 3, 2004. The excursion was planned by David Giles, SEG Regional Vice President for North America, ably assisted by Guillermo Gastelum and Kenneth Clark. In addition to the contingent from Mexico, participants also came from Australia, Canada, and the United States; see the group photograph. A useful guidebook was provided, with descriptions of the four properties visited. Additional plans were made available by companies during underground visits.

The first day was spent at Naica, a well-known, high-temperature, carbonate-hosted deposit first discovered in 1794, and first exploited by Peñoles in 1924. Naica has been a highly productive Peñoles property (2,500 tpd), located some 90 km south of the capital and within the Basin and Range physiographic province.

After being welcomed by Chief Geologist Roberto Villasuso and Peñoles Director of Mines Fernando Alanis, the group was transported to level 760, the deepest to date in the mine, where the fifth manto and Ag-Pb-Zn sulfides were examined. Naica is located in a dome of Cretaceous limestones cut by felsic dikes and sills. Before leaving Naica, we were treated to a visit to the Crystal Cave of giant selenium crystals on level 290, where lengths of up to 5 or 6 m are common; temperature in the cave, which was discovered in 1999, is 43°C.

The second day was devoted to Pinos Altos, located in the Barranca section of the Sierra Madre Occidental volcanic plateau, and intensely explored by Peñoles in recent years, having been discovered in 1871 and mined by a British company in the late 1800s. The epithermal Au–Ag–bearing vein systems were described by Guillermo Gastelum. They basically consist of two major west-northwest–striking structures some 8 km in length. Most of the time was spent on the surface at exposures along the Santo Niño vein, located in the Pinos Altos fault, a major structure of regional extent. The final part of the visit involved walking southward along the Queen Victoria adit near the bottom of the canyon to intersect the Santo Niño vein, a distance of about 1 km.

The third day was spent at the well-known and nearby Ocampo district, discovered in 1804; Gammon Lake Recourses consolidated its position in 2000. Chief geologist Jim McGlasson gave the group an overview of the district and, in particular, Gammon Lake initiatives to date. Briefly, mining of some of the more accessible veins is being accomplished by underground development at the same time as exploration in other parts of the district. As much as 160,000 m of drilling has been completed, about half of which is core, and 4 km of underground development has accrued. From the ramp at the arroyo level, we were able to examine the Aventurero, San Juan, and Esperanza veins, and a new shaft for hoisting purposes, designed for 1,500 tpd. Overall, the district is a low-sulfidation, epithermal deposit with one or two notable exceptions.

The second part of the visit was on the surface, where an open-pit operation is being planned in the Plaza de Gallos area and farther to the northwest. This pit will be approximately 2.5 km in length with a strip ratio of 5:1. A mill is planned for the top of the drainage divide. The day ended with a visit to the Basaseachi waterfall, 256 m in height, ranking as the 20th highest in the world.

The fourth and final day was spent at El Sauzal, recently put into production at 190,000 oz/yr Au for Glamis Gold. Access was afforded by light plane from the landing strip at nearby San Juanito, affording a spectacular view of the ash-flow tuffs of the Upper Volcanic Supergroup of the Sierra Madre along the Rio Urique Canyon. The mine, discovered recently—in 1995—was found by direct rock-chip sampling of resistent, highly altered outcrops. In 2002, Glamis Gold acquired the project through a merger with Francisco Gold. Two adjacent open pits, the Encinos (west zone) and Tajo Arroyo (east zone), are now in production to develop proven and probable reserves. We were received by Steven Weiss, who summarized the geology and mineralization and led us through the pit areas. Host rocks are dominated by dacitic to rhyolitic pyroclastic units and flow-banded rhyolite and porphyritic hornblende andesite. The bulk of the ore is located in a silicified megabreccia. El Sauzal is considered an epithermal, high-sulfidation gold deposit because of enargite, found at depth, and typical alteration.

In conclusion, and on behalf of the group, the organizers are to be congratulated for providing a well-organized, informative, and enjoyable excursion to four deposits representing three classes of mineralization. Thanks to the Glamis Gold, Gammon Lake Resources, and Peñoles for providing the time and expertise of their personnel to put this excursion together.
Breaking Down the Barriers to Mentoring

Jorge D. Benavides Alfaro (SEG 1981 F), Mauricio Hochschild & Company

Thought-provoking and resourceful environment allows leading young individuals to thrive. Corporations that seek a shortcut to developing such a positive environment by borrowing ideas and poaching talent will only develop a mismatch of individuals in an environment that thwarts initiative.

Unfortunately, the culture of individualism fostered by modern society works against mentoring in the corporate world, in which an individual is encouraged to look after himself and his personal achievements. Many mining companies today fill their executive positions with aggressive young individuals, who typically have a non-technical background and possess only superficial knowledge of mineral exploration. These executives are more inclined toward obtaining results quickly and seek growth through mergers and acquisitions, rather than through exploration. This philosophy has become the standard by which we teach our young professionals and is one of the causes for the decline of mining-related studies in universities.

There are several reasons which are attributed to the recent lack of mentoring in the mining community, including a decrease in the rate of discovery, despite increased expenditures, and the general downturn in the industry. I believe that there exist more profound causes. Corporate conduct patterns and management styles are at the root of the problem.

I encourage exploration managers to create an environment conducive to mentoring: (1) empower and motivate your reports to reach higher goals, (2) promote team-building and collaboration to wrestle confidently with the unknown, and (3) teach humility and an appreciation of others. Fundamental to this effort are the development of partnerships with academia and the funding of research and professional development through universities. Your effort will be rewarded with success in building a team of leading explorationists with their feet well set on the ground, eyes wide open and a soaring imagination that will successfully identify new ore deposits, time and time again.

*Previous contributions to this column have eloquently established the need for mentoring in mineral exploration. I agree with the authors of these articles. In addition, I question what prevents mentoring from happening spontaneously and why has mentorship declined in recent years? This article identifies some of the major barriers to mentoring in mineral exploration in the hope that these barriers will be overcome and the mentoring process improved in the industry.*

To understand the dynamics of mentoring and its effect in the mining industry, one must first understand the meaning of the term “mentor.” Traditional definitions include a trusted counselor, guide, tutor, or coach. However, it is in the origins of this word that I find the most powerful description: Mentor was the trusted friend of Odysseus, king of Ithaca; Odysseus entrusted Mentor with the task of bringing up his son, Telemachus, during the king’s epic voyage in Homer’s famous poem, *The Odyssey*. Thus, mentoring also connotes *parenting* and playing the role of a *protector*.

Mentoring must therefore be interpreted as a fusion of definitions to fully explain the complexity of the concept. It implies working with the innate abilities of a protégé, teaching all that you know, and promoting passion for experimentation and exploration of new frontiers well beyond your own. Mentoring involves the instilling of confidence, yet at the same time, humility—and an appreciation for the contributions of others. It also involves leading by example, and in time, stepping aside to allow mentored students or employees to succeed you.

The concept of succession is perhaps the most difficult obstacle to overcome when it comes to mentoring. Some managers utilize their power to protect their post, rather than stimulate “new blood” to replace them. This action can perhaps be understood as one of self-preservation, but in fact, it prevents the mentor from recognizing the opportunity for personal growth provided by the act of mentoring. Indeed, the mentoring process provides an opportunity for all involved to learn and further develop one’s own abilities.

In my career, I have been mentored by several outstanding individuals and have chosen to mentor others. Mentoring has allowed me to reach fulfilling and rewarding positions, thus enriching the life experience.

The greed for recognition of success (or bonus payments) is another impediment to mentoring. Indeed, it fuels the arrogant “I/we discovered it” delusion that has kept many explorationists, or whole exploration teams, from recognizing the contributions of third parties. The holders of these blind beliefs may find it difficult to learn the road map to success and discovery, which initially may have been achieved through serendipity. How many times have we seen the original “discoverer” of a deposit fail to find more deposits in the same district, while his competitors do? The road to discovery is paved by the contribution of many individuals, not just that of the one who laid the last stone. Failure to attribute merit to others can only blind one to finding the next discovery. A successful mentor practices humility and leads pupils to chart the path, avoid pitfalls, and recognize the experience and contributions of others in the road to success. In doing so, the exploration team will be successful again and again.

Time, effort and cost are other barriers to mentoring. The few leading corporations that produce a steady flow of well-rounded leaders in the mineral exploration business invest substantial funds into professional development. These groups also give considerable effort to the selection and coaching of young, bright individuals and to the development of successful multidisciplinary exploration teams. Many corporate leaders fail to recognize the benefits of mentoring and instead focus on the perceived negatives, believing that many young explorationists will inevitably leave the company and work for the competition, and that investments in university research will benefit other companies. This may be true to some extent. However, this is what leaders do, they lead! Others fail to realize that successful mining corporations are composed of talented teams, not only talented individuals. In promoting a fresh, open-door approach to research, successful companies develop a healthy interaction of ideas and thought processes. This
Field Trip Report – Central Mexico April 2004

Six student members participated in this student chapter-organized field trip to central Mexico.

On the first day, the group arrived in Mexico City, where we were given a presentation by Dr. Duncan Keppie of the University of Mexico. Following this we headed to the mining town of Taxco, where students took an underground mine tour of the Taxco Pb-Zn mine, owned by Grupo Mexico. We then headed west to Uruapan del Progreso, our base for our trip to Paricutín volcano and the lava-covered church and village near Angahuan. Paricutín erupted in a cornfield in February 1943, and the lava from this and subsequent eruptions over eight years covered two towns.

We then visited Colima, where we toured the Pena Colorado skarn mine operated by Pena Colorado Servicios, S.A. de C.V. The open pit mine is located in mountainous terrane, but instead of a typical concentric pit, the mine is cut into the side of the mountain. We also toured the Colima volcanic complex, which is made up of two southward younging stratovolcanoes: the dormant Nevado de Colima and the active Fuego de Colima. We were lucky enough to witness (and photograph!) a pyroclastic flow down the slope of Fuego de Colima.

We thank the SEG, the Department of Earth Sciences-Carleton University, and the Faculty of Science-Carleton University for their support with field trip grants. We also thank the mine personnel, tour guides, and others for making the trip a success.

Alana Hinchey
Treasurer, 2003-2004

Look for more student news on the SEG website at <http://www.segweb.org/ChapterReports.htm>

Québec-Labrador Excursion Report

The Université du Québec à Montréal chapter held a field trip October 17–19 in the Labrador trough, in collaboration with the IOC (Iron Ore Company), QuébecCartier, SOQUEM, and Quinto-Technology. The purpose of the trip was to learn about structural control and metamorphism of graphite, iron, and manganese deposits. The Labrador trough is a good example because it was highly deformed and metamorphosed during the Grenvillian orogenies.

First, we visited metamorphosed graphite showings (Lac Guéret), owned by SOQUEM and Quinto-Technology, near the Manic 5 dam, about 2 hours north of Baie-Comeau, Canada. Geologist Gabrielle Rioux accompanied the group. We learned about less conventional deposits, such as graphite, of the Lac Guéret project. In the afternoon, we stopped at the open pit of an old iron mine, Fire Lake, to see how the iron formation facies vary from a mine to another.

We then visited the specular hematite deposits at Mt. Wright mine, owned by QuébecCartier, near the city of Fermont. Claude Baillargeon, mine geologist, acted as tour guide. We also had the opportunity to see a blasting and some diamond drill core.

At Labrador City, we visited iron deposits owned by the Iron Ore Company (IOC). At this mine, we had some good discussions with the mine and exploration geologists.

We appreciate the support of Gabrielle Rioux and Michel Gauthier for the organization of this tour. We also thank the Département des Sciences de la Terre of the Université du Québec à Montréal, the SEG chapter, and the companies (IOC, QuébecCartier, Quinto and SOQUEM) that hosted us.

Eric Hébert
President, UQAM SEG Student Chapter

Ottawa-Carleton student chapter members underground at Taxco Pb-Zn mine. From left to right: (Back) Tanguy Nobilet, Martin Le Carpentier, Yohann Braulit, Guy Gbaguidi, Baptiste Laurent, Raphaël Chaux, Éric Hébert, Stéphane Lesimple; (At the top): Stéphan Poitras (Front): Tong Zhao, Stéphane De Souza, Danièle Goulard, Gabrielle Rioux, Christelle Masseret, Caroline Daoost, Carl Blodreau, Julien Weil, Raphaël Morand, Brice Sevin; (Down): Michel Gauthier.
8th SGA Biennial Meeting on “Mineral Deposit Research: Meeting the Global Challenge”

Co-sponsored by SEG

The 8th SGA Biennial Meeting will be held on August 18-21, 2005, in Beijing, the capital city of China. The Chinese economy is rapidly growing which is reflected in the expanding Chinese and global markets for minerals. The future mineral resource need of the global community depends on the discovery of new and unconventional resources that must be linked to ore deposit research. This meeting provides an exceptional opportunity to participate in technical presentations, workshops, and field trips by academic, industrial, and students dedicated to the study of ore deposits.

Beijing provides an exciting venue for the conference. Modern tourist facilities, interesting cultural attractions, and unique historical sites provide a background for the conference. Considering the tremendous progress in research and exploration of Chinese mineral deposits along with the remarkable economic growth during the last twenty years, the 8th SGA Biennial Meeting in Beijing provides opportunities for exchanging new ideas on research, exploration and mine development. Numerous field trips will be offered to some of the world’s largest ore deposits. We warmly welcome you to make plans to participate in the 8th SGA Biennial Meeting in Beijing.

For meeting information:
Website: <http://www.sga2005.com> • Email: mail@sga2005.com

SEG CoSponsored Events

SEG Gold Workshop
SEG Field Excursion to the porphyry copper deposits of Mongolia
SEG Thematic Session: “Exploration, Discovery and Mine Developments in China”

Gordon Research Conference on Inorganic Geochemistry and Ore Deposits

Proctor Academy, Andover, New Hampshire, July 31 – August 5, 2005

The Gordon Research Conference on Inorganic Geochemistry addresses the geochemistry of metal-rich systems, and has been held every three to four years over a period of 36 years. The meeting serves as one of the premier conferences for international scientists with differing levels of experience in ore deposit research. A major theme of the conference is to promote increased communication and collaboration between industry, academia, and government. The next Gordon will be held at Proctor Academy in Andover, New Hampshire, July 31 - August 5, 2005 and the organizers are seeking expressions of interest from those who wish to participate. Students are encouraged to attend and subsidies for students and junior level participants are anticipated, particularly for those presenting posters. We also seek the participation of women and members of minority groups.

The theme of this 5-day conference is “Metals in ore-forming systems: Sources, transport, and deposition.” The focus of the meeting is on ore-related processes, which will highlight linkages between factors involved in the concentration of metals in the earth’s crust and the resultant economic beneficiation of ore. The meeting will be interdisciplinary, with invited speakers who are experts in the fields of biogeochemistry, tectonics, structural geology, experimental geochemistry, and numerical modeling. A preliminary speakers program and conference details are available at the website: http://www.grc.uri.edu/programs/2005/inorgeo.htm

The 2005 Gordon Conference organizers are Jean Cline (cline@ccmail.nevada.edu), Steve Garwin (steve.garwin@geoinformex.com) and Chris Heinrich (heinrich@erdw.ethz.ch). Those who wish to participate should complete an application and pre-register at http://www.grc.org/application/apply1.cfm. Poster space will be available and those who wish to present a poster are invited to send a brief abstract to Britt Meyer at meyer@erdw.ethz.ch. Students and other participants who wish to apply for funding to attend the meeting should see the GRC website for instructions. Funding will be preferentially awarded to those presenting posters.
Wealth Creation in the Minerals Industry
SEG 2006 Conference
May 14–16, 2006 – Keystone, Colorado


The principal theme of the conference emerged at the SEG 2002 conference, amid a groundswell of enthusiasm among attendees for a conference devoted to the more economic aspects of economic geology. As was noted then, it was time to put the “E” back into SEG and the Society plans to do just that with this conference.

A three-day event is planned with a single stream of mostly invited papers on the first two days, with an open session for submitted and student papers on the third day (details of the program are on page 33 of this issue).

Day 1 is devoted to “The Business of Exploration” and will highlight the exploration approach to wealth creation from mining companies large and small, the perspective of Wall Street and the financial community, the critical importance of world-class discoveries in long-term value creation, two major case histories, and a hard-edged look at the costs, risks, and returns from the exploration process.

Day 2 focuses on Mine Development and Production as the methods of delivering and enhancing the value created by the discovery process. It will include presentations from a number of mine sites on the integration of mining, metallurgy, and geology, plus a critical review of reserves, resources, and reconciliation—an area of crucial importance in ensuring the delivery of real value. Sub-themes on Day 2 will discuss the changing industry approaches to sustainability and address the mine closure process, an area of growing importance in value-creation in the life cycle of mining.

Day 3 is dedicated to case studies, volunteered presentations, and student research on the broad topics of this meeting.

SEG 2006 will also feature pre- and post-conference workshops on topics that cover the following themes:

- Financial analysis and economic decision-making;
- Sustainability issues and social license to operate;
- Mining challenges in developing countries.

A selection of conference field trips to Cripple Creek, Climax, Henderson, Lisbon Valley, and Carlin will also be offered.

The Society is expanding its aim for this conference to increase appeal for those professionals who either directly influence the business bottom line in the minerals industry or are influenced by it. We are inviting decision-makers in minerals exploration and production companies, exploration geologists, financial analysts, researchers, and students with an interest in those activities that create real value in the minerals industry, either through exploration success or by best-practices in mining. The Organizing Committee expects that the conference will appeal strongly to a wide range of SEG members, given the current boom in the resources sector and the growing reliance of teaching and research institutions on the private sector for funding and support. The program also highlights practical topics not commonly taught in academia, but which are applied worldwide in working mines and at evolving prospects to improve profitability, optimize ore-body extraction and mitigate environmental and social disturbance. This meeting should also appeal to professionals in the mining finance community and to those working in the developing world where so many of the new discoveries are being made.

Mark your diaries and make your plans to be in Keystone in May next year!
Wealth Creation in the Minerals Industry

May 14–16, 2006
Keystone, Colorado USA

This conference is relevant to all professionals who influence or are affected by the bottom-line in the minerals industry. We invite decision-makers in mineral exploration and production companies, exploration geologists, financial analysts, researchers, and students with an interest in Wealth Creation in the Minerals Industry.

CALL FOR PAPERS DEADLINE:
JUNE 1, 2005
For details visit www.seg2006.org
E-mail queries and abstract submissions to seg2006@segweb.org

Technical Program

Wealth Creation – The Business of Exploration
- Exploration – The Value Creation Process
- The Basis of Wealth Creation – Exploration Technology and Mineral Economics
- Measuring the Effectiveness of Exploration

Wealth Creation – Generating and Delivering Wealth
- Mine Development and Production
- Sustainability of Wealth Creation
- The Business of Closure

Wealth Creation – Case Histories and Volunteered Presentations

Further Conference and Exhibit Details at www.seg2006.org

SEG 2006 Conference
Organizing Committee
John Dow, Chair
Nate Brewer
Jeffrey Hedenquist
Murray Hitzman
Brian Hoal
Eric Nelson
Borden Putnam
Laura Reed
John Thoms

Workshops and Field Trips
There will be pre- and post-conference workshops and field trips to world-class ore deposits at Cripple Creek, Climax, Henderson, and Carlin.

Society of Economic Geologists
7811 Shaffer Parkway
Littleton, Colorado 80127-3732 USA

General conference queries:
Tel: +1.720.981.7882
Fax: +1.720.981.7874
E-mail: seg2006@segweb.org

Conference exhibit queries:
Quality Business Services
3110 S. Wadsworth Blvd., Suite 307
Denver, Colorado 80227-4810
Tel: +1.303.914.0694
Fax: +1.303.382.8064
E-mail: dianna@qbsoffice.com
DAY 1 Wealth Creation – The Business of Exploration

• Pierre Lassonde (President, Newmont Mining Corporation) “Exploration – The Life Blood of the Mining Industry”

The Value Creation Process

• Geoff Stanley (Gold Analyst – BMO Nesbitt Burns) “Exploration – The Perspective of Wall Street”
• Richard Schodde and Jon Hronsky (Western Mining Corp.) “The Role of World Class Deposits in Wealth Creation”
• Tom Albanese (Chief Executive Copper and Exploration, Rio Tinto) “The Exploration Philosophy of Rio Tinto – A Longer Term View of Value Creation”
• Norm Keevil (Teck Cominco) “Wealth Creation with Junior Companies” (invited)
• Rob McEwen (Former Chairman and CEO, Goldcorp) “Challenge and Prosper: The What, Why and How the Goldcorp Challenge Worked”
• George Assie (Senior VP, Marketing and Business Development, Cameco) “A Fresh Look at Uranium” (invited)
• Doug Kirwin (VP Exploration, Ivanhoe Mines) “The Discovery of the Oyu Tolgoi Cu-Au Deposit”
• Oliver Warin (VP Exploration, BHP, retired) “The Discovery of the Ekati Diamond Deposit”

The Basis of Wealth Creation

• Philip Crowson (Chief Economist, Rio Tinto, retired) “Metals and Minerals: The Past 25 Years”
• Richard Sillitoe (Consulting Economic Geologist) and John Thompson (Chief Geoscientist, Teck Cominco) “Changes in Exploration Methods and Discovery Strategies”

Measuring the Effectiveness of Exploration

• Michael Doggett (Professor, Queen’s University) and Richard Leveille (President, Phelps Dodge Exploration) “Measuring Costs, Risks and Returns from Exploration – Improving the Success Rate”

DAY 2 Wealth Creation – Generating and Delivering Wealth

• Geoff Handley (Executive Vice President, Placer Dome) “Turquoise Ridge and Cortez Hills – A Contrast in Economic Outcomes”
• Steve Aaker (Newmont Capital) “Creating Value through Royalties”

Mine Development and Production

• Karin Hoal (Colorado School of Mines), Terry McNulty (T.P. McNulty & Associates) and Roland Schmidt (Hazen Research) “New Initiatives in GeoMetallurgy”
• Mark Johnson (COO Freepoint McMoRan Copper & Gold, or alternate) “Grasberg: Process Metallurgical Feedback into Exploration and Mining”
• Andre Douchane (President and CEO, North American Palladium) “Timing is Everything – Almost: The Optimization of Lac des Iles”
• Harry Parker (AMEC) “Reserves, Resources and Reconciliation”
• Leroy Schutz, Scott Santti et al. (Newmont Mining Corporation) “Integration of Mining, Metallurgy and Geology in the Development of the Gold Quarry Pit”

Sustainability of Wealth Creation

• Ian Thompson and Susan Joyce (Principals, On Common Ground Consultants) “Changing Industry Approaches to Sustainability”
• Leigh Freeman (Downing Teal), Paul Bartos (Colorado School of Mines) and Maeve Boland (Colorado School of Mines) “Human Resource Strategies for the Minerals Industry—Careers, Competencies and Compensation”

DAY 3 Wealth Creation – Case Histories and Volunteered Presentations on Meeting Topics

Pre- and Post-Conference Workshop Titles

• Geochemistry in Mineral Resource Development
• Sampling, QA/QC and Exploration Data Analysis
• The Role of Geophysics in Wealth Creation
• Resource & Reserve Estimation
• Economic Evaluations of Mining Projects
• Sustainable Development & The Social License to Operate
• What Constitutes a Bankable Feasibility Study?

Workshop and Field Trip Coordinators: Nate Brewer (Gold Fields), Eric Nelson (Colorado School of Mines)
Wealth Creation in the Minerals Industry

May 14–16, 2006  
Keystone, Colorado USA

Call For Papers Deadline: June 1, 2005
E-mail queries and abstract submissions to seg2006@segweb.org

Technical Program

Day 1  The Business of Exploration
Day 2  Generating and Delivering Wealth
Day 3  Case Histories and Volunteered Presentations

Who Should Attend?

- Decision Makers in the Minerals Industry
- Exploration Geologists
- Financial Analysts
- Researchers
- Students

Conference and Exhibit Details at www.seg2006.org
CALL FOR PAPERS – DEADLINE: JULY 12, 2005

SEG-GSA Annual Meeting • Salt Lake City, Utah • October 15-19, 2005

100th Anniversary of Economic Geology:
One day symposium of speakers from the 100th Anniversary Volume

“Centennial Celebration Symposium for the Society of Economic Geologists”

Proposed Topical Sessions Include

- The Evolving Earth: Implications for Ore Deposit Formation, Evolution and Beneficiation
- Borates, Uranium, Mineral Sands and Bulk Commodities: Deposit Models, Processes and Descriptions
- Advances in Understanding of Tectonic Settings and Structural Control of Ore Deposits
- Sources of Porphyry Copper Deposits: Magmas, Metals and Fluids
- Advances in Geophysics and New Technologies: Lithosphere and Crustal Architecture, Ore Deposit Visualization, New Technologies in Analytical Techniques and Mineral Processing, etc.

For Information contact:
Ricardo Presnell, Kennecott Exploration, 224 N 2200W, Salt Lake City, UT 84116
Tel: 801-238-2414, Fax: 801-238-2430, E-mail: ricardo.presnell@kennecott.com

SEG Sponsored Field Trips:

Bingham Canyon Porphyry Cu-Au-Mo Deposit: Friday, Oct. 14. Organizer: Ricardo D. Presnell, Kennecott Exploration Co., 224N 2200W Salt Lake City, UT 84116, (801) 238-2414, fax (801) 238-2430, E-mail: ricardo.presnell@kennecott.com

Lisbon Valley Sediment-Hosted Cu Deposit: Thursday-Friday, Oct. 20-21. Organizers: Jon Thorson, 5515 Nuthatch Road, Parker, CO 80134, (303) 805-2502, fax (303) 805-2503, jonthorson@rmi.net; Ricardo D. Presnell, Kennecott Exploration Co., 224N 2200W Salt Lake City, Utah 84116, (801) 238-2414, fax (801) 238-2430, E-mail: ricardo.presnell@kennecott.com

PRELIMINARY — SEG Business Meetings & Events Schedule

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<th>Afternoon/Evening</th>
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<td>SEG All Day Symposium – 8:00 am–Noon</td>
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<tr>
<td></td>
<td>SEG-GSA Meeting Coordinator, Ricardo Presnell</td>
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<tr>
<td>Sunday October 16</td>
<td>Technical Sessions: 8:00 am–noon</td>
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<tr>
<td>Monday October 17</td>
<td>SEG Program Committee Meeting w/ Breakfast – 7:00–8:30 am</td>
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<td></td>
<td>Technical Sessions: 8:00 am–noon</td>
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<td></td>
<td>Exhibits Open: 9:00 am–5:30 pm</td>
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<td>SEG Council Meeting w/ Lunch – Noon–3:00 pm</td>
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<td>Tuesday October 18</td>
<td>SEG Foundation Trustees Meeting with Lunch – Noon–3:00 pm</td>
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<td>Technical Sessions: 8:00 am–noon</td>
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<td>Exhibits Open: 9:00 am–5:30 pm</td>
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<td>Wednesday October 19</td>
<td>Technical Sessions: 8:00 am–noon</td>
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<td>Exhibits Open: 9:00 am–2:00 pm</td>
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EXPLORATION REVIEWS

ALASKA

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Western Alaska

Teck Cominco American announced fourth quarter and year-end 2004 results from its Red Dog mine. In the 4th quarter the mine produced 132,200 tonnes (t) of zinc in concentrate and for the year the mine produced 554,200 t of zinc in concentrate. Zinc ore grade and mill recoveries decreased to 21.3% and 84.8%, respectively, from 22.2% and 85.5% in the year previous quarter. The mine also produced 32,100 t of lead in concentrate during the 4th quarter and 117,000 t of lead in concentrate for the year. Lead ore grade decreased to 6.1% while mill recoveries increased to 66.6% from 6.4% and 65%, respectively, in the year previous quarter. As a result, primarily of higher zinc and lead prices (average $0.51 and $0.43/lb, respectively, for the quarter), the mine posted a $100M operating profit for the quarter, and a $207M operating profit for the year.

St. Andrew Goldfields announced results from its continuing exploration and development program at the Nixon Fork mine near McGrath. Work completed included an airborne magnetic and time domain electromagnetic survey, and drilling at its J5A embayment and 2201 and 2204 zones. Drill results include hole DH126, which returned 0.9 m grading 13.9 g/t gold and an additional 1.5 m grading 31.4 g/t gold, hole DH135 which returned 0.8 m grading 38.66 g/t gold, hole DH5-04 which returned 1.3 m grading 88.0 g/t gold and an additional 2.1 m grading 27.4 g/t gold. Surface trenching in 2004 also produced promising results from the Whalen zone where results included 1 m at 19.65 g/t gold and 2.6% copper and 0.4 m grading 44.8 g/t gold and +100 g/t silver.

Northern Dynasty Minerals reported discovery of deep but higher grade copper—gold mineralization at its Pebble prospect near Iliamna. The new discovery, dubbed the East zone, has been outlined over a 2,000 x 2,000 ft area which remains open in all directions except the west. Mineralized intervals at East zone occur beneath post-mineral Tertiary volcanics at depths exceeding 2,300 ft below surface. Highlights include hole 4292, which returned 163.7 m grading 0.86 g/t gold, 0.61% copper and 0.020% molybdenum; hole 4300, 132.1 m grading 0.98 g/t gold, 0.66% copper and 0.017% molybdenum; and hole 4301, 65.5 m grading 1.00 g/t gold, 0.73% copper and 0.016% molybdenum. The company expects to have a revised resource estimate completed in the first quarter of 2005 that will include all of the 2004 drilling completed in the Pebble and East areas.

Full Metal Minerals announced that it had signed an agreement with Bristol Bay Native Corporation to explore $65,000 acres of fee simple lands on the Alaska Peninsula. The agreement covers a portion of Alaska that is highly prospective for high- and low-sulfidation state gold and copper-gold mineralization. The agreement calls for a one-year selection period during which Full Metal must evaluate the land package and spend a minimum of $150,000 on the ground. The company then has the right to nominate selected portions of the package for upgrade to an exploration lease which will include minimum exploration expenditures of $4.4M over 7 years and cash payments totaling $175,000 over the same period.

Select Resources announced acquisition of the Shorty Creek gold-silver-copper project in the Livengood District from Fairbanks-based Gold Range Ltd.

Rimfire Minerals reported preliminary results from work conducted by joint venture partner AngloGold USA Exploration on the ER and Eagle prospects in the Goodpaster district. Work at ER included 12.6 line km of NSAMT ground geophysics, 234 soil samples, and three diamond drill holes totaling 997 m. Two holes tested the continuity of gold-bearing quartz veins over a 350-m strike while a third hole targeted a newly defined 1.0 x 0.5 km soil geochemical anomaly. Hole ER04-7 intersected a previously tested vein and yielded 1.2 m of 4.12 g/t gold. At the Eagle prospect, AngloGold completed soil geochemical surveys (485 samples), electromagnetic and radiometric geophysical surveys and nine diamond drill holes totaling 2,778 m. The 2004 program yielded a total of 26 intersections from 0.2 to 1.5 m in width assaying from 1.00 to 14.05 g/t gold.

Eastern Interior

Teryl Resources Corp. and joint venture partner Kinross Gold announced 2004 results from their Gil project exploration programs in the Fairbanks district. These efforts included 1,020 ft of trenching, 4,175 ft of reverse circulation drilling in 18 holes and collection of over 1,000 rock and soil geochemical samples. Significant drilling results include hole 2000-GEC-120, which returned 30 ft grading 0.052 opt gold; hole GER03-366, 15 ft grading 0.101 opt gold; hole GVR04-467, 25 ft grading 0.139 opt gold; and hole GVR04-484, 20 ft grading 0.275 opt gold.

Freegold Ventures announced the results from the exploration drilling on the Tolovana prospect at the Golden Summit project in the Fairbanks district. The program consisted of 3,584 ft of diamond core drilling in 7 holes. Significant results included 5 ft grading 0.559 opt gold in hole TLD0401, 1 ft grading 0.521 opt gold in hole TLD0401, 13.5 ft grading 0.052 opt gold in hole TLD0404; 4.5 ft grading 0.310 opt gold in hole TLD0402, 1 ft grading 1.263 opt gold in hole TLD0404, 17 ft grading 2.93 grams of gold per ton in hole TLD0403, 40 ft grading 3.03 grams of gold per ton in hole TLD0404 and an additional 59.5 ft grading 1.66 grams of gold per ton in hole TLD0404. Despite these results, the company announced that Meridian Gold has terminated its joint venture option on the project.

EXPLORATION REVIEWS
**ALASKA RANGE**

Usibelli Coal Mine announced that a second contract has been signed with Glencore Ltd. for shipment of 45,000 t of Alaska coal to Chile. This shipment is destined for a different end-user than the initial shipment sent to Chile in August. Additional shipments to Chile appear likely in 2005.

Piper Capital Inc. has announced that it has agreed to sell 22.1% of its outstanding shares to each of two London-based companies—Hidefield Gold PLC and Anglo Pacific Group PLC. Proceeds from these transactions will fund exploration of its Golden Zone gold-copper prospect in the Chulitna district. Piper also has agreed to grant Hidefield the right to acquire 50% of Piper’s interest in Golden Zone by providing $1.5M for exploration on the property by 2007. Piper and Hidefield retain a right to earn 100% interest in Golden Zone for cash and stock payments, subject to a 2.5% net smelter return royalty retained by the property owner, Mines Trust Company.

Golconda Resources Ltd. and joint venture partner Shear Minerals announced that material from drill hole 22 at the rim of one of several suspected pipes contained three micro diamonds in an 8-kg sample. Purple and orange garnets were observed while inspecting the fusion residues from drill cutting. Five G-9 garnets and 12 orange garnets were high magnesium pyrope garnets with high titanium content indicating a strong eclogitic component. Low manganese content shows that these garnets fall into the field of diamond-associated garnets. Also, the calcium/chrome ratio is that of garnets associated with diamonds and not with graphite. The company followed announcement of these results with announcement of a planned $1M exploration program for 2005 and commencement of drilling.

**SOUTHEAST ALASKA**

Bravo Venture Group Inc. announced results from 550 m of drilling at its Woevodowski Island project in southeast Alaska. Three drill holes (349 m) targeted interlayered sulfides in argillite and andesitic tuffs at the Mad Dog prospect. These holes returned values of up to 2.83 m of 2.2 g/t gold, 112 g/t silver, 0.50% lead and 10.6% zinc in hole MD04-07. High-grade gold in distinctive bluish colored quartz veins also was discovered, returning values up to 69.5 g/t gold. The quartz veins are hosted in multiple widely spaced, northeast-trending sub-parallel structures up to 10 m wide which can be traced over a 4 km² area. Within the structural zones, individual veins occur as 0.3- to 0.5-m-thick bodies up to several meters in length.


**AUSTRALASIA**

Geoscience Australia has released a review of mineral exploration in Australia for the year 2004. The review examines levels and trends in exploration in a national and global context. It also presents highlights of government programs that have released information to support exploration during the year. Overall expenditure in 2003–2004 rose by 7.4% to $786.7 million, an increase of 7.4%. Of the total, 39% was spent on the search for previous unknown mineralization. Highlights of the year include discoveries of nickel mineralization in the Yilgarn craton and elsewhere in Western Australia and of minerals sands in the South Australian portion of the Eucla basin. Gold mineralization was reported from a number of provinces across Australia. Ongoing exploration at known deposits yielded important results, including the release of an initial resource estimate at Prominent Hill copper-gold deposit and a major increase in resources at the Olympic Dam deposit, both in South Australia.


**NEW SOUTH WALES**

The industry gathered in October 2004 to update colleagues, shareholders, and the community on its exploration and mining projects at the NSW Miners and Explorers Conference held in Sydney—see <www.nswminersandexplorers.com.au>. The NSW Department of Mineral Resources has been merged into the Department of Primary Industries, with the head office moving from Sydney to Maitland in the Hunter Valley coalfields. The department’s excellent online services, including the acclaimed DIGS open file system of all past exploration throughout the state, are available at <www.minerals.nsw.gov.au>.

Newcrest’s flagship Cadia gold mine near Orange in the Lachlan fold belt (LFB) produced 680 koz Au and 85 kt Cu for the year, confirming its position as the second largest gold operation in Australia after Kalgoorlie’s Super Pit. The company announced a 3- to 4-year feasibility program at the Cadia East Cu-Au project which has 830 million tonnes (Mt) containing 18 Moz of gold and 2.9 Mt of copper. The study includes an 11-km underground decline to undertake further exploration and bulk sampling for metallurgical test work. At the nearby Ridgeway mine, a further 300-m vertical depth of mining is planned that will extend the life of the mine an additional 6 years and provide an extra 1.3 Moz gold and 163,000 t of copper.

Alkane Exploration has defined a number of prospective targets with several ore-grade intercepts confirming the potential of the area north of Cadia to host a major dioritic to monzonitic intrusive complex of the same age and composition as rocks hosting the Cadia-Ridgeway deposits. Rio Tinto is in the process of reconsidering its options if waiving re-assignment obligations under a 1997 agreement that transferred tenements to Alkane in which these targets have been identified. Meanwhile at Alkane’s Tomingley gold project, the
possibility of an underground development with the Hangingwall Zone in the **Wyoming One** deposit is now extended to a depth of about 450 m with recent encouraging drilling results. The Wyoming One deposit has a current resource of 6.38 Mt at 2.43 g/t gold for 498,000 oz.

In the Cobar section of the LFB, **TriakO Resources** has delineated a fourth Au-base metal lens at the **Hera** project, located 100 km northwest of its Mineral Hill underground Au-Cu mine near Condobolin. Recent intersections in the new lens at Hera include 5 m at 17.9 g/t Au, 10.3% Pb + Zn, and 45 g/t Ag. East of Cobar at Canbelego, **Golden Cross Resources** is exploring for repetitions of the Mt. Boppy gold deposit (once the largest gold producer in the state) and has reported a drill intersection of 5 m at 39.8 g/t Au at the **Birthday** prospect.

Farther south in the LFB, a program of 14 shallow drill holes by **Paradigm Gold** at Brown Mountain near Cooma intersected low-grade Cu-Au oxide mineralization beneath a newly recognized 300-m-long Y 10- to 40-m-wide gossan lens hosted by Silurian volcanics. Paradigm is planning a program of deeper drilling to test the mineralization in the sulfide zone. The geological setting is similar to the nearby mined-out Woodlawn VHMS deposit that produced 18 Mt at 2% Cu, 4% Pb, 10% Zn, 80 g/t Ag and 0.4 g/t Au. **Tri Origin Minerals** has commenced a ground geophysical survey on strike to the north and south of the Woodlawn mine.

**Staits Resources**’ exploration at the mothballed Hillgrove Au-Sb mine east of Armidale in the New England fold belt in the north of the state continued with surface and underground drilling at the Eleanor, Clarke’s Gully, and Metz vein systems, while **Malachite Resources** has reported tin values up to 2.35% Sn at surface at its Sheep Station Hill greisen vein system east of Inverell, with drilling planned in the near future.

**VICTORIA**

**Bendigo Mining** has reclassified the bulk of its gold mineralization from “resource potential” into the “inferred” category, boosting its JORC resource inventory by 11 Moz. The company has defined 23.5 Mt at 14.5 g/t for 11 Moz in inferred resources, adding to the 720,000 t at 10 g/t gold for 236,000 oz in the indicated category. A probable reserve of 656,000 t at 9.0 g/t gold for 193,000 oz is already in place. The Bendigo goldfield has been the second largest producer in Australia, yielding about 18 Moz of gold during 100 years of reef mining since discovery in 1851.

**Ballarat Goldfields** has increased the resource at its **Ballarat East** project by 57% to 3.1 Mt @ 11 g/t for 1.1 Moz after completing 18 months of drilling. Ballarat is currently developing an underground mine at Ballarat East, with a forecast mine life of 21 years. Initial production is put at 100,000 oz/yr at cash costs of $274/oz. The company has also expanded its exploration holdings in the area by acquiring the southern extension of its Ballarat East project. This area could be accessed from the existing decline at Ballarat East.

**Alliance Resources** reported diamond-drilling results from the **Alliance South** prospect along the Eaglehawk Reef which included gold intercepts of 0.6 m at 78.43 g/t, 1.05 m at 5.92 g/t, 3.95 m at 5.36 g/t and 2.8 m at 15.70 g/t, including 1.25 m at 33.05 g/t. The Alliance South prospect is part of the Maldon Goldfield that produced around 1.75 Moz gold between 1856 and 1926 at a recovered grade of 28 g/t gold.

**Synergy Metals** has reported drill intersections near to and below the **Maude** gold mine at its Glen Wills project. Results included 1.6 m at 16.6 g/t and 5.8 m at 18.9 g/t.

**TASMANIA**

There has been strong activity on both the mining development and exploration fronts in Tasmania over the last several months, fueled partly by the strong recovery in commodity prices, particularly tin and tungsten, in which Tasmania is well endowed. **Allegiance Mining N.L.** has completed the **Avebury** nickel project decline and development applications have been lodged. New intersections up to 370 m west of the resource boundary (12 m at 1.6% Ni, 4.5 m at 1.1% Ni at end of hole) suggest substantial additions to the resource are possible. Exploration drilling has continued both from surface and underground with a recent intersection of 12 m of 4.3% Ni at North Avebury. **Bluestone Tin Limited** has purchased and re-opened the **Renison Bell** mine and is investigating the feasibility of treating the Renison Bell tailings (identified resource of 17.4 Mt of 0.42% Sn) through a tin-fuming process. In addition, the company plans to mine the **Mount Bischoff** deposit, 55 km north of Renison Bell, that has an identified mineral resource of 1.9 Mt of 0.96% Sn. **Van Dieman Mines plc** plans to commence operations at two alluvial tin-sapphire operations in northeast Tasmania within 12 months. **GTN Resources Limited** has commenced a full feasibility study into resuming scheelite production on King Island and believes that there is potential for a 10-year project by extending the open cut. **Stemcor Holdings Ltd.** has purchased the **Savage River** magnetite mine and Port Latta pelletizing plant and will investigate the feasibility of extending the life of the operation beyond 2009 by mining underground. **Resource Finance and Investments Limited** has announced an indicated and inferred resource of 370,000 t of 1.7% Cu, 4.1% Pb, 4.2% Zn, 64 g/t Ag, and 0.3 g/t Au at the **Que River S Lens** deposit, and is investigating mining via open-cut methods. **TasGold Limited** has discovered a new massive sulfide intersection 12 m below an earlier intersection of similar thickness and grade at the **Wart Hill** prospect in southwest Tasmania. The new intersection consists of 3.5 m of 9.45% Zn, 5.01% Pb, 109 g/t Ag, and 0.3 g/t Au. The company has also reported intersections of gold-polymetallic mineralization at the **Higgs** prospect in northern Tasmania of 4 m of 10.5 g/t Au, 1.5 m of 25.5 g/t Au, and 18 m of 0.99 g/t Au, 76 g/t Ag, 5.75% Pb and 3.76% Zn. **TasGold** has also announced two narrow, high-grade gold intersections in the first hole drilled under the Panama prospect in northeast Tasmania of 0.5 m of 19.1 g/t gold and 0.8 m of 22.4 g/t gold. **Lefroy Resources Ltd.** has announced promising intersections of gold mineralization at Lefroy in northeast Tasmania. A hole intersecting the Pineapple reef returned 6 m of 6.38 g/t gold, including 1 m of 20.58 g/t, while a reef splay in the same hole returned 7 m of 2.66 g/t gold, including 1 m of 8.39 g/t. A hole 100 m to the east intersected 4 m of 12.0 g/t Au, including 1 m at 42.36 g/t Au.
NEW ZEALAND

Newmont commenced the Favona underground mine decline at Waihi in December and continued exploration drilling prospects nearby and in the Waitekauri valley in the Coromandel region. Heritage Gold NZ Ltd is undertaking a 23- to 25-hole underground diamond drilling program mainly in the Maria vein of the former Talisman mine, Karangahake, 15 km west of Waihi. Drilling on the Dominion Knoll prospects south of, but adjacent to Talisman, intercepted 4 broad north-trending mineralized zones. Glass Earth commenced separate airborne aeromagnetic/radiometric and airborne gravity surveys of the Taupo Volcanic Zone and southern Coromandel. Aurora Minerals Ltd reported gold grades up to 6.9 g/t in reconnaissance sampling of veins at the Backyard prospect in their Hazelbrook permit in Northland. In contrast to these epithermal prospects, new exploration projects in the North Island include Mercator Gold’s search for VMS deposits and a re-evaluation of titanomagnetite beach sands near Waverley on the west coast by Serico Developments Ltd.

In the South Island, exploration focused mainly on mesothermal gold. Oceana Gold continued construction work at its developing Globe Progress mine in the Reefton goldfield, while concurrent exploration drilling is aimed at expanding the reserves. Oceana abandoned its refurbishment of the Prohibition shaft at Blackwater, 16 km south of Globe Progress, and is looking at alternatives to access resources beneath the 840 m deep former underground workings. In Otago, drilling in the proposed Frasers underground mine intersected a second parallel structure (panel 2 deep) with a best intersection of 17 m at 3.04 g/t Au. The 2.5 km decline had progressed 366 m by the end of 2004 and is expected to reach the resources in late 2006 for underground mining to commence in 2007. CanAlaska will joint venture with Oceana in a RC drilling program on the Rise and Shine prospect near Bendigo in central Otago. HPD NZ Ltd is carrying out soil geochemical surveys to select drilling targets at their Mosaic, Ophir, Bendigo, and Nenthorn prospects, for a planned 2,000 m drilling program by the end of May. In Southland, Great Australian Resources Ltd will joint venture with local company Southwest Exploration Ltd in exploration of the East Longwood goldfield near Invercargill.

EUROPE

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Junior-dominated exploration surged forward in the last six months as metal prices stayed in very friendly ranges. Notable were strong Au intersections reported at all four Au-Ag targets drilled by Euromax in Bulgaria, and a new increased reserve at Dundee’s Chelophe high-sulfidation Cu-Au deposit. Finland appears poised for diamond discoveries, and numerous small-scale lode Au developments move forward. Anatolian reports success in both Cu and Au at its Turkish targets. Eldorado identified a potential porphyry Au target that sounds similar to the early days at Kisladag, and European Nickel made progress toward eventually adding European Ni production.

BULGARIA

Euromax intersected encouraging mineralization at all four of its Au-Ag targets drilled in late 2004. At Breznic, a low-sulfidation Au-Ag vein system surrounding a central, high-sulfidation alteration zone, 23 holes with 1.483 m of reverse-circulation (RVC) drilling in shallow holes at 50-m centers returned intervals of 4 m, 13.7 g/t Au, to as much as 16 m, 8 g/t Au; this zone is targeted for a follow-up core drilling. At the Petelevo high-sulfidation target in the Panagyurishte district, angle drilling returned up to 82 m of 3.8 g/t Au and 6.2 g/t Ag across steep structures that were likely underevaluated by the previous vertical Bulgarian state holes. These had defined a mineral inventory of approximately 16.6 Mt of 0.62 g/t Au. At Trun, western Bulgaria, RVC holes intersected as much as 108 m of 0.8 g/t Au at the K2 target and 46 m, 1 g/t Au at the Zlata target, in what could be a significant new district of granite porphyry-related Au systems. Soil surveys at the western margin of Trun returned very large Au anomalies, suggesting presence of an additional, completely untested system. An 11-hole, 1,253 m RVC program at Srebrna (Rakitovo) confirmed Au-Ag-(Pb) mineralization in deeply oxidized quartz stockwork zone in a Cretaceous granite porphyry stock, with intersections up to 21 m, 48 1.6 g/t Au. Euromax is a key driver for the South East European Exploration Conference and Field Trip planned for May 7–10, 2005 in Sofia, which promises to bring attendees up to date on exploration activity and potential of southeast Europe. Contact them at <see conference@cmi-capital.com or cmi-capital.com/seeconference>. After several years in Bulgaria, Hereward Ventures exited the Bulgarian minerals business for greener pastures in hydrocarbons, venturing its Tashlaka Hill Au and other targets to Ivanhoe Mines.

Dundee Precious Metals posted a notable reserve addition at the Chelophe high-sulfidation Cu-Au deposit, which now contains 24.93 Mt of 1.5% Cu, 4 g/t Au, and 10 g/t Ag measured and indicated, as well as at the Ada Tepe low-sulfidation Au deposit, which now has 5.22 Mt of 5 g/t Au and 3 g/t Ag measured and indicated. Spectacular drill intersections including 76 m of 47 g/t Au were intersected earlier at Ada Tepe but probably represent oblique hits along bonanza vein zones above the more uniformly mineralized, stratiform “Wall” zone.

TURKEY

Anatolian Minerals announced 1.5 Moz of oxide Au mineralization (all categories) with estimated 80 to 90% cyanide recoveries at Copler. This variably oxidized stratiform, limestone-hosted deposit is developed around a central weakly Cu-Au mineralized Tertiary intrusion.

After a long silence following last year’s notable Cu(Au) drill results from the Kizilviran porphyry target in eastern Turkey (47 m of >1% Cu), in February the Anatolian-Rio
Tinto alliance announced another intersection of 57 m of 1.03% Cu and 0.17 g/t Au in supergene-enriched mineralization above protore containing 0.2 to 0.6% Cu. In late summer Anatolian also reported 150 m of skarn and porphyry with visible Cu-Mo mineralization in drill holes at Ikiztepe prospect in the Bulgarian border region, but has not announced assays.

Eldorado Gold discovered a very interesting quartz veinlet stockwork and associated 800 m by 1,200 m Au anomaly at the “S Zone” at the Koyulhisar district; the target’s location 150 m topographically lower than the adjacent weakly Au-mineralized high-sulfidation alteration KK zone suggests this could be another emerging porphyry–high-sulfidation duplex similar to Kisdag—with similar ounces, it is hoped. Eldorado also discovered the “AS” porphyry-style Au-Mo-Cu target, potentially yet another virgin Turkish porphyry occurrence.

European Nickel (ENickel)’s 78 drill holes at the Coldag Ni laterite deposit confirmed shallow nickel mineralization previously identified by the Turkish survey (approximately 38 Mt 1.14% Ni and .05% Co). Its innovative simple heap leach test using direct acid leach showed encouraging early-stage nickel solubilities (~25% to date).

In early 2005, Oxiana announced the sale of its 95% interest in Cyprus Cu(Au) targets and in return will take shares in newly formed Mediterranean Minerals, representing an expected 15 to 20% of the issued capital upon a successful AIM listing.

**ROMANIA**

International Goldfields Ltd. Drilled 6 holes, 965 m to test three zones at Gladna, southwest Romania. Multiphase monzodiorite-andesite plugs are variably demagnetized, K-silicate and phyllic altered, and contain up to 5% pyrite with “elevated” Cu values, with mineralogical work apparently showing affinity to mafic-related systems such as Porgera—metals, it is hoped, to follow!

Rosia Montana Gold continued resource definition drilling at the low-sulfidation, dacite- and breccia-hosted Rodu and Frasin deposits of its Bucium target, including 48 holes,10,105 m and 1,579 m of channel sampling; they promise an updated resource estimate in early 2005.

Carpathian Gold intersected 6.5 m of 3.26 g/t Au in a new, near-vertical vein its Varatec project in northern Romania that extends the prospective zone westward about 500 m. At their Bafia Sprie project, in-house scoping study nears completion and a final production decision is expected in the first quarter of 2005 after third-party audits are complete. Carpathian’s third project, Baiut, is located about 2 km from Varatec and has a National Instrument 43-101 compliant inferred resource of 0.341 Mt of 4.75 g/t Au.

**SERBIA-MONTENEGRO**

ENickel’s subsidiary, Dinara Nickel, received exploration licenses in Serbia covering 72.75 square kilometres in Dobro Polje-Bukova Glava. In November, Dinara Nickel was also awarded the exploration license for the Mokra Gora Ni laterite target in the vicinity of Uzice, but abandoned the project in January owing to environmental and cultural sensitivity of the region. Ivanhoe optioned Hereward Resources’ Cu-Au targets in the Tertiary and Upper Cretaceous belts and can earn an 80% by spending US$500,000.

**IBERIA**

Rio Narcea continued feasibility drilling on its Salave Au project and the estimated measured and indicated 43-101 mineral resources is now 1.5 Moz Au at a grade of 3.0 g/t. Salave is a disseminated, intrusion-related deposit hosted in a granodiorite; gold occurs in subhorizontal to gently west-dipping irregular lenses in an area of 350 × 300 m.

A notable entry into the European sector is Peru’s highly capable Buenaventura, who will drive a ramp and explore deep, high-grade intersections at Rio Narcea’s Santa Marina gold mineralized area. High-grade
brecias similar to those at the adjacent El Valle mine returned previous intervals including 22 g/t Au over 1.0 m, 16.1 g/t over 2.5 m, and 2.0 g/t over 8.2 m, at 170 to 210 m below surface. Buenaventura’s underground expertise and persistence in more complicated, high-grade deposits should benefit both companies.

IRELAND

Tournigan Gold demonstrated potential for significant expansions of quartz vein system at the no. 1 vein at Curraghinalt Au, where a new diamond hole intersected 1.32 m of 66.95 g/t Au, 390 m below surface, opening up the potential for additional high-grade mineralization down dip of the known veins.

FINLAND

Activity in Finland reached new intensity, with a total of about 40 companies now exploring. Dragon Mining NL, through its local subsidiary, Polar Mining Oy, plans a two-mine gold operation around its now permitted processing plant at Vammala, southwest Finland, with ore to come from the fully permitted, new Jokisuivu mine and former Outokumpu Orivesi deposits (resources of 300,000 and 180,000 oz, respectively). Jokisuivu would be a brand new mine, whereas the Orivesi mine was under operation by Outokumpu Mining from 1994 to mid-2003 and by Polar to end of the 2003. At Orivesi, underground drilling defined a new lode of 0.36 Mt @ 15.3 g/t Au. Polar has also all permits for another gold mine, Pampalo, in easternmost Finland, but apparently has decided to continue drilling to increase the resource (currently 0.9 Mt @ 6.9 g/t Au) before developing. Scan Mining’s reopened Pahtavaara gold mine in Lapland, northern Finland, produced 34,000 oz Au in 2004; two new lodes were discovered. Riddarhyttan Resources AB again reported increases at Suurikuusikko to 14.9 Mt @ 5.2 g/t (2.5 Moz) Au through a six-rig, 20,000-m drilling program since June 2004. With the first >1 Moz resource confirmed in 2000, and all permits in place since early 2003, one just wonders when will they start mining? Northern Lion Gold now owns 100% of the Haveri tenements, including a gold mine operated from 1940’s to 1960’s, and where the current drilling campaign has indicated a number of previously unknown lodes. Also actively drilling for gold (± copper), in northern Finland, are Scandinavian Gold Ltd and Tertiary Minerals plc. Belvedere Resources Ltd is drilling several, possibly gold-copper porphyry and iron oxide-copper-gold-style, prospects at Kopsa and in the Kuusamo schist belt in central and northeastern Finland, respectively. Newcomer Taranis Resources Inc just started to drill at the Kettukkuusikko prospect in Lapland, which it acquired from the Ministry of Trade and Industry through tender in late 2004. North American Gold Inc came into the country in 2004 and now holds ground in nine localities in southern and northern Finland.

Finland’s main PGM player, Gold Fields Ltd., announced that its Arctic Platinum project in layered intrusions now potentially contain 25 Moz PGM plus Au, plus significant Cu and Ni. Drilling and metallurgical work for feasibility studies were carried out in 2004. Scandinavian Gold began an 1,850-m drill program targeting high-grade PGM-Ni pipes within the low-grade Keivitsa layered-intrusion prospect; their previous drilling showed as much as 1.01% nickel, 1.49 g/t platinum, and 1.39 g/t palladium over 29 m. Eight holes totalling 1,500 m on its Tepsa target north Finland failed to show encouragement (max 2 m of 0.09% Cu and 0.28 g/t Au).

In the base-metals sector, Vulcan Resources Ltd entered Finland by acquiring from Dragon Mining, in late 2004, the Outokumpu-style Kylylahti Co-Cu-Au deposit (3.35 Mt @ 0.3% Co, 1.8% Cu, 0.6% Zn, 0.2% Ni, 0.9 g/t Au) in eastern Finland, a set of komatiite-hosted Ni prospects in northeastern Finland, and a layered intrusion-hosted PGM prospect at Tornio in northeastern Finland. Vulcan has already started a prefeasibility study at Kylylahti. In addition, Anglo American plc and Inco Ltd demonstrate consistent interest in the nickel potential of the country by drilling in several targets in central and northern Lapland.

Luzenac Suomi Oy received environmental permits for the Alanen talc mine and processing plant in eastern Finland. This mine is planned to produce pigment-grade talc for paper industry. Planned mine over a 20-yr mine life with an annual production of 133,000 to 148,000 tpa (dry) talc concentrate and 5,500 to 8,500 tpa nickel concentrate.

International tenders during early 2005 by the Ministry of Trade and Industry of Finland: Ritakallio (gold in shear zones, SW Finland), Sakiatieva (gold in greenstones, Lakland), Haukiaho and Kaukua (PGM-Ni-Au in layered-intrusions, NE Finland), Heiskasenao and Rumpalinaava (soapstone, eastern Finland), and Kalkkimaki (carbonate rock, SW Finland). Diamond exploration accelerated in Finland in 2004, with three companies working in the Kaavi–Kuopio area.

European Diamonds plc’s re-evaluation of the Lahtojoki kimberlite pipe early in the year was encouraging enough that they are now taking a several-thousand-ton bulk sample. Other kimberlites in the Kaavi-Kuopio clusters are being reassessed by Nordic Diamonds plc while Gondwana Investments S.A. has tracked till indicator anomalies to delineate a number of drill targets on their property east of and adjoining the Lahtojoki claims. Karelian Diamonds Resources acquired more ground based on positive indicator samples in the Kuhmo area, 200 km northeast of Kaavi-Kuopio.

The other major development in the Finnish diamond sector in 2004 was the discovery of the country’s third kimberlite cluster, containing both Group 1 and 2 kimberlites, in the Kuusamo region, northeastern Finland, by Tertiary Minerals plc in mid-2004. Speculation is that some of the kimberlites in this cluster may be of the same age as those in the diamondiferous Arkhangelsk field in Russia. In total, nine companies are presently active in diamond exploration in Finland.

SWEDEN

Beowulf Gold, along with JV partner Phelps Dodge, announced an intersection of 194.4 m 0.35 g Au, 3 g/t Ag, 0.27% Cu and 0.14% Zn near mineralization partially tested by the SGU at its Jokkmokk target. The JV started a 1,500-m follow-up drilling program in late February. Beowulf independently plans three holes at Grundtrask, Skellefte district, where previous drilling showed values up to and adjacent boulders contain up to 2.6 % Cu with “significant” Au. Since November 2004, North Atlantic Natural Resources (“NAN”) drilled 10 holes, 1,296 m at Copperstone (formerly Svarttiden), Skellefte district, and announced a thin
but rich intersection of essentially solid metal with a little sulfur thrown in: 0.55 m of 1.86% Cu, 22.4% Zn, 7.42% Pb, 2.2 g/t Au, and 139 g/t Ag at 66-m depth.

**Slovakia**

Tournigan Gold completed a comprehensive diamond drill program at the Kremenica and Kremenica South low-sulfidation epithermal Au-Ag system, focusing on extension targets along strike of the main Sturec resource. Four holes, 522 m, were completed at Vratislav (Schramen and Schindler vein systems) and three holes, 332 m, were completed at Wolf, located 500 to 1,500 m north along strike from Sturec. At Vratislav, results include 22.6 m at 7.78 g/t Au; Wolf returned similar thicknesses of somewhat weaker Au-Ag downdip of the known mineralization.

At Kremenica South, Tournigan defined strong, locally ore-grade surface Au (AsSbHg) soil and rockchip anomalies, essentially along strike of the structural fabric which controls the Sturec resource at Kremenica 1 to 2 km north. Relative vertical distribution of volatile elements and Au show a classic zoning pattern permissive for discovery of significant low-sulfidation Au mineralization at shallow depth, particularly considering the proximity to one of Europe’s most significant bonanza Au districts. Six core holes totaling 1,510 m were completed at Certov Vrch; a seventh, 200-m hole was completed at Bartosova Lehotka some 2 km south-southeast of Certov Vrch in silicified rhyolites. Analytical results are pending.

Verona Development completed phase 1 of its exploration program (mapping, geochemical sampling, and 525.4 m, 6 core holes) at Kokava Cu-Au target, where Cu-Au-bearing quartz veins in a Paleozoic metamorphic complex are exposed in several adits in Medene mine and Runa areas. Despite the presence of historic placer workings, surface geochemical results were discouraging. One hole at Kokava-Bohate (Runa vein) returned weak mineralization (3.2 m of 1.62 g/t Au) and a second hole located in an area of historical placer workings was barren; results from remaining four holes are pending.

**South America**

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In January, Quadra Mining Ltd announced the discovery of two oxide copper zones known as Isabela Norte and Catalina Este on its Sierra Gorda project (Quadra Mining 100%), following completion of a 50-hole, 10,712-m, reverse circulation (RC) drill program last December. The Sierra Gorda property is located in Region II, 140 km northeast of the port city of Antofagasta and is host to a porphyry Cu-Mo system with zones of copper oxide and breccia.

Outokumpu, a previous operator, defined the Catalina resource with 110 Mt @ 0.6% Cu and 0.1% Mo that lies in close proximity to the newly discovered oxide zones. According to Quadra Mining, the newly discovered zones are underlain by primary copper mineralization that has yet to be tested.

Significant intercepts at Isabela Norte include hole 4-201: 162 m @ 0.60% Cu, hole 4-21: 154 m @ 0.56% Cu, hole 4-28: 72 m @ 0.71% Cu, and hole 4-36: 20 m @ 1.06% Cu. Significant intercepts at Catalina Este include hole 4-02: 188 m @ 0.40% Cu, hole 4-05: 156 m @ 0.43% Cu, and hole 4-38: 40 m @ 0.50% Cu and 72 m @ 0.51% Cu. Quadra has estimated a budget of US$3.4M for exploration at Sierra Gorda in 2005.

Far West Mining announced the remaining results from its latest drill program on the Candelaria project (BHP 30%, Far West Mining 70%) and the 4a3 target area in late January. Drilling on the 4a and 4c target areas was to resume in February. At the 4a3 target, eight holes tested for lateral extensions of the manto mineralization already intersected previously by stepping out from drill holes 4a3-001 and 4a3-003. All holes intersected manto and stockwork mineralization of variable grade and thickness with one of the holes, 4a3-020, returning 62 m @ 0.50% Cu, 40 m @ 0.52% Cu (stockwork) and 12 m @ 1.36% Cu (manto). Drilling to date on the 4a3 target area has been confined to a 4 km² area that lies within the much larger 10 km² 4a3 target anomaly identified using the Falcon gravity geometric/magnetic system.

Lumina Copper announced in January an independent mineral resource estimate for its Regalito property and claims that this new estimate

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ranks the resource fifth among the known leachable copper discoveries made in Chile in the last 35 years. The Regalito project is located in Region III and consists of 4,158 ha of exploration claims, approximately 115 km SE of Copiapo. Measured and indicated resources of 628 Mt @ 0.43% Cu with an inferred resource of 131 Mt @ 0.41% Cu, using a cutoff grade of 0.25% Cu. Further measured and indicated resources of 215 Mt @ 0.21% Cu and inferred resources of 60 Mt @ 0.20% Cu at a cutoff grade of 0.15% Cu have also been delineated and may be considered suitable for dump leaching. The mineral resource has been prepared in compliance with National Instrument 43-101. It is reported that 11 companies have signed confidentiality agreements and are evaluating the property.

In January, Metallica Resources announced that it and Noranda Inc. have acquired the 2% net smelter returns (NSR) royalty held by BHP Chile Inc. (BHP Billiton) on the El Morro project for US$2.0M. Metallica acquired a 30% interest in the royalty for US$0.6M, while Noranda acquired a 70% interest in the royalty for US$1.4M. In accordance with the terms of an exploration agreement between Metallica and Noranda for the El Morro project, Noranda may earn a 70% interest in the project by paying Metallica US$10M by September 14, 2005. In addition to the US$10M payment, the agreement calls for Noranda to complete a bankable feasibility study by September 2007 and finance 70% of Metallica’s 30% share of the capital required to develop the project, if requested by Metallica. In the event that Noranda chooses to not exercise its option to purchase 70% of the project, it has agreed to sell its percentage of the royalty to Metallica for its purchase price of US$1.4M.

In January, Noranda also began an 8,000-m diamond drilling program on the La Fortuna resource within the El Morro project. The objective of the drilling program is to improve the definition of the higher grade copper enrichment zone and to investigate the geologic distribution of the higher grade copper interval encountered in previous drilling. Noranda announced that it estimates the cost of the program at approximately US$1.7M.

PERU

Exploration activity for gold and copper in Peru remains strong, with several properties returning encouraging results. Anglo American recently optioned the early-stage, 50,000-ha Antay Cu property from owner Southwestern Resources. Anglo can earn 55% by spending US$5M in exploration and purchasing US$5M worth of Southwestern shares over five years with a firm commitment to spend US$1.5M in exploration (including 3,000 m drilling) and purchase US$2M worth of Southwestern shares. Anglo American has also optioned the Ataspaca Cu-Au property from Bear Creek Mining and Southwestern Resources and must spend US$2.75M and make cash payments of US$150,000 over four years to earn a 60% interest. Bear Creek Mining has optioned Rio Tinto’s Corani (formerly Minaspata) Ag-Au-Cu property located in southern Peru. Terms of the deal have Bear Creek paying Rio Tinto US$5.32M over three years to earn 70% in the 2,300-ha prospect. Rio Tinto retains back-in rights to 60% in the even of a large Au (+10 Moz) or Cu (+11 Mlb) resource. Work to date has outlined structurally controlled Ag-Au mineralization and soil anomalies with limited previous drilling by Minsur. Bear Creek Mining has acquired AngloGold Ashanti’s exploration data over an 180,000-km² area in southern Peru in exchange for share/warrant issues to AngloGold. Bear Creek will have 100% interest in prospects acquired in the data package area with AngloGold having back-in rights to 65%.

Partners Southwestern Resources and Newmont have optioned Cambior’s Minaspata property located just north of the Liam prospect. Terms of the deal have SWR-Newmont earning 51% by spending US$5M in four years with a commitment to drill 1,000 m in the first year. SWR-Newmont can earn an additional 9% by spending US$5M before the sixth anniversary and Newmont can earn up to 50% by producing a positive feasibility study. Geologix’s phase 2 drill program (11 holes totaling 2,800m) on its Cerro Calcoro gold property located in northern Peru failed to return significant results with the best intercepts being 60 m @ 0.73g/t Au and 14 m @ 0.47 g/t Au. Phase 2 drilling by International Minerals on their Pallancata Ag-Au prospect returned high-grade bonanza results including 6.6 m @ 2,061 g/t Ag and 11.5 g/t Au and 2.7 m @ 1,483 g/t Ag and 6.6 g/t Au. Drilling continues.

Acero-Martin Exploration has drilled eight holes (1,420 m) on its Pinaya gold project located in southern Peru. Results included up to 122 m @ 1.21 g/t Au, 89.3 g/t Au @ 1.0 g/t Au, and 85.5 m @ 0.37 g/t Au. Drilling has tested a strike length of 250 m and to 150 m vertical depth. Second-phase drilling is scheduled to commence in a few months and will test further strike extensions and geophysical anomalies.

Westmag Resources has entered into an exclusive data package review of AngloGold Ashanti’s exploration data over an 130,000-km² area in central Peru until June 1, 2005. Westmag, through its new Peru entity, Golden Eagle Resources, will have 100% interest in prospects acquired in the data package area with AngloGold having back-in rights in resources over 2 Moz gold equiv.

Sulliden Exploration has completed its phase 2 drill program on their Shahuinding Au-Ag property located in northern Peru, with a total of 8,500 m being drilled. A new resource estimate is expected soon. The property remains in heated litigation. Absolute Resources has staked the Hualatan gold prospect located in northern Peru. The property falls within the Absolut-AngloGold Ashanti regional JV in which Absolut has access to Anglo’s database over a 200 ¥ 40-km region and in return Anglo retains back-in rights to 65% in any property in the region with a resource over 2 Moz gold. Hualatan was previously drilled by JICA (Japan International Cooperation Agency). Drilling (57 holes totaling 5,247m) by Silver Standard on its optioned Berenguela silver property has returned up to 54 m @ 520 g/t Au, 83 m @ 329 g/t Ag and 37 m @ 503 g/t Ag.

Chariot Resources and Korean partners Korea Resource Corporation (KORES) and LG Nikko Copper plan to drill 37,000 m on their Marcona Cu project in 2005. Chariot has just raised US$23M to pay for the purchase price (from Rio Tinto) and help fund the aggressive drill program. Mina Justa has a current resource of 218 Mt @ 0.80% Cu. Milpo has optioned 49% of its interest in the Pukaqqa Cu deposit, located in central Peru, to Tomin Resources, a company traditionally focused on titanium, for US$1M in exploration and assuming Milpo’s staged payments still owed to Rio Tinto, who retain a 1%
Exploration Reviews (Continued)

Exploration Reviews (Continued)

NSR. Rio Tinto had outlined a resource of 85 Mt @ 0.91% Cu and 0.15 g/t Au at Pukaqqa.

A new resource calculation at Inca Pacific’s Magistral Cu-Mo deposits located in northern Peru increased the resource to 115 Mt @ 0.74% Cu and 0.05% Mo and is based on 32,640 m drilled in 108 holes. Quadro Mining has signed an option to earn up to a 65% interest in Magistral. Inca Pacific continues to drill its Antoro Sur Cu project with results including 1.89% Cu over 23.6 m and 1.46% Cu over 27.6 m. Rio Tinto has optioned its interest in Constanza project to Norsemont Mining. Norsemont can earn an initial 51% by making (underlying) property payments of US$5M, work commitments of US$7.8M and issuing 1.25 million common shares over a five-year period ending October 31, 2009. After much pain and heartache Manhattan Minerals has terminated its arbitration process in the infamous TamboGrande Au-Cu-Zn-Ag project and has pulled out of Peru entirely.

Xstrata hopes to begin its US$14M exploration program at Las Bambas in March this year. As part of the first-stage drill program, Xstrata plans to drill 66,000 m in 220 holes. Xstrata won the auction by offering US$121M for the property. An interim mineral resource estimate at Monterrico Mining’s Rio Blanco Cu-Mo property shows 1.25Bt @ 0.55% Cu and 0.026% Mo or 0.71% Cu equiv at a 0.4% Cu cutoff including 470 Mt @ 0.61% Cu and 0.023% Mo or 0.76% Cu equiv. At a 0.6% Cu cut-off the resource is 284 Mt @ 0.77% Cu and 0.55% Cu and 0.026% Mo or 0.71% Cu equiv. The bankable feasibility study is due at the end of 2005.

1800s and South Carolina was a significant gold producer in the late 1980s and early 1990s.

Triangle Minerals continues exploration on its Zn-Pb-Cu-Au target in North Carolina, where a 40-km strike length of garnite-rich stream sediment anomalies lies. Outcrops in streams contain up to 4% zinc in sulfidic schists. Triangle is also continuing work on the Deep River gold-copper porphyry target in North Carolina. Some companies have been exploring for diamonds based on historic occurrences and the presence of lamprophyre dikes and ultramafic rocks.

All mining activity relates to industrial minerals. In 2006, Asheville, North Carolina, will be hosting the International Forum on Industrial Minerals. The dates are May 6–13, with registration on May 7 and technical sessions running May 8–10. More information will be found on the website, <http://www.geology.enr.state.nc.us/NCIndustrialMineralsForum/index.htm>. This is always a great meeting to attend.

**WESTERN CANADA**

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**MANITOBA**

Total exploration spending in Manitoba for 2004 was estimated to be $32.6M. Having recently completed an ambitious $400M upgrade of its Flin Flon and Snow Lake operations, parent company Anglo American International was in negotiations to sell its Canadian subsidiary Hudson Bay Mining and Smelting (HBMS) to Ontzinc Corporation for $325M. The deal includes the HBMS 5 operating mines, two concentrators, the Flin Flon copper smelter and zinc refinery, and the HBMS large land position in Manitoba and Saskatchewan. Inco has joint venture projects ongoing with Nuinsco Resources at the Mel property northwest of Thompson and with Canadian Royalties on Inco ground south of Thompson. In the Gillam area northeast of Thompson, Falconbridge, BHP Billiton, Inco, and various junior companies are exploring for the extension of the Thompson nickel belt.

Bema Gold released an updated resource estimate for its Monument Bay gold property in northeastern Manitoba. Using a cutoff of 8 g/t Au, the inferred resource is now estimated at 1,069,258 t grading 15.36 g/t Au, representing 528,041 oz Au. Canadian Gold Hunter and partner Rare Earth Metals completed a 15-hole summer drilling program at their Assean Lake property. The majority of the drilling tested the Hunt zone. Foran Mining has been busy with mine planning work at its North Star gold project.

San Gold Resources and Gold City Industries completed deep drilling on the San Gold no. 1 deposit, 3 km east of Bissett. A second drill rig tested the San Gold no. 2 and 3 discoveries. The mine horizon has been extended via ground geophysics and drilling up to 9 km from the Rice Lake gold mine in Bissett. Wildcat Exploration drilled its Poundmaker property in the Rice Lake belt.

The search for diamonds in Manitoba is expanding. Major companies such as BHP Billiton, Dunsmuir Ventures, and Marum Resources still retain ground in the area, but exploration activity has slowed down, with attention now shifted to explore areas of the Hudson Bay Lowland (HBL). Companies new to the Manitoba mining scene, such as Diamonds North Resources and Falcon Ventures, along with Foran Mining, have acquired significant ground positions in the Kaskatatma River area near the Ontario border. Companies such as BHP Billiton, Ashton Mining, and partners Geodex Minerals and Arctic Star Diamonds have acquired (or optioned) large holdings in the HBL northeast of Gillam.

**NUNAVUT**

Exploration activities continued at a high level across Nunavut, focused on gold, diamonds, and base metals with or without PGMs. Expenditures were...
estimated to come in at $168M in 2004. Nunavut’s only operation, Echo Bay’s Lupin mine opened up to extract and process the crown pillar and is awaiting a decision as to whether to extract the shaft pillar before ceasing operations.

The largest exploration program in the territory was Miramar Mining’s Hope Bay project, which saw more than 40,000 m of drilling focused on the Madrid and Boston deposits, with some excellent results from both, including 64 m grading 9.8 g/t Au in the Naartok zone at Madrid. Miramar was also active on the Back River project, where it has an option to earn 60% from Kinross, and drilling returned positive results from the Goose Lake deposit, including 36 g/t Au over 17 m.

At Cumberland’s Meadowbank project, in-fill drilling suggests the presence of a near-surface, high-grade zone at the Goose Island deposit, including 119 g/t Au over 4.9 m. The project is currently undergoing a cost review following the announcement of significant increases in capital cost earlier in 2004. Cumberland also has a 22% interest in the Meliadine West project with Comaplex Minerals, where drilling on the West Tiriganiaq deposit appears to indicate potential for additional resources at depth and along strike. Results from a 9,300-m drilling program include up to 40 g/t Au over 16 m.

Committee Bay Resources and partner Gold Fields continued their C$79M exploration program on the Committee Bay belt in eastern Nunavut. They drilled 31 holes, focusing on the Three Bluffs area. In late November, they reported a near-surface, high-grade inferred resource of 1.3 Mt grading 10.2 g/t Au, at a 4 g/t Au cutoff. Placer Dome drilled 6 holes in 2004 on its Maze Lake project, 90 km southwest of Rankin Inlet. Encouraging gold values were encountered in a potassic-altered shear zone, which appears to straddle a felsic-mafic volcanic contact.

Commander Resources explored the Qimmig project, a banded iron-formation gold prospect on Baffin Island. Results include 9.5 g/t Au over 6 m. A new discovery, the Durette showing, was traced over a 700-m strike length.

Wolfden was active on both its High Lake polymetallic deposit and its Ulu gold project. At the former, Wolfden reported that it continues to expand the massive sulfides in the West zone, including a 51-m intercept grading 0.8% Cu, 7.6% Zn, 103 g/t Ag and 3.8 g/t Au. In November, Wolfden announced the discovery of a new polymetallic zone and the initiation of a feasibility study. In January, 2005, Wolfden provided results of a mineral resource estimate within the AB, D and West zones. For 2005, the budget for the High Lake project is approximately $20M. At Ulu, drilling has both infilled and expanded the existing gold resource (including 10 g/t Au over 19 m) and discovered a high-grade Cu-Zn-Ag-Au massive sulfide zone at depth.

Sabina Resources has been drilling for extensions to the Hackett River massive sulfide deposit held under option from Teck Cominco, as well as testing new targets. One hole intersected four zones of mineralization, including 14% Zn and 190 g/t Ag over 13 m and 6.7% Zn and 231 g/t Ag over 37 m. Strongbow is active on a number of fronts, including the Musk VMS project, held under option from Noranda, where one hole intersected 5.5 m grading 0.9 g/t Au, 352 g/t Ag, 0.3% Cu, 3% Pb, and 22% Zn on a step out from the previously defined resource.

Baffin Island may get an iron ore mine at last, as Baffinland Iron Mines significantly expanded its Mary River iron deposit that last saw active exploration back in the 1960s. Core samples have been shipped to the labs for metallurgical characterization to determine the potential for direct shipping iron ore to Europe. Starfield Resources continues to infill and expand the Ferguson Lake Ni-Cu-PGE project, intersecting PGE-rich mineralization both with and without massive sulfides, including some high-grade PGE values up to 12.6 g/t Pt and 8.2 g/t Pd over 1.5 m. Following the rising prices, Hornby Bay began exploring for uranium in the Coppermine area of Nunavut, and there are other signs of renewed interest in uranium across the territories.

Diamond exploration has been active in a number of areas. On the Melville Peninsula, Stornoway Diamonds, BHP, and Hunter Exploration reported a 10-t sample from the AV-1 kimberlite on the Aviat project returned a grade of 0.8 ct/t. AV-1 is one of five kimberlites discovered on the JV properties and its discovery prompted an unprecedented staking rush, with 9.1 million acres of claims recorded in 2003 versus 0.9 million in 2002. Tahera’s Jericho project is slowly moving through the permitting process toward production, having received its project certificate. A $35M credit facility has been arranged with Tiffany & Co., potentially clearing the way for the development of Nunavut’s first diamond mine. Diamonds North is exploring the large Arnak property for its diamond potential with partner Kennecott and the adjacent Amarak property with BHP Billiton; while on Victoria Island, Diamonds North has entered into an agreement with Teck Cominco on a large block of ground straddling the Nunavut NWT border, including the Blue Ice project. The partners report encouraging results from the Vega kimberlite.

Stornoway discovered three new kimberlite units on its Aviat property and 3 holes intersected kimberlite in drilling. Till sampling programs encountered favorable chemistry and 6.5 ct of diamonds were recovered from a 7.4-t-kimberlite sample. Twin Mining explored its Jackson Inlet property, finding new kimberlite units with 13 diamonds recovered from 3 samples. Till sampling, ground geophysics, and drilling were completed. The West Churchill diamond play was active in 2004, with partners Shear Minerals, Stornoway Diamonds, and BHP Billiton exploring an 8.5-million-acre land package between Rankin Inlet and Baker Lake. Over 22 kimberlites have been discovered and high-interest G10 indicators are widely dispersed. BHP’s 100% owned Qilalugaq property near Repulse Bay underwent bulk sampling. Diamonds were recovered from four separate samples, although none of the samples contained values that would be expected to be economic.

**NORTHWEST TERRITORIES**

Miramar Mining announced the closure of the Giant mine, which follows the closure of the Con Mine in 2003, bringing to an end 66 years of gold mining in the city of Yellowknife and the last operating gold mine in the NWT. North of Yellowknife, Tyhee continues to be active on its Discovery and Nicholas Lake shear-hosted gold deposits, similar to those in Yellowknife. Tyhee drilled 26 holes totalling 9,946 m on the Ormsby zone. April 2004 resource estimates for the Ormsby zone total 2 Mt, grading 10 g/t Au. Tyhee commenced underground development, exposing multiple
mineralized zones. Anaconda Gold announced some high-grade intercepts at its Damoti Lake project, held under option from DoubleStar Resources, including 32 g/t Au over 2.25 m close to surface. Thirty-four holes were drilled in two phases totaling 2,721 m. Based on its results, Anaconda has begun estimating a new resource for the project.

Seabridge has been drilling away on its Courageous Lake project, both infilling and expanding the 48 Mt refractory FAT gold deposit which grades 2 g/t Au. An 8-hole, 3,000-m drilling program intersected up to 3.9 g/t Au over 34.5 m on a 300-m step-out from the previously defined resource, while four holes were drilled on the Olsen and Walsh Lake targets, several kilometers south of the FAT deposit. Canadian Zinc planned a 27-hole, 6,000-m program on the Prairie Creek Pb-Zn-Ag property focused on infill drilling on the main deposit, and south extension exploration. Recent results include 51.4% combined Pb-Zn, 367 g/t Ag over 1.1 m and 38.1% combined Pb-Zn, and 244 g/t Ag over 0.7 m. Fortune Minerals generated a new resource utilizing 2003 drilling for the NICO gold-cobalt-bismuth deposit, 160 km northwest of Yellowknife, which totals 15.5 Mt, grading 1.6 g/t Au, 0.14% Co, and 0.16% Bi. Fortune is coordinating a feasibility study for the deposit.

Both Ekati and Diavik continue to operate at full tilt, making Canada the second largest diamond producer in the world. At Ekati, the Panda underground project was approved in May, with first ore scheduled for delivery in 2005. This position looks to be enhanced by the development of De Beers’ Snap Lake project, which was granted a water license in 2004 and has begun phase 1 of development. The Ekati mine produced 4 million carats during the first 9 months of 2004. Open-pit production was supplemented by underground mill feed from the Koala North kimberlite. The Diavik mine has produced approximately 6 million carats of diamonds during the first three quarters of 2004. Production was on track to produce 7.5 million carats.

Exploration activity remained at a high level with the following highlights: Artic Star and Kennecott Canada Exploration completed four holes totaling 450 m on the Credit Lake property. De Beers, Mountain Province, and Camphor Ventures commenced a $25M prefeasibility study on the Gabcho Kue property. The study plans to advance the project to the permitting stage, and included a 9,800-m, 98-hole geotechnical drilling program. Diamondex Resources completed diamond drilling on the Lena West property. Diavik Diamond Mines and Aber Diamonds carried out extensive exploration programs on their Diavik Leases claim groups, including airborne and ground geophysics followed by diamond drilling of 30 holes totalling 2,700m. Two new kimberlite units were identified. Diavik Diamond Mines (90%) and Southern Era (10%) com-
pleted a 75-t bulk sample from the C12 and C13 kimberlite pipes on the Commonwealth project.

Snowfield began a 20-hole program on the Drybones 4 claim; 4.1 m of kimberlite were intersected in the first hole. The X Claims, a joint venture between Kennecott Canada Exploration and GGL Diamond, were drilled; a new kimberlite, EG-01b, was intersected.

Southern Era Diamonds completed an exploration program on the Yamba Lake property, earning a 60% interest from Tangueray, Mill City, and Techsite Strategies. Stornaway Diamonds is earning a 51% interest in Strongbow’s LDG, Daring Lake and Starfish properties.

SASKATEWAN

Exploration in Saskatchewan is at an all-time high!

Uranium, gold, rare earths, diamonds—exploration for all of these commodities went “through the roof” in 2004. Only base metal exploration was down. Total exploration expenditures for 2004 are estimated at $53M, up more than 60% from last year’s actual expenditures of $31.3M. A total of 350 new claims totaling one million ha were staked in the Athabasca basin in 2004; 94 claims lapsed, and 85 are pending.

Uranium

Not long ago, Cameco and COGEMA, along with two or three others, were virtually the only players in the northern Saskatchewan exploration game. Today, at least 20 junior companies are active, and the two majors are partnering with several smaller companies. Uranium prices have more than doubled from a year ago, and the demand is growing, sparking renewed interest. In total, nearly 3.5 million ha of new claims and permits were acquired throughout Saskatchewan in 2004; the majority of which was in the Athabasca basin. It has been estimated that 2004 uranium exploration expenditures will total at least $25.6M, almost double last year’s spending ($13.3M).

Adding fuel to this increase in exploration activity was the announcement in early February 2005 of a discovery on the Virgin River project (jointly controlled by Cameco, COGEMA, and Formation Capital). Uranium intersections of up to 5.83% U3O8 over a 6.4 m interval were obtained in DDH VR-18.

Significant uranium mineralization was also reported from two separate UX-Cogema–held properties. At the Shea Creek, located to the south of the former Cluff Lake mining operation, uranium intersections were obtained in several drill holes, the most notable of which contained up to 4.33% U3O8 over 3.0 m (DDH SHE 109-1). At the Black Lake property near Stony Rapids, SK, a new zone of uranium mineralization containing 0.69% U3O8 over a 6.4 m was encountered in DDH BL-18.

JNR Resources and partner International Uranium Corp. (IUC) reported in late 2004 that a 33-hole, 12,437-m summer drill program obtained a number of high-grade uranium intersections, including 4.03% U3O8 over 10 m (including 19.96% U3O8 over 1.4 m) in DDH ML-61, 5.14% U3O8 over 6.2 m in DDH ML-55, and 4.01% U3O8 over 4.7 m in DDH ML-48 near the main Maverick mineralized zone.

Significant follow-up exploration programs are planned for 2005 in all four of these prospective projects.

Federal and provincial tax credits are helping encourage exploration. The province’s 6-year, $12.6M Mineral Incentive Program encourages corporations and prospectors to get out and explore. New areas which have not been looked at for 25 years are being explored again.

DIAMONDS

Diamonds are the second most sought-after commodity, with more than $17M spent this year. More than 30 companies and individuals hold more than 890,000 ha in the Fort a la Corne Forest east of Prince Albert. Other companies are working on the Candle Lake, East Side and Smeaton kimberlite properties.

The Fort a la Corne diamond project, a joint venture between partners Kensington Resources, De Beers Canada Exploration Inc., Cameco, and UEM Inc., contains as many as 70 kimberlites. This project boasts an exploration budget of $7.6M for 2004–2005, to be used in defining higher grade units within the kimberlite cluster, with a view to reaching feasibility within three years. Thirty-two drill holes were completed by mid-November, as well as five large-diameter holes on the southern part of the main kimberlites. Drilling continues as part of their aggressive action plan and the joint venture has indicated that it plans to spend $25M on continuing exploration in 2005–2006.

Shore Gold wowed the province on December 1 when it displayed 700 carats of diamonds from its 96-square-mile, advanced exploration Star kimberlite in the Fort a la Corne area at the Geological Survey Open House in Saskatoon. The company is bulk sampling the Star in an underground operation, and has announced that it has recovered 3,050 carats which have been valued at an estimated $135/carat. Planning for ongoing exploration at the Star kimberlite is underway.

GOLD

With the price of gold on the upswing, gold exploration expenditures in 2004 have increased to an estimated $6M, up 110% from last year.

Claude Resources has found more gold mineralization close to its operating Seabee mine. The three new gold-bearing zones at Porky Lake Main, Porky Lake West, and Santoy Lake are all within trucking distance of the existing mill. Total indicated resources for all three zones include 340,000 t grading from 7.3 to 8.42 g/t gold.

Golden Band Resources has been quietly amassing land in the La Range belt near Waddy Lake since 1994. They now have rights to more than 73,500 ha, including seven known gold deposits, four former producing mines, and the licensed Jolu gold mill and tailings facility. The company relocated its head office to Saskatoon in February 2004. Their main objective is to identify enough gold resources (1 Moz) to warrant building a new central mill in the Waddy Lake area. In the short term, the company plans to use the currently mothballed Jolu mill to process ore from the Bingo deposit, where they plan an underground exploration program in 2005.

Several smaller companies are also active in gold exploration. Anglo Rouyn Tailings limited Inc. is recovering gold from tailings from the former Anglo-Rouyn copper-gold mine near La Ronge.

In the far north, GLR Resources has completed several drilling campaigns on its wholly owned Goldfields property near Uranium City. These holes were needed to fulfill the requirements of the feasibility study being undertaken by AMEC of Saskatoon. Ten holes drilled this fall intersected from 1.51 to 6.19 g/t gold.
RARE EARTHS
GWG Minerals spent more than $2M in 2004 evaluating its Hoidas Lake rare earth deposit northeast of Uranium City. The Hoidas Lake JAK zone was stripped and a 250-t bulk sample collected. Last year’s expenditures were just over half-a-million dollars.

BASE METALS
Only $1.8M was spent on exploring base metal properties in 2004, a drop of 18% from $2.2M in 2003. Some work was done on copper-zinc in the Flin Flon area; Golconda Resources Ltd. is testing 10 claim blocks in the Wapawekka Lake area; Phelps Dodge Corporation has staked claims around Janice Lake (Wollaston area).

Anglo American announced that it was selling its Hudson Bay Mining and Smelting operations to OntZinc for $325M. The Konuto mine near Denare Beach, SK is scheduled to close in 2005.

Late in 2004, Foran Mining signed a new agreement with Cameco and its Hanson Lake joint-venture partner BHP Billiton by paying $1.5M before Dec. 31, 2004; another $2M by May 31, 2006 (in cash and/or shares); and providing a 1% net smelter royalty (NSR) to the joint venture. The McIlvenna Bay deposit contains a resource of 14.5Mt, grading 0.68% zinc, 0.91% copper, 0.4% lead, 0.45 g/t Au, and 23.7 g/t Ag, and could potentially be the source of future ore for OntZinc’s Flin Flon smelting operations.

OIL SANDS
Oilsands Quest Inc. is a new name in oil exploration, and they’re taking a look at Saskatchewan’s northwest side. The Calgary-based company is a subsidiary of Can West Petroleum Corporation, formerly Uranium Power Corporation, a Calgary-based private company. The new area of interest straddles the Alberta Saskatchewan border, right next door to the world-class oil deposits of Fort McMurray. IUC recently paid half of the $2.5M cost for 100% ownership in the 2,100 (1.4 million acres)-square-mile Firebag East oil sand project. Oilsands Quest will pay the other half. Personnel are on site in Saskatchewan. Starting in December 2004 they will drill an initial 20 wells to sample the deposit in what they call a “grassroots exploration program.” CanWest is also working in the oil shales in the Pasquia Hills near Hudson Bay.

LIMESTONE
The Pinehouse limestone project is still alive and well, says geological consultant Paul Ogryzlo of Saskatoon. Limestone is used in the uranium milling process and current supplies come from Exshaw, Alberta.

A drill program completed one year ago removed a 150-kg sample from each of two limestone beds. Cameco, a significant user of high quality lime in Saskatchewan, tested these samples in the lab and found they would meet their specifications. Identification of environmental issues and a cost analysis is continuing.

Sources: Saskatchewan Mining Association, Opportunity North, Saskatoon Star-Phoenix.

WESTERN UNITED STATES
Regional Correspondent: Roger C. Steininger (SEG 1978 F) Consulting Geologist, 3401 San Mateo Ave. Reno, NV 89509 Tel: 775-323-7775 Fax: 775-323-1134 E-mail: audoctor@aol.com

It was 10 years ago that Tom Loucks asked me to consider writing this column. How time flies, and have we been through a lot together! I first started writing about juniors and their creative press releases, but Bre-X took much of the fun out of that. Then the metals price depression, when it was a stretch to find things to write about. Now that we are back to the “good old days” there are lots of organizations to pick on. I much prefer these times. Since the villagers are not outside my window with pitchforks and torches I assume that the membership wants me to continue—well, at least a majority of you. I want to thank the many people who have given me so much favorable feedback on this column. At times that is what keeps me going. And for the few who take the time to send an email with corrections, additions, and new information, thank you, especially you, Mr. Coyner. Now back to the hard-hitting reporting that you have all come to expect.

CALIFORNIA
Bullion River Gold is starting exploration and production (?) at the French Gulch and North Fork mines in Shasta County. Underground and surface drilling programs are planned at French Gulch, and an underground drilling program is anticipated at the North Fork. Someone is actually conducting exploration in California; how novel.

Has Jake Margolis become the California Explorinator, following in the footsteps of Arnold the Terminator and Governator?

Golden Queen Mining is re-evaluating the Soledad Mountain project (Kern County), hoping that a new approach to metallurgy and engineering will result in a viable project. How many times has this been undertaken?

IDAHO
Formation Capital completed another drilling program at the Idaho Cobalt project (Lemhi County) in 2004, resulting in the extension of the Ram deposit downward below previous drilling and along strike an additional 200 ft. Mineralization is still open in all directions. The company is currently preparing an update of the resource estimate to include these new drill holes. The news release states that grades in the new drill holes are consistent with grades in the previously defined deposit.

MONTANA
Remember all those quartzite cuts in the hands, arms, and other body parts as we sampled the Revett Formation? They’re back! Revett Silver has reopened the Troy mine and started shipping concentrate. They are also seeking permits to develop the Rock Creek deposit, including constructing a mill. Mines Management Inc. also
started down the permitting path to develop the Montanore silver-copper deposit. With all this going on the Forest Service will be too busy to fight fires this summer. They will put mining permits before everything else, won’t they?

**NEVADA**

Gold Summit continues to report exciting results from drilling at Monte Cristo (Esmeralda County), including one interval that exceeds 3 opt Au. When I asked if Gold Summit is thinking of mining this deposit, a reliable source said, “Not tomorrow.”

Royal Standard’s underground development at the Goldwedge property (Nye County) has crosscut a mineralized structure on the 6742 level. This structure is at least 70 ft wide and contains at least five high-grade zones. Channel sampling of the first high-grade zone produced 25 ft of 0.204 opt Au with 15 ft of 0.329 opt Au. Surface drilling traced the zone for 1,100 ft, and the argillized structure on the 6742 level. This property (Nye County) has crosscut a mineralized zone produced 25 ft of 0.204 opt Au with 15 ft of 0.329 opt Au. Surface drilling traced the zone for 1,100 ft, and it is still open along strike and at depth.

The Standard mine operation at Florida Canyon (Humboldt County) poured its first gold in December 2004. Full production of 30,000 to 40,000 oz of gold should be attained in 2005.

Queenstake Resources continues to report positive results from Starvation Canyon, about 12 miles southwest of the SSX mine at Jerritt Canyon (Elko County). During 2004, 58 holes totaling 45,077 ft outlined a “high-grade” zone that is at least 2,000 ft long, which is open along strike and downdip. High-grade gold mineralization occurs in pods at the intersection of northeast striking cross-faults with a persistent northwest-trending structural zone, primarily in Units 2 and 3 of the Hanson Creek Formation. This northwest-trending zone is traceable for at least 4.5 miles. Gold mineralization seems to be closely associated with decarbonatization and localized argillization. Silicification is concentrated above high-grade gold mineralization, in many cases in overlying Roberts Mountains Formation.

Drilling at the Miranda Gold-Newcrest joint venture Redlich project in Esmeralda County produced significant results. The 19-hole, 11,094 ft program encountered narrow high-grade gold mineralization within broader, lower grade zones. The best high-grade intervals are in two separate holes, consisting of 10 ft of 0.68 opt Au and 15 ft of 0.33 opt Au. Mineralization is in low-sulfidation epithermal quartz veins within a structural zone hosted by argillized Tertiary volcanic rocks.

Augusta Resources has constructed a land position in the Mt. Hamilton area (White Pine County). They have acquired the Shell deposit which contains an estimated 1.1 million tons (Mt) of 1.20% Mo with gold and tungsten, and 0.5 Mt of a quarter-ounce per ton gold with molybdenum and tungsten. If memory serves, this deposit is halfway to China. The other area they acquired is the Mt. Hamilton project with contains several million tons, in two zones, of tungsten, molybdenum, and copper mineralization. This is the old Union Carbide property that we all visited in the 1970s.

Centerra Gold continues to explore the Ren property in Elko County. Last year’s drilling was integrated into a new resource update, and more drilling is planned for 2005. At a 0.23 opt Au cutoff, the indicated resource is about 2 Mt averaging 0.382 opt Au and the inferred resource is 1.39 Mt with an average grade of 0.370 opt Au. This mineralization is at least 2,500 ft below the surface in four separate areas. Over half of the gold mineralization is in the JB zone. Gold mineralization is “typical” Carlin-type hosted in Devonian Popovich Formation, with associated decarbonatization, silicification, and collapse brecciation.

Barrick Gold is moving ahead with developing the East Archimedes deposit at Ruby Hill (Eureka County). The deposit contains a proven reserve of 13.99 Mt with an average grade of 0.061 opt Au and a probable reserve of 2.58 Mt, of a similar grade(?). The permitting process is expected to take about two years.

Golden Phoenix Minerals has sold its remaining 30% interest in the Borealis project (Mineral County) to Gryphon Gold. Golden Phoenix will now focus on the development of the Ashdown molybdenum project in Humboldt County. Production from Ashdown is scheduled for the near future.

Bravo Venture Group has taken a new slant on gold exploration by looking at cuttings from an oil well drilled in 1989 near its South Lone Mountain property (Eureka County). They have identified Roberts Mountain Formation at about 1,400 ft that contains a 120-ft
interval of about 0.01 opt Au. The 50 ft of tuff and gravel immediately above bedrock (1,350–1,400 ft in the hole) contains about 0.07 opt Au. Joe Kizis could spend a lot of money chasing this one.

During the last two years Barrick Gold has undertaken a program of relogging, geological reinterpretation, and extensive drilling in a block on the northwest margin of the Goldstrike pit (Eureka County). This has resulted in the addition of about 2 Moz of gold to the reserve base. See, I told you geology works. It takes more than filling up the white bags and drilling the anomalies to find gold deposits.

Newmont is moving ahead with development of the Emigrant deposit (Elko County). Gold occurs in the lower Mississippian Webb Formation and the top of the underlying Devonian Devils Gate Limestone. Most of the deposit is decarbonatized and silicified. The reserve contains about 1.2 Moz of gold with an average grade of 0.018 opt Au. The mineable deposit is oxidized and will be developed as a run-of-mine heap leach operation.

Atna Resources reported on developments at the Beowawe property (Lander County) and Pinson (Humboldt County). Three holes at Beowawe intersected favorable alteration and trace elements, but only one contained any gold (maximum value 220 ppb). More drilling is planned. At Pinson, Atna calculated a new resource estimate using previous and this year’s drilling. The Front Range and CX zones contain measured and indicated resources of 1.8 Mt with an average grade of 0.30 opt Au and inferred resources of 4.2 Mt of 0.32 opt Au, all at a 0.15 opt Au cutoff.

Castleworth Ventures completed a resource estimate for the Pan Gold project in White Pine County. Total indicated resources for North and South Pan are 15.9 Mt with an average grade of 0.019 opt Au. The inferred resource for the two deposits is 8.3 Mt with an average grade of 0.017 opt Au.

Gateway Gold claims to have discovered a new Carlin-style gold system at the Dorsey Creek property near Jerritt Canyon (Elko County). Six holes encountered gold-arsenic-antimony mineralization, with gold ranging from 0.007 to 0.074 opt Au.

Vista Gold drilled five reverse circulation holes totaling 4,070 feet at Mountain View (Washoe County). Three holes encountered substantial intervals (65–340 ft) of mineralization with grades averaging 0.024 to 0.045 opt Au. These holes may significantly expand the deposit.

Victoria Resources drilled seven holes to follow-up hole OC-36 (80 ft of 0.30 opt Au). The results, while not as impressive, suggest that the area of mineralization has some size. Three holes contain intervals of mineralization of several tens of feet with grades up to 0.07 opt Au.

Oregon

During the summer of 2004, Quincy Gold drilled 18 core holes totaling 14,069 ft to test for high-grade epithermal gold-bearing quartz veins at the

UNESCO-SEG Latin American Metallogeny Course

Lima, Peru
August 22 – September 2, 2005

This year the course is devoted to Acid Mine Drainage.

Organizers: Dr. Bernhard Dold (Lausanne) and Dr. Silvia Rosas (Lima)
Instructors: Dr. Ricardo Amils (Madrid), Dr. Carlos Ayora (Barcelona),
Dr. Miguel Cardozo (Lima), and Dr. Julio Bonelli (Lima).

Website: <http://www.unige.ch/sciences/terre/mineral/seminars/latinometal.html>

For information contact:
Dra. Silvia Rosas, Pontificia Universidad Católica del Perú,
Fax: +51-1-6262852; E-mail: mineria@pucp.edu.pe

Deadline for registration May 31, 2005.
Quartz Mountain project (Lake County). Results reported suggest that most of the mineralization encountered is similar to the dispersed low-grade gold mineralization previously known.

**UTAH**

Palladon Ventures and Western Utah Copper formed a partnership to explore and develop the OK Copper property, and surroundings, in Beaver County. A concurrent IP survey and 10-hole drill program apparently expanded a known chalcocite blanket to the southwest of the OK mine. The blanket is 50- to 150-ft thick, below 60 to 100 ft of oxidized and leached cap. Drilling outlined an area of about 1,900 × 700 ft with visible copper mineralization. Assays from two holes contain 65 ft of 0.20% Cu and 85 feet of 0.28% Cu, as chalcocite.
Pursuant to the Society’s Bylaws, names of the following candidates, who have been recommended for Fellowship by the Admissions Committee, are submitted for your consideration. Each applicant’s name and current position are followed by the names of their SEG sponsors. If you have any comments, favorable or unfavorable, on any candidate, you should send them, in writing before June 15, 2005. If no objections are received by that date, these candidates will be presented to Council for approval.

Address Comments To:
Chair, SEG Admissions Committee
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Davidson, Garry J., University of Tasmania, Hobart, TAS, Australia; Ross R. Large, David R. Cooke;
Kilias, Stephanos P., National University of Athens, Athens, Greece; Maria I. Economou-Elloupolos, Jeffrey W. Hedenquast;
Testa, Stephen M., Testa Environmental Corporation, Mokelumne, CA; Jonathan G. Price, Brian G. Hoal;
Tumenbayar, Baatar, BEMM Co., Ltd., Ulaanbaatar, Mongolia; Andrei Tsvetkov, Noel C. White.

To All SEG Fellows:
The Society Welcomes
The Following
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Richard N. Eliason, Queenstake Resources U.S.A., Inc., Elko, NV; Robert W. King, Universidad de Concepcion, Concepcion, Chile; Joseph M. Kurtak, Bureau of Land Management, Anchorage, AK; Kenneth J. Maiden, CopperCo Limited, Cheltenham, NSW, Australia; Brent I. A. Mclnness, CSIRO Exploration and Mining, Kensington, WA, Australia; JulIan E. Misiewicz, Gold Fields International Services Ltd., Oxford, Great Britain; Chris Osterman, Continuum Resources Ltd., Tucson, AZ; Donna M. Sewell, Anglogold Ashanti, Como, WA, Australia; Stephen P. Sugden, Harmony Gold (Australia) Pty. Ltd., Leeming, WA, Australia; David J. Thomas, Cameco Corporation, Saskatoon, SK, Canada; Henry E. Unger, Newmont Mining, Denver, CO.

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Mongolia, Dianella, WA, Australia; Richard J. Mazur, Mirador Management Company, Delta, BC, Canada; James M. McDonald, Makwa Exploration Ltd., Calgary, AB, Canada; Brad J. Mercer, Committee Bay Resources Ltd., Edmonston, AB, Canada; Adam S. Miethke, Rio Tinto - Pilbara Iron, Mareeba, QLD, Australia; Farzaneh Mogaddam, Tehran University, Tehran, Iran; Ramin Mohammadniaei, IZMDC, Zanjan, Iran; Mohammad Mohammadzadeh, Piranshahr Natural Resources Department, Piranshahr, Iran; Henry Montano-Vela, Compania Minera Barrick Misquisichica S. A., Lima, Peru; Dhiq Montiel M., Minera San Xavier S. A. de C. V., San Luis Potosi, Mexico; Hamid Mosazadeh, Kanazin Consulting Company, Tehran, Iran; Greg Z. Mosher, Wardrop Engineering Inc., North Vancouver, BC, Canada; Anthony R. Norman, Geocentric Exploration, Prahran, VIC, Australia; Aleksandar Obrenovic, SEE doo, Belgrade, Serbia and Montenegro; Santiago T. Olovide, Servicios Industriales Penoles S. A. de C. V., Torreon, Coahuila, Mexico; Mohammad Parizadi, Management and Planning Organization, Tehran, Iran; Patrick Parker, Geological Consultant, Tain, Ross-shire, Scotland; Peggy J. Peñaloza Choque, Compania Minera Antamina S. A., Lima, Peru; Paul W. Pittman, PWP Consulting, Brampton, ON, Canada; Lorie G. Poulton, Miramar Mining, Quill Lake, SK, Canada; Nicole E. Preuss, Darling Ltd., Tucson, AZ; Abbas Ranjbar, IMIDRO, Tehran, Iran; Jean M. Richardson, SGS Lakefield Research, Lakefield, ON, Canada; Christian C. Rios Vargas, Bear Creek Mining, Lima, Peru; Bruce F. Robertson, Lithofire Consulting Geologist, Northbridge, WA, Australia; Michel Roby, Geological Consultant, Val d’Or, QC, Canada; Maritza Rodrigues Guevara, Compania Minera Barrick Misquisichica S. A., Lima, Peru; Paul A. Rose, Lakewood, CO; Joel W. Rotert, QGX, Ltd., Ulaanbaatar, Mongolia; Michal J. Russer, Exploration Geologist, Mississauga, ON, Canada; Asadollah Safari, Industries and Mines Organization, Semnan, Iran; Sandy Sears, Roca Mines Inc., Anchorage, AK; Grigore Simon, Newman Mining Corporation, Denver, CO; Roderick L. Smith, Altius Resources Inc., St. John’s, NL, Canada; Dominik Spodniewski, Pilbara Iron Pty. Ltd., Perth, WA, Australia; Christopher C. Spurway, Troy Brasil, Brasilia, Brazil; Jorgen Stenvold, Store Norske Spitsbergen Grubekompani, Longyearbyen, Norway; William E. Stone, Nevada Star Resources Corporation, Vancouver, BC, Canada; Greg M. Stott, Ontario Geological Survey, Sudbury, ON, Canada; Senpedej Topookhoo, Mongolyn Alt (MAK) Corporation, Ulaanbatar, Mongolia; Ian D. Trinder, Exploration Geologist, Mississauga, ON, Canada; Marlene M. Vara, Compania Minera Antamina S. A., Lima, Peru; Vessica E. Villafuerte Maturrano, Compania Minera Antamina S. A., Lima, Peru; Karen M. Volp, Pan Australian Resources, Scarborough, QLD, Australia; Robert P. Wares, Cyarus Consulting Inc., Montreal, QC, Canada; Robert R. Wheatley, Meridian Gold, Reno, NV; Erin E. Workman, Novagold Resources Inc., Vancouver, BC, Canada; Isabel M. Yarza, Delcosur S. A., Montevideo, Uruguay; Eric Yollick, Yollick Law Firm PC, The Woodlands, TX; Mozaffar Zeinali, IMIDRO, Tehran, Iran; Xingchun Zhang, Chinese Academy of Sciences, Guiyang, Guizhou, China; Xiaodong Zhou, Barrick Gold Corporation, Toronto, ON, Canada; Youqin Zhou, SGS Lakefield Research Ltd., Lakefield, ON, Canada.

The Society Welcomes The Following

NEW SEG STUDENT MEMBERS:

Lukas Ackerman, Charles University, Prague, Czech Republic; Matthew D. Affolter, University of Utah, Salt Lake City, UT; Razaoq Alabi, University of Ilorin, Ilorin, Kwara State, Nigeria; Quincy B. Allan, Imperial College of London, London, Great Britain; Carolina Almeida, Queen’s University, Kingston, ON, Canada; Eszter Badenszki, Eotvos Lorand University, Budapest, Hungary; Benjamin C. Bateson, Queen’s University, Kingston, ON, Canada; Michael J. Bavea, James Cook University, Townsville, QLD, Australia; Lorraine M. Beane, The University of Texas at Austin, Austin, TX; Robert C. Brown, University of Minnesota, Duluth, MN; Jorge Carriedo Veci, Instituto Geogogico y Minero de Spain, Salamanca, Spain; Jonathan Cloutier, Queen’s University, Kingston, ON, Canada; Paul J. Dunbar, Queen’s University, Kingston, ON, Canada; Louise A. Fisher, James Cook University, Townsville, QLD, Australia; Nicola Z. Fry, The Australian National University, Canberra, ACT, Australia; Sergio I. Gelcich, University of Toronto, Toronto, ON, Canada; Shawnna M. Gilbertson, Colorado School of Mines, Golden, CO; Emma L. Goffton, University of British Columbia, Vancouver, BC, Canada; Elizabeth A. Haynes, North Carolina State University, Hillsborough, NC; Thomas Hawkins, Imperial College of London, Camerton, Great Britain; Alan B. Hemingway, Kwantlen University College, Surrey, BC, Canada; Joanna L. Hodge, The University of Western Australia, Perth, WA, Australia; Peter Jung, Eotvos Lorand University, Baja, Hungary; Christos Kanellopoulos, University of Athens, Athens, Greece; Janos Kodolanyi, Eotvos Lorand University, Budapest, Hungary; Douglas C. Kreiner, Colorado State University, Fort Collins, CO; Kamonporn Kromkuhn, University of Tasmania, Hobart, TAS, Australia; Rodney Maier, University of Tasmania, Hobart, TAS, Australia; Ifigenia Megremi, University of Athens, Athens, Greece; Dianne E. Mitchinson, The University of British Columbia, Vancouver, BC, Canada; Cecile E. Noverraz, University of Geneva, Geneva, Switzerland; James W. Nizamoff, University of New Orleans, New Orleans, LA; Terence S. Ortslan, McGill University, Montreal, QC, Canada; Timea Penzes, Eotvos Lorand University, Timar, Hungary; Juan Peralta, Queen’s University, Kingston, ON, Canada; Galen J. Pettigrew, University of Tasmania, Fern Tree, TAS, Australia; Edward J. Poulsding, Royal School of Mines, London, Great Britain; Amelia Rainbow, Queen’s University, Kingston, ON, Canada; Mathieu M. Richer, University of British Columbia, Vancouver, BC, Canada; Carlos J. Rosa, University of Tasmania, Faimoe, Portugal; Kate E. L. Rubingle, Queen’s University, Kingston, ON, Canada; Linda J. Seward, Imperial College, London, Great Britain; Kris S. Smith, University of Arizona, Marana, AZ; Weerapan Srichan, University of Technology, Bangkok, Thailand; Elitsa S. Stefanova, Sofia University, Sofia, Bulgaria; Victoria A. Sterritt, The University of British Columbia, Vancouver, BC, Canada; Bernardett Szabo, Eotvos Lorand University, Esekevadkert, Hungary; Balint Szappanos, Eotvos Lorand University, Szofok, Hungary; Theodora J. Tagmatarchi, National and Kapodistrian University of Athens, Athens, Greece; Nicholas D. Tailby, The Australian National University, Canberra, ACT, Australia; Oksana Tsaban, Franko Lviv National University, Lviv, Ukraine; Katy E. Tsesmelis, Imperial College, London, Great Britain; Ibroo P. Ukoh, The University of Mines and Technology, Tarkwa, Ghana; Jose A. Vizquerra Benavides, Queen’s University, Kingston, ON, Canada; Jon A. Woodhead, Colorado School of Mines, Golden, CO; Selina W. M. Wu, The University of British Columbia, Richmond, BC, Canada.
# Membership Application

Membership in the Society is open to all geoscience graduates holding a bachelor’s degree. Student Members must be full-time students. Subscriptions to the journal, *Economic Geology*, and the quarterly *SEG Newsletter* are included in the membership. Applicants should submit this form with the appropriate membership fee to Society of Economic Geologists, Inc., 7811 Shaffer Parkway, Littleton, Colorado 80127-3732, USA. Phone: +1.720.981.7882; Fax +1.720.981.7874; E-mail: seg@segweb.org

## Section I (to be completed by applicant)

### Personal Information:

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<th>Last Name</th>
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## Section II (to be completed by the sponsor who must be a Fellow of the Society)

I sponsor the above-named individual for ☐ Membership ☐ Student Membership.

To the best of my knowledge the information provided by the applicant is correct.

<table>
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<th>Sponsor’s Name (Type or Print)</th>
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<td>☐ Fellow, Society of Economic Geologists</td>
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<td>☐ Head, Earth Science Department (for student sponsorships)</td>
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When the application is approved, I authorize the Society of Economic Geologists to charge the appropriate membership dues to: ☐ Visa ☐ MasterCard ☐ American Express ☐ Discover US$._____.

Card No: 
Expiration Date: 

Membership categories and benefits are detailed at [http://www.segweb.org/SEGapplication.pdf](http://www.segweb.org/SEGapplication.pdf).

Signature of Applicant: 
Date: 

Exploration for PGE Deposits

MAC Short Course at the 10th International Pt Symposium, Oulu, August 6-7, 2005

http://platinumsymposium.oulu.fi/

Registration includes hotel accommodation for one night, breakfasts, lunches and dinner for Eur160 (double occupancy) or Eur200 (single occupancy).

This course will give non-specialist geologists a series of tools with which they can identify prospective areas, recognize significant indicators of mineralization and synthesize geological, geochemical and geophysical data to make new discoveries of PGE mineralization.

Speakers: JE Mungall, J Hanley, G Cawthorn, M Iljina, M Lavigne, T Oberthur, N Tolstykh, A Wilde, C Farrow, N Arndt, CM Lesher, M Economou, A Green, S Balch, E Cameron, S-J Barnes.

Contact: James E Mungall
mungall@geology.utoronto.ca

Vernon DeRuyter
Exploration Geologist & Hydrologist
Tel: 520-419-2645, 744-8600
Fax: 520-744-8601
6880 West Ina Road
Tucson, Arizona 85743
www.rocksandwaters.com•<deruyter1@mindspring.com>

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John L. Lufkin, Ph.D.
University of Colorado/Denver
Thin-section and Ore Microscopy Studies
(303) 216-1076
Juddith Kinnaird is co-director of the Economic Geology Research Institute, School of Geosciences, University of the Witwatersrand

Mission Statement
In a time of shrinking geology courses worldwide, and especially in economic geology, I am committed to ensuring success of the SEG and particularly to promoting the next generation.

African correspondents
As a regional representative for the Society, I plan to promote the activities of the Society in sub-Saharan Africa. My goal will be to develop regional links with a network of correspondents in various countries throughout the region and encourage them to develop and report on activities of interest to the Society.

Student chapters
It is vital that the Society maintain the next generation of students and promote the local student chapters. There is an active student SASSEG (South Africa Students SEG) organization at present and I have encouraged all my postgraduate students to take an active part in the running of this chapter. They have organized field trips, talks, and a very successful student Geocongress in July, which attracted students from 13 African countries. I am fully committed to supporting the continued growth of this successful student organization. Although at the moment the chapter is primarily Witswatersrand and Rand Afrikaans University students, I plan to encourage students from other universities to join the Society, and especially to join with the regional field trips.

Promotion of economic geology
I am committed to raising the profile of economic geology at regional meetings and ensuring that topics on gold, platinum, and other metals are an important part of the program. At the recent Geoscience Africa meeting held at the University of the Witwatersrand last July, economic geology topics were a main feature of the program, and I was co-convenor of the base metal session and a co-convenor of a platinum workshop and field trip.

Call for Nominations – SEG Distinguished Lecturer for 2005
Committee Chair – Nick Badham (SEG 1981 F)

Now is the time to support your Society and reward a colleague by nominating him or her for the highly respected and widely recognized SEG Distinguished Lecturer Award. The 2005 nominee will be selected on the basis of his/her preeminence in economic geology in some phase of scientific research or application of the science to minerals exploration and/or development. See the list of previous winners at <http://www.segweb.org/DistinguishedLecturer.htm>. Please include the following information with your nomination: (1) the name, date of birth, education and professional affiliation of the candidate; (2) Citation(s) of publication(s) for which the award is to be made (note critical papers and provide reprints, if possible), and other published works; (3) A brief statement explaining the significance of the research, to include its pertinence to economic geology, its demonstrated effects, the originality and creativity shown in the research, the clarity of presentation, and its impact on scientific theory or technology.

Please go to <http://www.segweb.org/Lindgren.html> for details on nomination process. Nominations should be sent, preferably in electronic format, to: Society of Economic Geologists Attn: Lindgren Award Committee 7811 Shaffer Parkway, Littleton, CO 80127-3732 U.S.A. Tel: +1.720.981.7882, ext. 210, Fax: +1.720.981.7874 E-mail: seg@segweb.org (preferred method)

Call for Nominations for Penrose and SEG Silver Medals and Marsden Award for 2005
Nominations for the Society’s Penrose Gold and Silver Medals and the Marsden Award are due by September 1, 2005, for review by the SEG Council. Members and Fellows of the Society are urged to participate in this important process by nominating outstanding candidates for these prestigious honors.

How To Nominate

The SEG award nomination form may be obtained from the SEG website. Go to <http://www.segweb.org/AwardNom.pdf> to download the form. If you do not have access to our website, you may request a copy of the nomination form from SEG Headquarters. Tel: +1.720.981.7882, ext. 210, Fax: +1.720.981.7874; e-mail: seg@segweb.org. To access the SEG awards website go to <http://www.segweb.org/awards.htm>

Correction
Please note that on page 59 of the January 2005 SEG Newsletter the new Regional Vice President for Asia should have been listed as Dr. Yasushi Watanabe, replacing Dr. Koh Naito.
SEG 2005 Traveling Lecturers Program

Thayer Lindsley Lecturer
David R. Cooke

International Exchange Lecturer
Michael D. Doggett

Regional Vice President Lecturer
Richard A. Leveille

All requests for lectures should be directed to
Christine Horrigan, Traveling Lecturers Secretary, SEG, 7811 Shaffer Parkway, Littleton, CO 80127-3732
Tel: +1.720.981.7210 Fax: +1.720.981.7874 Email: christinehorrigan@segweb.org

SEG THAYER LINDSLEY LECTURER FOR 2005

Associate Professor
David Cooke is the leader of the fluid flow and fluid chemistry research group at the Centre for Ore Deposit Research (CODES), University of Tasmania. David and his students have been using geochemical techniques to investigate ore-forming processes in porphyry, epithermal, and sediment-hosted deposits of Australia, southeast Asia, and South America for the past 20 years. A member of the editorial board of *Economic Geology*, David also serves on the executive committee of the Geological Society of Australia.

David would like to coordinate his speaking program with his field commitments, which will include Chile, Peru, the Philippines, Australia, and New Zealand. He plans to attend the SGA meeting in Beijing, China (August 18–21) and the STOMP Conference (August 29–September 2) in Townsville, Australia, and the GSA Meeting (October 15–19) in Salt Lake City, Utah, USA.

Talk titles:
1. Breccias in epithermal and porphyry deposits: The birth and death of magmatic-hydrothermal systems;
2. The giant stratiform, sediment-hosted Zn-Pb-Ag deposits of northern Australia;
3. Porphyry copper-gold deposits: Characteristics, genesis and on-going controversies;
4. El Teniente porphyry copper-molybdenum deposit, Chile: Formation of the world’s largest porphyry copper-molybdenum deposit in an active continental margin.

SEG INTERNATIONAL EXCHANGE LECTURER FOR 2005

Michael Doggett is an associate professor and director of the mineral exploration master’s program in the Department of Geological Sciences and Geological Engineering at Queen’s University in Kingston, Canada. He received an honors degree in geology from Mount Allison University in 1983. After a year of playing and coaching semi-pro hockey in France, he returned to school at Queen’s University, where he completed his M.Sc. degree in 1987 and his Ph.D. in 1994. During this period and for the following several years, he worked as a research associate at the Centre for Resource Studies and as an industry consultant. From 1997, Dr. Doggett has been teaching at Queen’s University and running the mineral exploration program. His main areas of teaching and research relate to the economic analysis of mineral exploration and acquisition at both corporate and industry-wide levels. In addition to his academic responsibilities, Dr. Doggett has carried out numerous consulting assignments for mining companies, governments and international agencies. He has offered professional development courses in more than a dozen countries, training more than 600 industry professionals in the field of project evaluation. His accomplishments were recognized by the Canadian Institute of Mining, Metallurgy and Petroleum in 2002 with the awarding of the Robert Elver Award in Mineral Economics.

Talk titles:
1. Exploration in the context of mineral supply: Focus on copper
2. Geologic and economic characteristics of gold supply: Focus on Canada;
3. Overcoming the odds: Why continue to explore?

SEG REGIONAL VP LECTURER FOR 2005

Richard A. Leveille (SEG 1998)

Richard is currently President of Phelps Dodge Exploration, based in Phoenix, Arizona. Other positions he has held with Phelps Dodge Exploration include Chief Geologist, Vice President of Exploration-South America, based in Rio de Janeiro, and Chief Geologist-South America, based in Santiago, Chile.

He began his Latin American adventure as Senior Geologist for Kennecott, based in Guadalajara, Mexico, after working as a geologist for Kennecott Exploration in Salt Lake City, Utah, and for Bear Creek Mining in Anchorage, Alaska. Richard’s work as a mining engineer at Phelps Dodge’s Tyrone open-pit porphyry copper mine followed a stint as underground geologist at the Amax Lead Company of Missouri’s Buick mine.

After receiving his B.S. degree in geology from the University of Utah, Richard graduated from the University of Alaska-Fairbanks with an M.S. degree in geology.

He is married with two daughters—and paints, plays the piano, canoes, bikes, and hikes in his free time.

Talk titles:
1. Meeting the future demand for copper: Where will it come from?
2. Risk, rewards and returns of copper exploration in the 20th century and beyond.
New Zealand Minerals Conference 2005
13-16 November 2005, Auckland, New Zealand

This international conference will focus on realising the mineral potential of New Zealand. Key papers will highlight the regulatory, commercial, and environmental framework of New Zealand, and will examine its mineral potential. The conference will include studies of New Zealand’s geology, growing coal and gold production, and current and planned mining operations.

The conference will be linked with field trips to epithermal gold deposits and active geothermal fields in the North Island, and orogenic lode gold deposits in the South Island. We will also run the popular “mines and wines” field trip, which provides a broad overview of mineral production in the North Island, and also samples some of New Zealand’s fine wines.

Abstracts and papers will be published in a proceedings volume available at the conference.

For program developments visit
www.ausimm.co.nz

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CAREER-RELATED CHANGES

RICHARD CLEATH (SEG 1987) has been named vice president of exploration for Absolut Resources.

RICHARD H. DE VOTO (SEG 1976 F) retired from Canyon Resources, effective March 1, but will remain as chairman.

GEORGE H. GALE (SEG 2002) has been named vice president of exploration for Rare Earth Metals Corp., Vancouver, BC. Previously, George was head of the mineral deposits unit of the Manitoba Geological Survey.

THADDEUS (TED) GROBICKI (SEG 1986 F), an executive director for Harmony Gold Mining Co Ltd., will work directly with chief executive Bernard Swaneoep in a restructuring move for the company, a South African gold producer.

DAVID KELLEY (SEG 1990 F) has joined the Newmont Mining Corp. geochemistry group. He will be providing support to exploration efforts in the Americas, including development and application of methods for exploration through cover. New contact information is as follows: Newmont Mining Corp., Malozemoff Technical Facility, 10101 E. Dry Creek Rd., Englewood, CO 80112; tel. 303-708-4822; e-mail, dave.kelley@newmont.com.

DIETER A. KREWELD (SEG 1993 F) has been appointed director of Strathmore Minerals.

DORIAN L. (DUSTY) NICOL (SEG 1984 F), has been appointed president and CEO, in addition to being executive vice president and director of exploration, for Queenstake Resources Ltd.

G. NEIL PHILLIPS (SEG 1985 F) has announced that he has stepped down as head of CSIRO Exploration and Mining to devote more time to gold research.

HOWARD STOCKFORD (SEG 1983 F) has accepted a position with Crowflight as special advisor, exploration and mining.

AWARDS & ACCOMPLISHMENTS

GEOFFREY V. BLACKBURN (SEG 1988 F) has been named 2004 Prospector of the Year by the Association of Mining and Exploration Companies (AMEC). The prestigious Australian award was presented jointly to Geoff and Denis O’Meara, in recognition of their discoveries of the Wingina Well gold deposit, 60 km south of Port Hedland. Geoff is principal consultant to DeGrey Mining.

ROBERT C. HAYS, JR. (SEG 1996) and TIMOTHY G. THOMPSON (SEG 2001) accepted the PDAC Thayer Lindsley International Discovery Award as members of a 29-person geology team that discovered the Placer Dome Cortez Hills gold deposit in north-central Nevada. Bob is superintendent for Cortez exploration and development; Tim is chief geologist of Placer Dome’s Bald Mountain mine. In accepting the award, Bob recognized the support of joint-venture partner, Kennecott Minerals.

SPENCER R. TITLEY (SEG 1961 SF), a professor at the University of Arizona, has been elected to membership in the National Academy of Engineering. This high honor was awarded for Spence’s innovative research in understanding how mineral deposits form.

MARK HANNINGTON (SEG 1991 F), AL GALLEY (SEG 1992 F), ANTHONY NALDRETT (SEG 1970 SF), and MICHAEL DOGGETT (SEG 2001) have been asked to speak at the GeoSoc conference, to be held in conjunction with the annual meeting of the Canadian Institute of Mining, Metallurgy and Petroleum, April 24–27, in Toronto. Mark, the Editor of Economic Geology, recently left the Geological Survey of Canada (GSC) for an appointment at University of Ottawa, Al is a geologist with the GSC, and Tony is professor emeritus with the University of Toronto. Michael is director of the master’s program in mineral exploration at Queen’s University and the 2005 SEG International Exchange Lecturer.

THANK YOU!

ROGER C. STEININGER (SEG 1978 F) has served for 10 years as western United States regional correspondent for the SEG Newsletter. His first column, under the heading “Great Basin,” came out in the April 1995 issue. The Society takes this opportunity to thank him for volunteering so much of his time and hopes he’ll continue keeping us all informed about exploration activities in his part of the world for years to come!

DECEASED IN 2004

CHRISTOPHER B. GILLETTE (SEG 1998), of Reno, Nevada, died recently. No other information is available at this time.

STANTON W. (STAN) CADDEY (SEG 1985 F), a consulting geologist, died February 19 at his home in Littleton, Colorado. He was 55 and had been battling cancer for a year. A native of the state of Washington, Stan received a B.S. degree from Western Washington State University and a Ph.D. in geology from the University of Idaho. He had worked with Kenneccott’s Geologic Research Division and then was an exploration geologist for Occidental Minerals. He then worked as geologist and manager of special projects for Homestake Mining Company, before starting his own consulting business. A well-rounded and versatile explorationist, Stan specialized in applied structural geology, using this analysis tool to locate ore at Creede, Colorado, and at the Homestake mine in South Dakota. He also made important contributions to understanding the geology of iron formation-hosted gold deposits. Stan is survived by his wife, Lujean, his parents, two daughters, and three grandchildren.

TSU-MING HAN (SEG 1995 SF), of Ishpeming, Michigan, died on February 3, 2005. No other information is available.

COLIN D. MCLACHLAN (SEG 2003), of Baroid Industrial Drilling Products, Chagrin Falls, Ohio, died recently. No other information is available.
GUIDEBOOK SERIES:

- GB 29: Geology and Ore Deposits of the Oquirrh and Wasatch Mountains, Utah: D.A. John & G.H. Ballantyne; Editors; 1997 (Revised 1998), 308p.; 19 colored figures, 2 oversize colored plates (in pocket)
- GB 30: Gold Deposits of Northern Sonora, Mexico: K.F. Clark, Editor; 1998, 252p.; 12 colored figures, 1 oversize figure, 2 oversize plates (in pocket)
- GB 34: Epithermal Gold Mineralization and Modern Analogues, Kyushu, Japan: C.A. Feebrey, T. Hayashi, & S. Taguchi, Editors; 2001 188p. AVAILABLE ON CD ONLY!

ECONOMIC GEOLOGY MONOGRAPH SERIES:


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Vol. 98:7 A Group of Papers Devoted to the Metallology of Gold in the Fennoscandian Shield: Guest Editors, K. Sundblad & N.J. Cook $30.00 $24.00
Vol. 98:8 Map Series Issue with Geology of the Bajo de la Alumbrera Porphyry Copper Deposit, Argentina, by John M. Profett; 4 oversize maps in pocket $50.00 $40.00
Vol. 98:8 Offprint. Geology of the Bajo de la Alumbrera Porphyry Copper Deposit, Argentina: John M. Profett; 4 oversize maps in pocket, 2 foldouts; 40p. $35.00 $28.00

title=GB 8; Industrial Mineral Resources of the Delaware Basin, Texas, and New Mexico; J.R. Kyle, Editor; 1990, 203p.; listprice=$24.00; memberprice=$19.20

[GB 22: Carbonate-Hosted Lead-Zinc-Fluorite-Barite Deposits of Northern America; K.C. Misra, Editor; 1995, 254p.; listprice=$48.00; memberprice=$38.40]

[GB 26: The Carlin-Type Gold Deposits Field Conference; P.G. Vikre, et al., Editors; 1997, 294p.; 3 colored figures; listprice=$48.00; memberprice=$38.40]

[GB 29: Geology and Ore Deposits of the Oquirrh and Wasatch Mountains, Utah; D.A. John & G.H. Ballantyne, Editors; 1997 (Revised 1998), 308p.; 19 colored figures, 2 oversize colored plates (in pocket); listprice=$28.00; memberprice=$22.40]

[GB 30: Gold Deposits of Northern Sonora, Mexico; K.F. Clark, Editor; 1998, 252p.; 12 colored figures, 1 oversize figure, 2 oversize plates; listprice=$28.00; memberprice=$22.40]

[GB 31: Epithermal Mineralization of the Western Carpathians; F. Mólnár, J. Lucia, & J.W. Hedendiquist, Editors; 1999, 274p.; listprice=$28.00; memberprice=$22.40]

[GB 32: PART I. Contrasting Styles of Intrusion-Associated Hydrothermal Systems; J.H. Dilles, et al., Editors; PART II. Geology & Gold Deposits of the Getchell Region; E.J. Craford, Editor; 2000, 234p.; listprice=$28.00; memberprice=$22.40]


[GB 34: Epithermal Gold Mineralization and Modern Analogues, Kyushu, Japan; C.A. Feebrey, T. Hayashi, & S. Taguchi, Editors; 2001 188p.; listprice=$28.00; memberprice=$22.40]

[GB 35: PART I. Proterozoic Iron and Zinc Deposits of the Adirondack Mountains of New York and the New Jersey Highlands; J.F. Slack, Editor; PART II. Environmental Geochemistry and Mining History of Massive Sulfide Deposits in the Vermont Copper Belt; J.M. Hammarstrom & R.R. Seal II; 2001, 294p.; listprice=$28.00; memberprice=$22.40]

[GB 36: Cretaceous Porphyry-Epithermal Systems of the Srednogorie Zone, Bulgaria; K. Bogdanov & S. Strashimirov, Editors; 2003, 132 p.; listprice=$28.00; memberprice=$22.40]

ECONOMIC GEOLOGY MONOGRAPH SERIES:

- EG Mono 9: Mineral Deposits of Alaska: R.J. Goldfarb & L.D. Miller, Editors; 1997, 483p.; 9 colored figures $45.00 $36.00

- EG Mono 10: The Giant Kidd Creek Volcanogenic Massive Sulfide Deposit, Western Abitibi Subprovince, Canada: M.D. Hannington & C.T. Barrie, Editors; 1999, 676p.; 32 colored figures; hard bound $60.00 $48.00

- EG Mono 11: Massive Sulfide Deposits of the Bathurst Mining Camp, New Brunswick, and Northern Maine: W.D. Goodfellow, S.R. McCutcheon, & J.M. Peter, Editors; 2003; 930 p., hardbound. Includes CD-ROM. (extra postage; see below) $69.00 $55.20

SPECIAL PUBLICATIONS SERIES:


- SP 4: Carbonate-Hosted Lead-Zinc Deposits: D.F. Sangster, Editor; 1996, 672p.; hard bound $60.00 $48.00

- SP 7: Geology and Ore Deposits of the Central Andes: B.J. Skinner, Editor; 1999, 368p.; listprice=$30.40; memberprice=$24.32

- SP 8: New Mines and Discoveries in Mexico and Central America: T. Albinson & C.E. Nelson, Editors; 2001, 362p.; listprice=$54.40; memberprice=$43.52


- SP 10: Volcanic, Geothermal and Ore-Forming Fluids: RULES and Witnesses of Processes within the Earth: S.F. Simmons & I. Graham, Editors; 2000, 340 p.; listprice=$47.20; memberprice=$37.76


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Members may purchase a single copy of each publication at 20% off the listed price.

Sub-Total $______ $______

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**Vid. 1:** 1) The Genesis of Magmatic Ni-Cu (PGE) Sulfide Deposits
   2) Physical Volcanology, Geochemistry and Petrogenesis of Komatiite Basalt Lava Channels and Channelized Sheet Flows in the Cape Smith Belt, New Quebec: C. Michael Lesher, Laurentian University, Sept. 1998
   $25.00 $20.00

**Vid. 2:** 1) Worldwide Exploration: Can We Afford It?,
   2) Exploration Strategic Planning: Michael J. Knuckey, President, Noranda Mining Exploration, Ltd., Nov. 1998
   $25.00 $20.00

**Vid. 3:** 1) The Porphyry to Epithermal Continuum: Evidence from Volcanoes and Ore Deposits, 2) Characteristics of and Exploration for Epithermal Gold Deposits in the Circum Pacific: Jeffrey W. Hedenquist, Consulting Economic Geologist, April 1999
   $25.00 $20.00

**Vid. 4:** 1) Epithermal Gold Deposits—Characteristics, Classes and Causes 2) Convergent Evolution and Ore Deposits: Noel C. White, Consulting Economic Geologist, Sept. 1999
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**Vid. 8:** 1) Tectonic Setting and Structural Controls in the Giant Eocene-Oligocene Porphyry Copper Deposits of Northern Chile 2) Late Cenozoic Mineralization and Crustal Evolution in a Thickening Arc: The Maricunga and El Indio Mineral Belts: Constantino Mpyodozis, Chilean Geological Survey, Mar. 2001
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CALENDAR OF EVENTS

2005

May 14. Controversies on the Origin of World-Class Gold Deposits: Carlin and Wittwatersrand. One-day forum to examine and discuss the origins of these deposits, in conjunction with Geological Society of Nevada Symposium. Organizer: John Munro; E-mail: munro@unr.edu; Information: <http://www.segweb.org/GSNforum.html#>.


★ May 24 – 27, IV International Congress of Prospectors & Explorers ProEXPLO 2005. Lima, Peru. Website: <www.proexplo.com.pe>; E-mail: proexplo@insp.org.pe.

Jul. 31-Aug. 5. Gordon Conference on Inorganic Geochemistry. Metals in ore-forming systems; Sources, transport, deposition. Proctor Academy, Andover, NH. Attendance by invitation. Contacts: Steve Garwin, E-mail: Steve.Garwin@geoforumex.com; Christoph Heinrich, E-Mail: christoph.heinrich@erdw.ethz.ch; Jean Cline, E-mail: cline@ecma.nedl.edu. See p. 30.


★ Aug. 22-Sept. 2. UNESCO-SEG Latin American Metallurgy Course. Website: <www.unige.ch/sciences/terre/mineral/seminars/latinometal.html>. Contact: Dra. Silva Rosas; Fax: +1.51.626.2852; E-mail: mineria@pucp.edu.pe. See p. 30.


★ May 7-8. Irish Association for Economic Geology (IAEG). Weekend Course Copper Deposits: Genetic Studies and Case Histories. For information, contact Vincent Gallagher at E-mail: vincentgallagher@usi.ie; Website: <www.iaeg.org>.


★ May 15-18. Symposium 2005 Mines and the Environment. Ronyn-Noranda, Quebec, Canada. Organized jointly by Universite du Quebec en Abitibi-Temiscamingue (UQAT) and the Canadian Institute of Mining, Metallurgy and Petroleum (CIM). Information at <www.cim.org> or contact Chantal Murphy at (CIM) 514-939-2710 ext. 1309, E-mail: cmurphy@cim.org.

★ Nov. 15-17. VIII Congreso Argentino de Geologia Economica. Buenos Aires, Argentina. E-mail: congreso@age.org.ar; Website: <www.age.org.ar>.

OTHER EVENTS

2005


★ May 7-8. Irish Association for Economic Geology (IAEG). Weekend Course Copper Deposits: Genetic Studies and Case Histories. For information, contact Vincent Gallagher at E-mail: vincentgallagher@usi.ie; Website: <www.iaeg.org>.


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★ Sept. 12-16. XXVII Convention Minera and EXTEMIN Mining Technological Exposition. Arequipa City, Peru. E-mail: convencionminera@simp.org.pe. Website: <www.convencionminera.com>.


★ Dec. 8-17. Modular Course in Exploration Geophysics. Sudbury, Ontario, Canada. Information: Contact Michael Lesher, Mineral Exploration Research Centre, Department of Earth Sciences, Laurentian University. Ramsey Lake Road, Sudbury, ON, Canada. Ph: 705-675-1151 ext. 2364; Fax: 705-675-4989. E-mail: mlesher@laurentian.ca. Website: <http://earthsciences.laurentian.ca>.
THE 100TH ANNIVERSARY
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