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SEG NEWSLETTER

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April 2014 Number 97

SEG 2014 Conference
See p. 32–40 for details

Deep Exploration Technologies Provide the Pathway to Deep Discovery

***David Giles**† (SEG 1981F), University of Adelaide, Deep Exploration Technologies CRC;*
***Richard Hillis**, Deep Exploration Technologies CRC; and **James Cleverley**, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Deep Exploration Technologies CRC*

THE CHALLENGE OF DEEP EXPLORATION

The long-term global mineral exploration challenge is framed by strongly increasing demand (Northey et al., 2014), reduced reserve inventories (overwhelmingly contained within deposits discovered more than 20 years ago; Schodde, 2010), and decreasing discovery rates of greenfields deposits (Schodde, 2013). Global mineral exploration productivity, defined by the number of world-class discoveries and the exploration cost per discovery, has declined over the last 20 years (Schodde, 2013). Between the 1980s and 2000s, the average global exploration cost per discovery increased by 160% in real terms and, in mature exploration jurisdictions such as Australia, by as much as 260% (Schodde, 2011).

In 1975, the world had copper reserves equivalent to 61 years of production; by 2000, this had been reduced to just 26 years and, by 2012, despite a sustained period of elevated Cu prices, it had rebounded to just 39 years of production (USGS, 2013). Growth in production since 2000, largely driven by higher Cu prices, has resulted from the exploitation of increasingly lower grade reserves at higher production costs, with global weighted average Cu head grades declining from 1.0% to 0.7% (SNL Metals Economics Group, 2013). With regard to gold, after the bull run of gold discoveries in the 1970s, 14 deposits of 20 Moz or more were made worldwide in the 1980s, 11 in the 1990s, and five in the 2000s. Decreasing discovery rates of greenfields deposits in relatively well explored countries reflect the fact that easy-to-find mineral deposits with surface expression have largely been discovered, and we are now faced with the more technically difficult and costly task of exploring at depth beneath barren cover rocks.

FIGURE 1. DET CRC's coiled tubing drilling rig at its launch during the DET CRC Annual Conference, November 2013. (See p. 24)

The exploration community's response to the challenge of deep exploration has been to (1) divert exploration effort to

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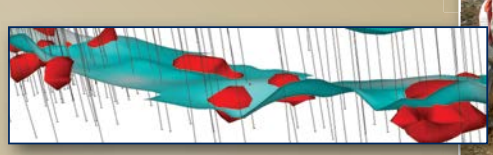

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DEADLINE FOR NEWSLETTER #98:
May 31, 2014

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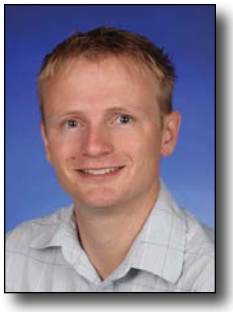
FROM THE NEWSLETTER TECHNICAL EDITOR

Shaun Barker, the SEG Waldemar Lindgren awardee for 2013, has been named SEG Newsletter *technical editor. He will begin his duties after the April issue.*



SHAUN BARKER
(SEG 2010 FL)

An Introduction!

Some background: I completed my undergraduate education at the University of Otago in New Zealand, before receiving a Ph.D. from the Australian National University. I then spent five years working as a postdoctoral research fellow for the Mineral Deposit Research Unit at the University of British Columbia in Vancouver. During this time, I contributed to a range of mineral industry-sponsored research projects, including identifying exploration vectors for Carlin-type gold deposits in Nevada and developing new analytical methods for stable isotopes in mineral exploration. I am currently based at the University of Waikato in New Zealand, where I contribute to a range of classes, including introductory earth science, field studies, and igneous petrology and geochemistry. I am continuing research on various mineral deposits in New Zealand and overseas, as well as the development and application of new analytical technologies relevant for mineral exploration. I have broad interests in geochemistry and economic geology, with a focus on both field and laboratory studies.

My goals: As the new technical editor for *SEG Newsletter,* I want to see the publication continue its valuable role as an educational tool for industry, consultants, and academics, reporting on factors that have led to exploration successes (and failures), as well as highlighting ongoing challenges (both near- and long-term) for the minerals industry, and I particularly encourage contributions across these areas. I would like to see increased contributions from academic and government researchers, focusing on recent research results that have significant implications for economic geologists (e.g., in drilling and geophysical, geochemical, mineralogical, environmental areas), especially in the development and application of new tools and techniques that have potentially significant implications for the minerals industry. As an academic, I encourage other academics to submit articles to *SEG Newsletter*—I can almost guarantee they will be read by more people than they will be if published in almost any journal!

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30th september, 3rd october 2014

Africa is well endowed with mineral resources and yet much of Africa's mineral treasures remain to be discovered. Mining has played a pivotal role in the economy of many African countries with contributions to foreign exchange earnings exceeding 50% in some instances. There is no doubt that the exploitation of mineral deposits could form a substantial, if not the strongest, platform on which to base the future uplifting of the African economy. The discovery of new deposits as well as the economic and sustainable exploitation of known deposits requires skills that are not as readily available in many areas of Africa as they might be in other parts of the world. The aim of these SGA Short Courses was firstly to train African geoscientists in the specific field of metallogeny. This third edition is reinforced by an additional focus on underground mining practises and exploration strategies, in order to cover the largest spectrum of the mining industry. For practical reasons, the course will be divided into two sessions with some overlapping.

First circular - 1st March 2014
FULL CIRCULAR DETAILS at www.segweb.org/events#14AM3
African Metallogeny III

FROM THE EXECUTIVE DIRECTOR

Summary of Activities for the Year 2013

Brian G. Hoal
SEG Executive Director and Editor

NEW OFFICERS

In the July/August election of officers for January 2014, the membership elected François Robert, President-Elect, 2014; Regina Baumgartner, Vice President for Student Affairs (2014–2016); and David J. Hall, Jingwen Mao, Mesut Soylu as Councilors (2014–2016).

MEMBERSHIP

As of December 31, 2013, SEG membership in all categories totaled 7,540, 1.0% higher than the level at the end of last year. Members are currently distributed through 105 countries worldwide, compared with 108 countries in 2012. About 61% of the membership works for industry (corporate or self-employed); the remainder are in academia (32%, including students), government (4%), and retired (3%). Nearly 58% of our members are from three countries, namely the United States (25%), Canada (19%), and Australia (14%)—see Membership Status report. The majority of members (56%) come from outside North America (USA and Canada). About 89% of new applicants are from outside the USA with the bulk of applications coming from South America (31%), Canada (22%), Australasia (18%), Europe (15%), and Asia (7%). For the year, the Society processed 1,118 new applications (7 Fellows, 464 Members, and 647 Student Members). In March 2013, SEG launched an online membership application that resulted in more than a third of new applications being electronic versus print. In addition, 46 Members upgraded to Fellowship, with Fellows now making up 19% of total membership.

Through December 31, the Society had 81 active Student Chapters located in 28 countries: Canada (14), the USA (13), Brazil (7), Australia (6), United Kingdom (5), Colombia (4), Argentina (3), Peru (3), Chile (2), China (2), France (2), Germany (2), Indonesia (2), Switzerland (2), Austria (1), Bolivia (1), Bulgaria (1), Czech Republic (1), Greece (1), Hungary (1), Mexico (1), Romania (1), Slovakia (1), South Africa (1), Turkey (1), Uganda (2), and Ukraine (1). A further 11 chapters are now considered to be inactive.

The Stewart R. Wallace Fund disbursed $60,140 to 54 Student Chapters in 24 countries: Canada (11), USA (10), Brazil (4), Australia (3), United Kingdom (3), France (2), Germany (2), Indonesia (2), Peru (2), Switzerland (2), and one chapter in each of Argentina, Austria, Bolivia, Bulgaria, Chile, Colombia, Czech Republic, Hungary, Mexico, Romania, Slovakia, South Africa, Turkey, and Uganda. At year-end, students made up a record 22% of the total membership.

The SEG Foundation continues to provide important subsidies required to sustain special membership classes such as Students, Senior Fellows, and Lindgren Awardees.

CONFERENCES, FIELD TRIPS, AND SHORT COURSES

In 2013, the Society organized, sponsored, or participated in the following conferences, workshops, symposia, field courses, and field trips:

- SEG sponsored the Mineral Deposits Studies Group Meeting at the University of Leicester, UK, January 2–4, 2013. R. Sillitoe, T. Naldrett, and R. Goldfarb gave keynote presentations.
- SEG sponsored the 7th Annual workshop, Ore Deposits Models and Exploration in Guangzhou, China, January 13–19, 2013, with SEG Regional VP support. R. Goldfarb, N. White, S. Scott, and D. Leach were among the instructors.
- SEG successfully launched the society's new Geofacets program in partnership with Elsevier at the AME BC Mineral Exploration Roundup in Vancouver, Canada, January 28–31, 2013. The event took place at the Vancouver Rowing Club on January 28. SEG staff members (B. Hoal, A. Jamison, and S. Crawford) were involved with the launch and SEG exhibit booth.
- The SEG held a pre-Mining Indaba Meeting short course on the Geology of Gold Deposits at the University of Cape Town, South Africa, February 2–3, 2013. The presenters were R. Goldfarb, S. Simmons, B. Rusk, and H. Frimmel.
- SEG held a PDAC pre-meeting, two-day course entitled, "Ni-Cu-PGE Deposits in Mafic/Ultramafic Rocks: Insights and New Discoveries," on March 1–2, 2013, in Toronto, Canada. Presenters included the following: N. Arndt, S-J Barnes, S. Barnes, D. Good, G. Heggie, D. Layton-Mathews, C.M. Lesher, C. Li, J. Mungall, A. Naldrett, D. Peterson, E. Ripley, and D. Rossell.
- Other SEG activities at PDAC, March 3–6, 2013, included an announcement of the new SP16 Sillitoe volume *Geology and Genesis of Major Copper Deposits and Districts of the World: A Tribute to Richard H. Sillitoe* by sponsor Rio Tinto, an exhibit booth run by SEG staff (C. Horrigan and A. Jamison) and business meetings of the SEG Council, Foundation Trustees, Executive Committee, and Publications Board at the Radisson Admiral Harbourfront Hotel in the period March 1–2, 2013.
- The SEG sponsored the Latin American Geosciences Student Conference, "Emerging Region, New Trends" held in Medellín, Colombia, on April 8–11, 2013. The SEG Medellín Student Chapter organized this event. R. Goldfarb and S. Simmons presented a course and J. Perelló, SEG 2013 Thayer Lindsley Lecturer, was a keynote speaker.
- A joint SEG-CSM Orogenic Gold Course was held at the SEG Course Center in Littleton, Colorado, USA, April 11–12, 2013. Presenters: R. Goldfarb and H. Poulsen.
- SEG Foundation Precious Metals Deposits of the Southwestern U.S. 11th Student-Dedicated Field Trip was held May 12–18, 2013. Nineteen students were selected from 39 applicants and two professionals attended. Field Trip leaders were W. Chávez and E. Petersen.
- SEG Practical Methods in Economic Geology Workshop was held at the SEG Course Center in Littleton, Colorado, USA, May 13–18, 2013. Instructors:

to page 6 • • •

. . . from page 5 Summary of Activities for the Year 2013 *(continued)*

O. Christensen, G. Closs, D. Coulter, M. Hitzman, J. Jaacks, E. Jensen, D. Maher, D. Rousseau, and K. Witherly.

- SEG provided support through website advertising and member broadcasts for the VIII International Congress of Explorers (ProEXPLO 2013) in Lima, Peru, May 19–21, 2013.
- SEG sponsored the Metamorphism in the Ore Environment Special Session during the GAC-MAC 2013 Meeting in Winnepeg, Canada, May 22–24, 2013. Invited SEG speakers were A. Tomkins (Monash University) and P. Spry (Iowa State University).
- SEG provided promotional support in the form of website and newsletter advertising for the East Asia: Geology, Exploration Technologies and New Mines 2013 Meeting in Bali, Indonesia, May 27–29, 2013. S. Garwin, A. Mitchell, and D. Kirwin were speakers.
- SEG sponsored the 2013 EGRU Conference, FUTORES, in Townsville, Queensland, Australia, June 2–5, 2013. This event included a Noel White Symposium on ore deposits sponsored by the SEG and SGA. Zhaoshan Chang was the conference chair and organizer. SEG exhibited at this event.
- SEG co-sponsored the UNESCO-SGA-SEG African Metallogeny Course in Zambia, June 17–21, 2013. H. Frimmell was the course organizer.
- SEG sponsored the GSSA Geoforum 2013 Conference in Johannesburg, South Africa, July 3–5, 2013. SEG pre-meeting IOCG Course was presented by M. Hitzman. The SEG exhibit booth was handled by B. Hoal, Executive Director.
- SEG sponsored a pre-SGA 2013 Meeting Gold Deposits of the Russian Northeast Field Trip, July 25–August 5, 2013. Leader was N. Goryachev.
- SEG provided newsletter and website advertising for the XIV Colombian Geological Congress-First Explorers Symposium in Bogota, Colombia, July 31–August 2, 2013.
- SEG co-sponsored the 12th SGA Biennial Meeting in Uppsala, Sweden, August 12–15, 2013. SEG sessions were part of the technical program and several members handled the SEG exhibit booth. R. Herrington, Regional VP Europe, was the SEG Coordinator.
- SEG sponsored a session (Theme 13) at the Goldschmidt Conference in Florence, Italy, August 25–30, 2013. L. Fontboté, R. Herrington, and N. Arndt were the SEG coordinators. SEG 2013 Distinguished Lecturer, A.E. Williams-Jones, was a keynote speaker.
- The SEG/SEG Canada Foundation Whistler 2013 Conference was held in Whistler, BC, Canada, September 24–27, 2013. There were approximately 850 attendees with 9 short courses and 6 field trips offered. The SEG exhibit booth had strong sales with the following new publications introduced at the meeting: Special Publication 17 and CD - *Tectonics, Metallogeny, and Discovery: The North American Cordillera and Similar Accretionary Settings* and SEG Compilation 7 - *Porphyry Copper, Gold, and Molybdenum Deposits: 1905–2012*. G. Carlson, SEG Canada Foundation President, was the Chair of the Organizing Committee.
- The SEG co-sponsored the Precambrian Research Center Professional Workshop Series held at the University of Minnesota (Duluth), October 6–13, 2013. A workshop entitled Copper, Nickel, & Platinum Group Element Deposits of the Lake Superior Region was organized by J. Miller.
- SEG-CSM Epithermal Deposits Course was held at the SEG Course Center on October 10–11, 2013. The 33 participants included 12 students. Presenters were S. Simmons and S. Enders.
- The SEG sponsored and provided advertising in the *SEG Newsletter* for the Diamonds and Their Primary and Secondary Sources Course held at the University of Pretoria, South Africa, October 15–18, 2013. Course leaders were M. de Wit and J. Bristow.
- SEG provided promotional support in the form of newsletter and online advertising for the Exploration, Resource and Mining Geology Conference 2013 in Cardiff, Wales, UK, October 21–22, 2013.
- SEG co-sponsored the 2013 GSA Annual Meeting celebrating its 125th Anniversary. N. Kelly, SEG Meeting Coordinator, planned and organized seven SEG sessions. T. Thompson and R. Stegen were the leaders for the SEG Colorado Porphyry-Molybdenum Deposits and Leadville District field trip attended by 21 professionals and 5 students. The pre-meeting SEG course, "Modeling Structural Evolution to Improve Geological Models for Exploration and Mine Development," was held at the SEG Course Center, October 24–25, 2013. J. Ellis and O. Vidal Royo instructed 9 participants, including 2 students. The SEG Staff manned the exhibit booth at the Colorado Convention Center.
- The SEG Mapping Course to the Copper Creek district in Pinal County, Arizona, USA, took place November 3–9, 2013. The 15 participants, including 2 students, were led by W. X. Chávez, Jr. and E. Petersen.
- The SEG co-sponsored the 26th International Applied Geochemistry Symposium (IAGS) in Rotorua, New Zealand, November 18–21, 2013. A total of 600 registered for the meeting. Six SEG sessions with 22 presentations were part of the technical program. SEG also provided funding for student attendance. Meeting coordinator was A. Christie.
- SEG provided promotional support in the form of advertising in the *SEG Newsletter* for the 119th Northwest Mining Association Meeting in Reno/Sparks, Nevada, USA, December 2–6, 2013. The SEG also had an exhibit booth at this meeting manned by R. Nielsen and J. Dreier.
- SEG-Western Mining Services Senior Exploration Management Course was held at the SEG Course Center in Colorado, USA, December 3–6, 2013. The 12 participants were instructed by B. Suchomel, J. Welborn, and J. Hronsky.
- SEG sponsored the 8th Annual Ore Deposits Models and Exploration Workshop in Heifei, China, December 9–15, 2013. Instructors included S. Scott, J. Scott, Z. Chang, H. Chen, D. Cooke, R. Goldfarb, D. Leach, C. Li, N. White, and K. Yang.
- SEG exhibited at the AGU 2013 Fall Meeting held in San Francisco, California, USA, December 10–13, 2013. N. Jamison organized and handled the booth.

EDUCATION

The SEG Foundation (SEGF) and the SEG Canada Foundation (SEGCF) together awarded almost US$400,000 in research grants and fellowships to a total of 100 students in 13 countries. Out of 107 student research grant applications received, SEGF awarded 40 grants for a total US$109,931, while the SEGCF awarded 26 additional grants

totaling CDN$69,300. Research Grant awardees attend 30 different universities in 12 countries: Canada – 22, United States – 20, United Kingdom – 5, Australia – 4, Spain – 4, China – 4, Argentina – 2, Slovakia – 2, and one each from Germany, South Africa, and Switzerland. In the Graduate Student Fellowship program, and factoring in one student withdrawal, a total of US$185,000 was awarded to 27 students and CDN$30,000 to six students entering graduate school in 2013, or who were currently enrolled as first-year graduate students. GS Fellowship Grant Recipients attend 23 different universities in 8 countries, Canada – 11, USA – 10, Australia – 4, United Kingdom – 4, and one each from Bulgaria, Germany, South Africa, and Switzerland. Adding US$60,140 in Student Chapter grants from the SEG Wallace Fund and CDN$75,200 in student support for the SEG-SEGCF Whistler conference, annual support of student programs was well in excess of US$500,000.

SEG AWARDS AND LECTURESHIPS

The SEG Awards Dinner was held at the SEG-SEG Canada Foundation 2013 Whistler Conference in Whistler, BC, Canada, on Wednesday, September 25, 2013 at the Whistler Conference Centre. The following SEG Awards were presented: R.A.F. Penrose Gold Medal 2012 to Robert O. Rye (F74); SEG Silver Medal 2012 to José Perelló (F89); Ralph W. Marsden Award 2012 to Allan P. Juhas (F79); Waldemar Lindgren Award 2012 to Martin M. Reich (FL11); Brian J. Skinner Award 2012 to Julie V. Rowland (M13); SEG Distinguished Lecturer 2013 to Anthony E. Williams-Jones (F90), SEG International Exchange Lecturer 2013 to Stephen J. Turner (F93), and SEG Thayer Lindsley Lecturer 2013 to José Perelló (F89). SEG Regional Vice President Lecturer 2013, Nicholas T. Arndt (F12), was unable to attend.

International Exchange Lecturer

Stephen J. Turner, Chief Geologist, Asia Pacific Region for Newmont Mining Corporation, presented lectures at James Cook University, Townsville, Queensland, Australia; Futores Conference, Townsville, Queensland, Australia; SEG/SEGCF Whistler 2013, Whistler, BC, Canada; Geological Society of Canada, Ottawa, ON, Canada; University of Ottawa, Ottawa, ON, Canada; Toronto Geological Discussion Group, Toronto, ON, Canada; CIM Geology Group, Saskatoon, Saskatchewan, Canada; Saskatchewan Geological Society, Regina, Saskatchewan, Canada; Akita University, Akita, Japan; Japan Mining Industry Association, Tokyo, Japan; and IAGS Conference, Rotorua, New Zealand.

Thayer Lindsley Lecturer

José Perelló, Corporate Manager, International Exploration for Antofagasta Minerals presented lectures at the following locations: Laurentian University (SEG Student Chapter), Sudbury, Canada; Universidad Nacional de Colombia-Sede Bogotá, Bogotá, Colombia; Latin American Geoscience Student Conference (LAGSC), Medellín, Colombia; Universidad Nacional de Ingeniería (UNI), Lima, Peru; ProExplo 2013 Conference, Lima, Peru; Universidad de Concepción (Nazca Student Chapter), Concepción, Chile; Geomin Conference 2013, Santiago, Chile; Universidad de Atacama, Copiapo, Chile; Universidad Nacional de San Agustin (SEG Student Chapter), Arequipa, Peru; Department of Earth Sciences, Geneva, Switzerland; and the XIV Congreso Colombiano de Geología, Bogotá, Colombia.

Regional Vice President Lecturer

Nicholas T. Arndt, Professor at the Université de Grenoble, France, presented lectures at the University of Sofia, Sofia, Bulgaria; Babes-Bolyai University, Cluj, Romania; Belgrade University, Belgrade, Serbia; Eotvos Lorand University, Budapest, Hungary; University of Leicester, Leicester, UK, and the Colorado School of Mines, Golden, Colorado, USA.

Distinguished Lecturer

Anthony E. Williams-Jones, Professor in Economic Geology and Geochemistry at McGill University, Canada, presented two talks at the GEOMIN 2013 Conference in Santiago, Chile, July 24–26, 2013. He gave the SEG Distinguished Lecture as the plenary plus a second lecture on the vapor transport of metals. He was a keynote speaker at the Goldschmidt Meeting in Florence, Italy, in August 2013 and gave another distinguished lecture at the GSA 2013 Meeting in Denver, Colorado. Also, in the fall, he gave talks at several universities that included the following: University of New Brunswick, Fredericton, NB, Canada; Memorial University of Newfoundland, St. John's, NL, Canada; University of Western Ontario, London, ON, Canada; Ottawa-Carleton Universities, Ottawa, ON, Canada; Camborne School of Mines, Penryn, Cornwall, United Kingdom; and Cardiff University, Cardiff, Wales, United Kingdom.

Honorary Lecturers

The existing list of SEG Honorary Lecturers follows: M. Stephen Enders (Consultant, Denver, Colorado, USA), Richard J. Goldfarb (US Geological Survey, Denver, Colorado, USA), William X. Chávez, Jr. (New Mexico Institute of Mining and Technology, Socorro, New Mexico), Michael C. de Wit (BRC Diamond Core, Irene, South Africa), Mark D. Hannington (University of Ottawa, Ottawa, ON, Canada), Chusi Li (Indiana University, Bloomington, Indiana, USA; Jeffrey W. Hedenquist (Hedenquist Consulting Inc, Ottawa, Canada), Douglas J. Kirwin (Consultant, Bangkok, Thailand), Noel C. White (Asia Now Resources Corp., Kenmore East, Australia), and Kevin B. Heather (Regulus Resources Inc., and Rock Doctor Limitada). New 2013 Honorary Lecturers appointed were Daniel G. Wood (retired from Newcrest Mining & BHP Billiton and currently an adjunct professor at The University of Queensland with the W H Bryan Mining and Geology Research Centre) and Cornel E.J. de Ronde (GNS Science, Lower Hutt, New Zealand). Yasushi Watanabe (Institute for Geo-Resources and Environment AIST, Tsukuba, Ibaraki, Japan) and Francisco I. Camus (Independent Consulting Geologist, Santiago, Chile) stepped down as Honorary Lecturers effective July 2013.

SEG PUBLICATIONS

Sales revenue for SEG publications increased 56% increase over 2012 and was made up primarily of bookstore orders (74%) with the remainder coming from exhibit booth sales. Member sales continue to make up about 82% of total publication sales. Revenue is attributed to sales of 30 different Guidebooks, 17 Reviews volumes, 17 Special Publications, 10 Monographs, 7 Compilations, 23 Videos, 6 Conference Series volumes, as well as *Economic Geology* and *SEG Newsletter* back issues, the Dummett DVD, 100th Anniversary Volume of Economic Geology, Anniversary Collection DVD (100th, 75th, and 50th volumes), and the Tables for Opaque Minerals (CD). The most popular publication in overall unit sales was Special Publication Number 16, *Geology and Genesis of*

to page 8 • • •

. . . from page 7 Summary of Activities for the Year 2013 *(continued)*

Major Copper Deposits and Districts of the World: A Tribute to Richard H. Sillitoe, edited by Hedenquist, Harris, and Camus, followed by Special Publication 17, *Tectonics, Metallogeny, and Discovery: The North American Cordillera and Similar Accretionary Settings*, edited by Maurice Colpron, Thomas Bissig, Brian Rusk, and John F.H. Thompson. Sales of e-doc downloads represent a 65% increase over the prior year with downloads covering most publications.

Four scheduled issues of the *SEG Newsletter* and nine issues of *Economic Geology* were released through December. The "Sillitoe volume," Special Publication 16, was released in April, with pre-sales offered at PDAC in March. Special Publication 17, on the North American cordillera and similar accretionary settings, was released on time for the Whistler 2013 conference in late September, along with Compilation 7, on porphyry copper, gold, and molybdenum. Guidebooks 43 and 44 were released for the GSA meeting and Whistler, respectively. Compilation 8, on Mexico ore deposits, and Compilation 9, on the Northern Cordillera, were in production, with second quarter 2014 release dates planned. Special Publications 10, 11, and 15 were reprinted. Lecture video No. 24 was released during the fourth quarter: *Magma Dynamics and the Formation of Magmatic Sulfide Deposits*, by Nicholas T. Arndt. The GeoScienceWorld e-books project was close to beta testing by year-end. Shipping costs continue to climb with USPS flat rate priority envelopes increasing 40–54% for international destinations and flat rate priority boxes increasing 24–34%. Higher e-doc sales are probably related to the increases in shipping rates, but there is no similar offset for increased size of journal issues that are included as part of existing member and subscriber benefits. As a consequence, both membership dues and institutional subscriptions were increased for print options in 2014.

The table of contents for the journal continues to be emailed to all members on release of new issues, while mobile access to content is available and used increasingly. In partnership with Elsevier, SEG offered the Geofacets Millennium Edition (now containing over 4,000 maps from *Economic Geology*) to our membership in 2013.

MARKETING

SEG exhibited at the following meetings from January through July 2013: AME BC Roundup, Vancouver, Canada; PDAC, Toronto, Canada; Latin American Geosciences Student Conference - Emerging Region, New Trends, Medellin Student Chapter, Colombia; 2013 EGRU Conference, FUTORES, Townsville, Queensland, Australia; and Geoforum 2013, Johannesburg, South Africa; 12th SGA Biennial Meeting, Uppsala, Sweden; SEG-SEGCF Whistler 2013, Vancouver, Canada; GSA 2013 Annual Meeting, Denver, Colorado, USA; NWMA 119th annual meeting, Reno/Sparks, Nevada, USA; and the AGU Fall Meeting, San Francisco, California, USA. Marketing efforts were focused on SEG-sponsored events, especially those within the Education and Training Curriculum, and utilized a variety of media, including the *SEG Newsletter*, third-party publications, e-blasts, website, and social media (Facebook, LinkedIn, Twitter, Google+, and Instagram). SEG's Website Coordinator took over management of the existing public SEG LinkedIn Group. In six months, membership almost doubled to over 4,300 and this venue has been effective in promoting events and publication releases. The SEG 2014 Keystone Conference website was built in-house and is mobile friendly, and SEG is now on Wikipedia.

EDUCATION AND TRAINING CURRICULUM

With the continued assistance of a part-time contract Program Coordinator, SEG, SEGF, and SEGCF organized and/or sponsored sixteen courses/workshops and nine field trips during the year. A draft course prospectus/catalog was made available to the Education and Training Committee at its meeting in Whistler in September and is now available to download from the website.

SEG OFFICE ADMINISTRATION

The office is staffed by twelve persons, including three on a part-time basis—effectively 11 full-time equivalents. In addition, two contract workers were engaged in the copyediting of manuscripts for publication and a further contract worker continues to fill the role of Program Coordinator in the Education and Training Committee. Temporary summer workers were engaged in scanning publications for the online bookstore and administrative records, assisting with processing of publication orders, helping to organize off-line archives, and performing data entry tasks.

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PRESIDENTIAL PERSPECTIVE

What Goes Down . . .

JUDITH A. KINNAIRD
SEG President 2014

In writing this column, I have paused to reflect on my life in the last two weeks, one week of outstanding good fortune and one week where everything seemed to go wrong, including mechanical problems on a flight that didn't take off, throwing out a complete schedule of meetings with knock-on effects for many people. One hopes that the good news, with the unexpected award of some research funding and then the granting of a Centre of Excellence in Economic Geology to my institution, shared with the adjacent University, 7 km away, will have more long-lasting positive effects than the bad week will have negative.

All this made me realize that life in the mining and exploration industry is a lot like my experiences of the last few weeks, except that it seems we have suffered the bad times for several years now. Commodity prices have softened since the highs of a few years ago: platinum, which reached briefly to 2200 US$, is now just over 1400 US$ an ounce; nickel, which was above 22 US$ a pound in mid-2008, is now about 6 US$ per pound; uranium oxide, which briefly reached 140 US$ per pound, is now less than 40 US$; and copper, which was over 4.5 US$, has been less than 3.22 US$ per pound. Whilst gold bucked the trend after the 2008 crash, rising to over 1800 US$ per ounce in mid-2011, it has also fallen back to just over 1300 US$, currently. In the deeper mines of the Witwatersrand, the cost of producing an ounce is about 1200 US$, whereas in cheaper open cast operations elsewhere in the world, production cost may be almost half that.

Softening of metal prices isn't just bad news for miners, explorers, and investors; it also has impact on local communities, sometimes with the least able to weather the storm being most severely affected. Many projects have been put on hold, shafts on some mines closed, while some mines have been put on care and maintenance awaiting improved metal prices. But what goes down must go up, and as stockpiles are drawn down and shortages become apparent, output must rise. Part of this, of course, will be driven by improved economic outlook. As fortunes improve, the demand for consumer goods will rise again. Various commodity consultants I have heard talk in the last few months predict that it is not until 2015 or 2016, however, that the fortunes of a whole basket of metals will rise.

Scarce metals have been in the news. These are metals that are regarded as of strategic importance to maintain technological output in developed countries and include antimony, platinum group elements, mercury, tungsten, niobium, and rare earth elements (REE). Several governments have identified REE as of strategic importance to their military supply and for advanced technologies. Although rare earths have been produced from places like California and South Africa in the past, the current major world producer is China, where the major deposit on the Mongolia side of the border is Bayan Obo. In the 1990s, some previously producing REE mines worldwide closed, following under-cutting by low Chinese prices. In April 2009, China declared that it planned to restrict the export of rare earths as it needs their production for their own uses and they intend to supply finished goods rather than raw materials—especially hybrid cars, so there has been a rush to find new deposits and re-open previously abandoned projects. REEs are used in small amounts in our everyday lives: they produce colors in TV plasma screens, they are used in cell phones, computer laptop hard drives, DVDs, LEDs, rechargeable batteries, magnets, fluorescent lighting and low-energy light bulbs and car catalytic converters. For example, the Toyota Prius requires 1 kg of neodymium and dysprosium for the electric motor and generator and 10 to 15 kg of lanthanum and cerium for the battery pack. REE are used extensively in military applications such as precision guided weapons, night-vision goggles, radar systems and other crucial military technology. An important application of magnets is in wind generators, with 100 kg of neodymium required per 1 MW capacity of the generator. As a result of the Chinese announcement on reduced export quotas, and bearing in mind that the annual demand for REEs is going to continue building from 130,000 tons in 2010 to 200,000 tons in 2015, the price rose quite dramatically, so that cerium saw an 1800% increase in price from 1 January 2010, when it was 8US$ a kilo, to 154$ by 2011. It was due to such a dramatic price hike that many countries began to exploit domestic REE resources. The US decided to restart the exploitation of rare earths in 2011 and expected a capacity of >20,000 tons in 2013. Other countries such as Vietnam, South Africa, Australia, India, and Kazakhstan have either just started, or are about to start production of rare earths but again, prices have fallen back in the last 18 months, which may result in operations being suspended. The planned production is likely to alleviate the shortage of light REEs and, indeed, some analysts believe that there might be an oversupply in the near future that may further contribute to a fall in prices. As exemplified by REE in China, not all scarce metals are necessarily rare. They are perceived to be scarce because of concerns about security of supply. For example, South Africa, Zimbabwe, and Russia provide ~90% of the world's platinum supply. Whilst these scarce metals are required to secure the continuity and development of the technological industries, in many cases, because they are not required in such large tonnages as many other metals, existing mines are small or limited in number worldwide, again with a limited capacity for job-creation.

. . .boom and bust cycles, which have resulted in many in the geological and allied sectors being laid off, or university graduates failing to get jobs in the relevant field, have led to a cutback in University funding for economic geology and mining.

Perhaps what industry personnel do not realize is that in times of low metal prices, there is a knock-on effect in tertiary education as well. These boom and bust cycles, which have resulted in many in the geological and allied sectors being laid off, or university graduates failing to get jobs in the relevant field, have led to a cutback in University

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. . . from page 9 Presidential Perspective — What Goes Down . . . *(continued)*

funding for economic geology and mining. Further, some governments, especially in Europe and the United States, have become aware that such graduates often leave their place of origin to seek their fame and fortune on another continent, and this is used as the rationale for cutting back on investment in geological sciences and mining.

In the modern era, with a lot of exploration for resources occurring in the developing world, international exploration and mining companies recognize the strategic economic, social, and political value of partnering with local communities to build capacity within the countries in which they operate. Apart from its infrastructural challenges, the developing world poses particular challenges with regard to developing the necessary home-grown high level skills required to utilize the cutting-edge technologies that increasingly need to be employed to find new resources, and to extract and better manage resources that are particularly geologically complex, in order to maximize their lifespan and economic value.

At the heart of the skills challenge is the nature and quality of training of geoscience professionals in the developing world. The opportunity to contribute to such capacity building and skills enhancement in Johannesburg, for example, is an exciting prospect. It is therefore all the more rewarding, in the current downturn, to know that the South African government has chosen to award a Centre-of-Excellence status for the creation of a center focusing on economic geology in Johannesburg. It will form a focus not just for South Africa, but in the coming years, it is hoped, for the whole of southern Africa. One of the aims of the Centre is to provide first-class research into ore deposit formation and also to provide skills training for those in education and government who need improved knowledge in order to guide the decision-makers in their country for future developments.

In the January column I mentioned that 20% of our membership is comprised of students who are perhaps the most severely affected by the current job situation. Also in the January issue, Murray Hitzman had important advice to minerals companies—that they need to re-think their approach to hiring students, since the petroleum industry is hiring the best students because they engage in the activity earlier in the year than do the minerals companies. Although we are dealing with difficult times for our industry at the moment, industry is still recruiting, albeit at a much reduced level compared with the heady days before 2008. However, we frequently hear the cry "no skills" from industry, whilst the graduates cry "no jobs." It would be interesting to hear the perspective from both sides. In these difficult times, I would urge all SEG members from Fellows to students to keep up-to-date with current situations, emerging markets, and upcoming opportunities. The *SEG Newsletter* is a great place to start. If you feel that it doesn't cover items of interest to you, then how about your making a contribution to the *SEG Newsletter*? We would love to hear from you.

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The Department of Geosciences at Texas Tech University invites applications for the Pevehouse Chair in Geosciences. The purpose of this endowed position is to support innovative research and education that are broadly aligned with petroleum geosciences and may include geophysics, structural geology, geomechanics, sedimentology, petrophysics, and organic geochemistry. A Ph.D. in geosciences or closely allied field is required, as is a record of research as demonstrated by professional publications. The chair holder will conduct a vigorous, externally-funded research program, direct graduate student research, and teach undergraduate and graduate courses in his/her specialty. The position is expected to be filled at the tenured Full Professor level.

Texas Tech is a state-supported, graduate research-oriented university with over 32,000 students. The Department of Geosciences consists of twenty-four tenured/tenure-track faculty, with teaching and research emphases in solid earth geosciences, atmospheric science, and geography. It offers degree programs in solid earth geosciences at the BS, MS, and Ph.D. levels. The chairholder will join a dynamic, growing Department with more than 200 undergraduate majors and more than 60 graduate students. Texas Tech is committed to growth in disciplines aligned with hydrocarbon geology through addition of at least one junior faculty position.

The Department computer labs are equipped with GIS, geologic mapping/modeling, and seismic processing/interpretation software packages. Available experimental/analytical facilities include a stable isotope laboratory, XRD, XRF, analytical SEM, TEM, laser ablation ICP-MS, a heat flow lab, and remote sensing spectroradiometers In addition, the Department of Petroleum Engineering maintains experimental and analytical facilities in petrophysics, drill fluids, cement, enhanced recovery, and reservoir simulation, as well as X-ray CT/nuclear magnetic resonance imaging lab.

Lubbock is located on the Southern High Plains in close proximity to the Permian Basin. The city has a population of over 225,000 and the semi-arid climate is conducive to outdoor activities. Cultural amenities include musical, theatrical, and sports events, and the city offers numerous options for shopping and dining. The city also offers the best healthcare facilities in the region, including the university's Health Sciences Center. The cost of living is low compared to national norms.

Applicants must first go to the employment website of the university at http://jobs.texastech.edu. There, go to "Search Postings", search for requisition number 87107, and fill out necessary forms in applying for the position on-line. Then, applicants should submit a letter of application, curriculum vitae, a statement of teaching and research interest, names and contact information (including e-mail address) of at least 3 professional references. These documents should be uploaded to the employment website and we request that copies by emailed or sent directly to: Dr. Calvin Barnes, Pevehouse Chair Search Committee, Department of Geosciences, Texas Tech University, MS 1053, Lubbock, TX 79409-1053.

Additional information on the department can be found at website http://www.depts.ttu.edu/gesc/. E-mail questions regarding the position are received at cal.barnes@ttu.edu. Review of applicants will begin immediately and continue until the position is filled.

Texas Tech University is an affirmative action/equal opportunity employer, committed to excellence through diversity. Texas Tech welcomes applications from minorities, women, veterans and persons with disabilities.

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FROM THE TREASURER

2013 Year-End Summary

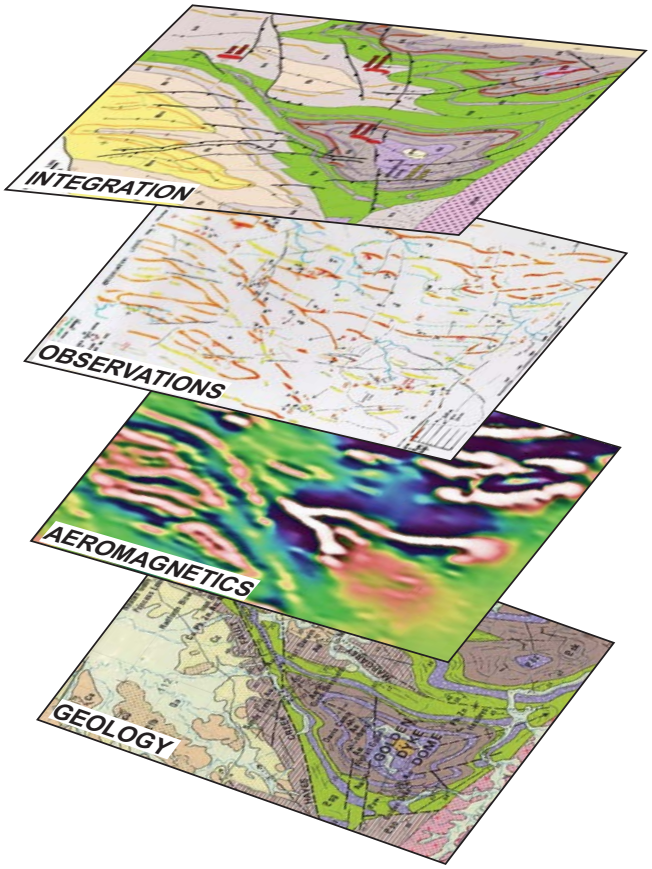
HAROLD J. NOYES
SEG Treasurer

With higher than projected revenues and contained expenses, the Society turned a projected operating deficit into an operating income of $267,609. Positive revenue variances were primarily related to publication sales and sponsorships as well as a carryover from the SEG 2012 conference in Peru and continued growth in the membership. These higher revenues were assisted by a tailwind of lower than anticipated expenses for editing of the journal, delays in production of several publications, postponement of a major software upgrade, and well-managed building maintenance and repair costs. Net income from investments of $275,726 was higher than budget and net assets experienced a gain of $1,522,946. Financial assets on December 31, 2013, were $13,357,111 with Total assets of $17,213,002.

For the Foundation, total contributions of $518,720 exceeded budget by 59% due to several significant contributions from individuals. All but one corporation completed their multi-year pledges to the Graduate Student Fellowship Fund by the end of 2013, while another corporation terminated its involvement in this program. General and Administrative expenses were under control and Programs and Services were well within budget. Our auditor complimented the Foundation on keeping a relatively low ratio of G and A to Programs and Services, well within general guidelines for non-profits. Net income from investments of $97,691 came close to budget and the year ended with a net gain of $366,357. Total financial assets on December 31, 2013, were $4,942,864.

Both organizations enter 2014 in strong financial position and with continued expansion in programs aimed at increasing our relevance in the field of economic geology.

Year End 2013	SEG, Inc.	SEG Foundation, Inc.	Total
Revenues/ contributions, total	$ 2,222,845	$ 518,720	$ 2,741,565
Expenses, total	$ 1,955,236	$ 594,372	$ 2,549,608
Value of assets	$17,213,002	$4,942,864	$22,155,866



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SEG FOUNDATION PRESIDENTIAL PERSPECTIVE

The Foundation Charts Its Path

ANDREW T. SWARTHOUT
SEG Foundation President 2014

Last week I had the honor and pleasure of chairing my first SEG Foundation (SEGF) Board of Trustees meeting as well as attending the SEG Council meeting led capably by Judith Kinnaird. In my second column as SEGF President, I'd like to share my observations of the Foundation's state of well-being. Firstly, the business of the SEGF is in great hands, thanks to the dedication and leadership of its Trustees. Importantly, it is also clear that our SEG members are stepping up to the plate in support of our programs, especially those that assist students. SEGF is a non-profit corporation, and the continued commitment of industry and members is integral to executing our many programs.

We continue to enjoy strong support, although donation shifts occurred during 2013. The downturn in the minerals sector over the past five years presents us with challenges that I am confident we can meet. While individual contributions increased significantly, corporate donations did not, as industry sponsors re-think their long-term donation pledges and budgets. Historically, the ratio of corporate to individual donors has been on the order of 2:1. In 2013, the ratio reversed to 1:2, reflecting the importance of the Foundation's purpose to its members and their commitment to its objectives. The Foundation is working hard to again increase corporate pledges; however, it is heartening to see that our constituency is willing and able to fill the funding gap.At the Foundation meeting in Toronto last week, several initiatives were tabled to maintain and improve the fund-raising efforts.

Foundation Purpose: One of the primary messages learned, particularly by those of us relatively new to the SEGF, is the purpose of the Foundation. If one mandate were to be selected, it is the objective of raising funds for the Society, aimed at student support and ongoing education. Sponsored field courses, student grants and fellowships, and innovative workshops and conferences are crucial in attracting, retaining, and training geoscientists. The hugely appreciated time volunteered by members who are leaders in our field of economic geology defrays certain costs; however, the Foundation relies on donations in order to execute these activities, providing financial assistance for student attendees, logistics, and other administrative services.

Globalization: Another important message emerging from our meetings is the need for the Society and Foundation to further solidify their global brand. While the Society has increased its membership ranks worldwide, contributions to the Foundation maintain a largely North American identity. Several measures are being considered to bring in more Trustee members from diverse geographies to assist in sending out a message of the Society's increasingly global relevance and benefits. New SEG conference venues (Hobart, Australia, 2015; and Izmir, Turkey, 2016) will facilitate this diversification and broaden fund-raising efforts. The Foundation can learn from the enormous success of the SEG Canada Foundation, under the leadership of Gerry Carlson, by replicating this success worldwide. Our student members are predominantly outside North America and SEG Foundation is in a position to better serve them through increased activity in emerging regions where the Society is having a measurable impact.

Finally, some comments on the "downturn," particularly aimed at young professionals. I never cease to be amazed at how surprised our industry is when we enter a downturn. It is never expected, even though we have seen at least one in every decade. Likewise, the high cycles are never thought to have an end. The fact is that we exist in a cyclical business and, while this down cycle has been painfully long, it too will end. Recently, gold producers collectively wrote down from their reserves about one year's worth of production simply by applying lower gold prices and higher operating costs. Generally, mining companies' pipelines of exploration properties and growth opportunities have evaporated, as exploration and acquisition budgets have been slashed. As we have seen in previous "down cycles," our industry will awaken to the fact that the depletion of mineral reserves without a growth plan leaves us in a dire deficit situation. When this will happen is anybody's guess, but it will cross many commodity boundaries and cause an epidemic of increased activity as the industry scrambles to fill its growth needs. Hiring and financing euphoria will return as quickly as it disappeared between 2008 and 2010. And, we will need energetic, young earth scientists to fill the need. At a recently attended BMO Global Metals & Mining Conference, the mood suggested that this phenomenon is already occurring as economic conditions improve during early 2014. As markets recover, it is hoped that funds will be more thoughtfully raised and spent on exploration and mining projects than has been the case in previous boom cycles. This is increasingly becoming the task of upcoming professionals and their education and training is a key challenge for both the Society and Foundation.

The Foundation-supported programs are critical to SEG members, to economic geology students, and to all members of our profession, and your support is vital to the Foundation! Thank you again for your continued financial backing, your ideas, and your commitment to making our Society an international leader.

Thank you!

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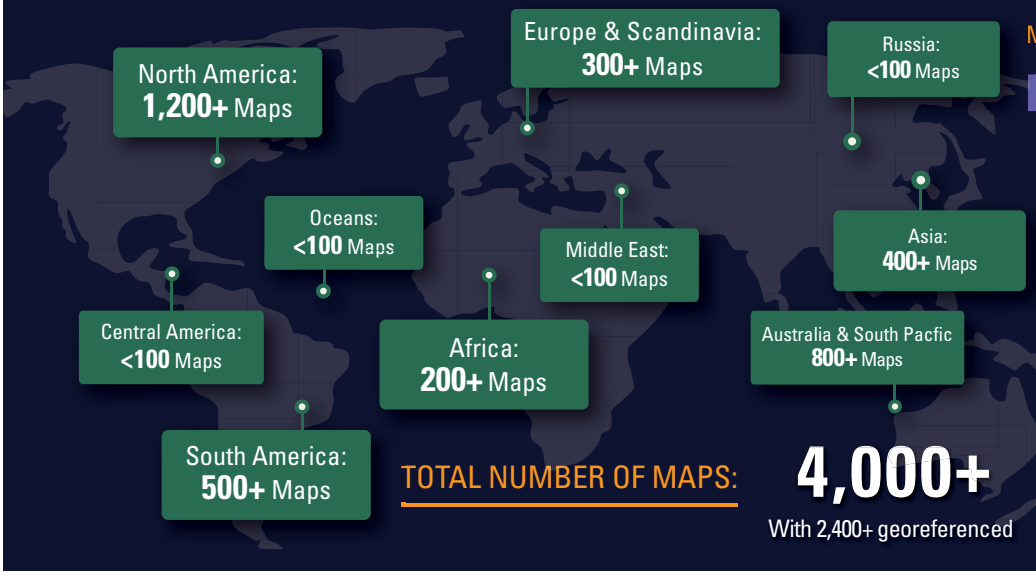

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VIEWS

The Ore Finders

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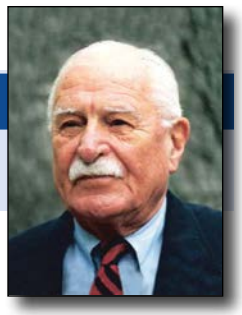

Siegfried Muessig

(SEG 1957 SF)

An Introduction to Sig Meussig's Exploration Canons

Discovering an orebody is a difficult and challenging task—few seekers of ore succeed. Even fewer succeed in being involved with several world-class discoveries, including one as significant as the giant Escondida copper orebody in Chile. When a person of this caliber takes the time to write down his thoughts on how orebodies can be discovered it is worth taking close note of what is written—even if these thoughts were first publicized 21 years ago.

Dr. Siegfreid (Sig) Muessig is a rare individual, one who in the late 1960s built a company, Getty Exploration, into a much-respected and highly successful discovery team with a formidable reputation as a finder of ore. Sig's thoughts on how to find ore were first made public in 1993, at a talk that he gave to the Denver Regional Exploration Geologists Society. They were subsequently disseminated to a wider exploration audience in the April 1998 issue of the *SEG Newsletter*, where they were presented as 18 Exploration Canons in a Special Feature paper, "The ore finders."

As Sig noted in his 1998 paper, his thoughts were not all original. Many he accumulated over the years from wise individuals who, no doubt, learned the truths contained in these pearls of wisdom the hard way, by trial and error. These thoughts, or canons, represent a collective body of practical knowledge that is as relevant to seekers of ore today as it was to my generation and to previous generations. I have no hesitation in recommending them as wise counsel for all aspiring ore finders, and for this reason, SEG is reprinting Sig's 1998 note as a Views column, with minor edits for current style.

Dan Wood

What makes for success in exploration? Is it money? Is it superior technology? Is it the presence of superior scientists? Is it superior and persistent organizations? All these attributes are desirable and their presence will enhance the chances of success; but we've all seen examples of well-funded, capable organizations that find nothing though they do some of the right things, such as exploring in the trends and using the latest models and technology.

What then are the critical ingredients without which no exploration group is going to make discoveries, except through blind luck or brute force? Much has been written about exploration philosophy, and many colleagues such as Paul Bailly and Stan Holmes have made important contributions to the literature on the subject. For the most part, however, they and others have concentrated on the character of the organization and on the scientific, technological, financial, and political aspects of successful exploration. Indeed, of the "five main ingredients of exploration success" given by Brian Mackenzie, the 1992 Denver Region Exploration Geologists Society (DREGS) Distinguished Lecturer, four are organizational and the other states the one we all put first: superior scientific and technical skills.

To have any chance of success, an exploration effort has to be geologically and economically well conceived, directed, and executed. It has to be well funded, well staffed, organized effectively, and has to assess the political risk in the areas in which it operates, The unit has to have relaxed and open communications, and distinctive and strong leadership. These attributes deal solely with what we might call the front end of the exploration process and involve the scientific, technological, and management aspects of the organization—and there is general agreement as to the importance of these factors. They also involve effectiveness and efficiency, which are laudable characteristics, but do not furnish a real basis for successful exploration.

Very few authors have dealt with the role of the **individual** and his or her desirable characteristics. Those that have talk about "hunger," "motivation," "vigor," "inquisitiveness," "persistence," etc. There is no doubt that these are great qualities, but they are not enough; we have all seen hungry, motivated, and vigorous failures. In what follows, I will concentrate on the behavior, attitudes, and most importantly, the understanding of individuals, as they alone make the decisions leading to discovery. Organizations only set a permissive and favorable climate within which individuals act. Exploration is like research; it is an intellectual activity and it is the **decisions and actions of individuals**, not their organizations, that lead to the discovery hole.

I want to emphasize what we might call the tail end of the exploration process, the operational phase, where the actions and decisions of individuals come into play. It is these actions and decisions that are the added critical ingredients of success. How then can we guide the individuals, be they exploration managers or field geologists? Or, put another way, what philosophy and principles can guide the successful explorer—the ore finder? I propose a set of principles—**the exploration canons**—that should be part of the intellectual equipment of ore finders, actual or wannabe.

The exploration process is moved along the track toward discovery, or failure, by the cumulative actions and decisions made in parallel or in sequence by individuals. Thus, one or more individuals determine the direction of the track. A basic premise is that most decisions are not made by consensus. One needs sound advice, but not a cast of thousands to make operational decisions. Group

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decisions tend to average out good ideas until they reach mediocrity! If there is to be much of a chance of success, these individuals and their colleagues should be guided by the philosophy expressed and inherent in the proposed principles—the exploration canons.

My thoughts are obviously not all original. As is the case with most of us, I have been exposed over the years to wise individuals, all of whom influenced my thoughts and professional attitudes. Therefore, with thanks to my unnamed mentors, I hope that my thoughts might stimulate discussion and perhaps reduce the time and money needed to find that next orebody.

I want to preface my thoughts with an observation of Charles Park, ". . . getting in close is the art of geology." One obviously needs to know the geology of the area being studied, and of the deposits that occur or may occur there. Be realistic about the geologic permissiveness of the area and develop a realistic model, one that distinguishes observations and facts from inferences and hopes. This aspect of the exploration process—the good science part—is not all that difficult. Many unsuccessful organizations are scientifically sound. **Good science does not necessarily generate or trigger good exploration.** It is what is done with the data that is important. Attention to the proposed canons will improve the odds for discovery.

THE EXPLORATION CANONS

■ **Exploration is not a science.** The aims of exploration are fundamentally at odds with those of science. Science seeks understanding, whereas exploration seeks discovery, by whatever means, with or without understanding. Paraphrasing John Ridge (CIM 1983), the way it gets there is really of no concern in the search for ore. The empirical model is more useful than the generic one. If I had to pick a basic flaw in the philosophical approach of many organizations to exploration, it would be here. Many geologists tend to ignore or disbelieve data and observations simply because they cannot explain them—no scientific cause can be established. As a result, many either walk away or they over-geologize and then walk away. Consider a classic case: the Wegener hypothesis of continental drift was derided primarily because no understandable cause could be developed, so plate tectonics lay "undiscovered" for many years. It follows that one should:

■ **Go with the facts, forget the theory**. If there is a question of genesis vs. empirically derived facts or observations, go with the facts, forget the theory, ignore the model. For example, in a drilling program, when the physical model has been tested, considerations of the genetic model, whether understood or not, should have no bearing on the decision to drop or continue.

Let me illustrate my experience at Escondida. The alteration pattern at Escondida fit the classic halo of the porphyry copper model and five holes drilled through alluvial cover in the most "prospective" area were all blank. A secondary target did not fit the model, but was drilled because of the favorable appearance of the leached capping and the presence of a coincident geochemical anomaly. The first hole hit the orebody.

■ **Try for the definitive test.** An absolute essential of the "exploration kit" should be the concept of the "definitive test." One should constantly strive to test the target with the drill as soon as possible. If the test is negative, walk away, unless new ideas or data from the drilling justify further work. Too many geologists become victims of excessive scientific arguments and do more work, even though the target could have been adequately tested relatively quickly with the drill. Sometimes it costs more to reduce risk than to take it by drilling.

■ **The odds are best in the shadow of the head frame.** This obvious, important principle reflects the fact that ore-forming processes tend to occur as multiple events and produce multiple deposits in favorable geologic settings. This is not to say there cannot be isolated deposits such as Bingham, or the cryolite at Ivigtut, or the Kramer borax deposit. However, since deposits do tend to occur in clusters, the odds are improved by exploring in or close to mineral districts, the identified mineral trends, or the extensions of trends. Some groups tend to shy away from expensive district or trend land plays, preferring to go where ground is cheaper. But remember, where land is cheap, it's cheap!

■ **Save the agonizing for mineralized trends.** Generally speaking, in areas without mines or prospects ("virgin" areas), unless early drilling of targets gets results, it is better to walk away. However, even negative results can lead to meaningful reassessment of the prospect, especially of geophysical or geochemical anomalies. From this might emerge a quite different interpretation or a new set of drill targets. This may be especially true in deeply weathered terrain or in the search for the deep blind orebodies.

■ **Look for ore, not mineralization.** Mineralization furnishes clues, and in the early stages of exploration, mineralization (alteration) may lead to ore, but at the target stage, you should be looking for ore. An important corollary is:

■ **To find an orebody, you have to drill ore holes.** This may seem to be stating the obvious, but each of us knows of deposits that have been overdrilled in the vain hope of improving the grade. Mineral deposits, by definition, need to have continuity and grade to become orebodies. It follows, that if an "ore hole" cannot be offset by others, there probably is no orebody there. Continued drilling usually results in finding more mineralization or alteration, neither of which can be put through the mill.

■ **There needs to be room for the ore.** This is such an obvious principle that is often ignored when drilling out a deposit. Is there actually room for the tonnage needed to make an ore body, or are there structural, stratigraphic, or other constraints on the necessary space? The more known about the detailed geology of the prospective area, the less attention should be paid to the model and the more given to this principle.

■ **Improve it or drop it.** Unless a property is improved, generally, at each stage of exploration, you should walk away, especially in virgin territory.

■ **Do not chase spurious anomalies.** Unless the model or other knowledge of the local geology account for an unexpected anomaly, either geophysical or geochemical, disregard it and continue with the program at hand.

■ **Do not be preoccupied with explaining anomalies.** If the drill hole or other evidence has tested the

anomaly and there is no evidence of an orebody, walk away, even though the anomaly is not explained. If, however, in the geologic environment being explored there is strong correlation between certain kinds of anomalies and ore, or conditions that are guides to ore, then perhaps more effort should go into trying to explain the anomalies. The key here is that the anomaly itself is tested. If it is blank, it's best to walk away.

- **Do not be preoccupied with pathfinders.** Generally speaking, the metal sought is its own best pathfinder. Some groups are enamored of expensive multi-element surveys, but John Prochnau claims that he has never seen a gold discovery in which indirect evidence—geochemistry or geophysics—played the principal role. Some use arsenic as a pathfinder for gold, claiming that its halo is larger than that of gold and therefore sampling can have a lower density. I am not convinced.

- **Do not be preoccupied with stereotyped concepts**. Avoid overemphasis of such qualities as "ground preparation," "leakage," and yes, structural control, unless they can be clearly correlated with the occurrence of ore in the geologic setting or district being explored. These factors should not override the significance of ore intercepts or other favorable drill-hole or sample results. For years the conventional wisdom in the Republic district, Washington, was that pyroclastic rocks were poor ore hosts; when the drill hit pyroclastic rocks, the hole was stopped. As a consequence, the three ore intercepts of the Golden Promise vein system, drilled in pyroclastic rocks in 1963, were ignored for over 20 years, until further work showed that veins in pyroclastics do "make ore."

- **Do not be technology driven.** Some organizations fall in love with a given geophysical method, with geophysics itself, or with other indirect methods, such as satellite imagery, and overuse them, when more direct, simpler methods, such as mapping, sampling, and drilling will give faster, cheaper, and more definitive results.

- **Acquire first, study later.** It is amazing how this basic principle is so often ignored. When a discovery is made and the land play is on, some groups insist on taking samples or doing other work before making a commitment. As a consequence, they arc commonly left with fringe acreage or a competitor gets the deal.

- **Disregard competitor's previous actions.** Do not base exploration strategy on your supposition of the reasons behind a competitor's previous action in the area you're exploring. If the available data compel you to a course of action, take up the ground and plan a series of drill holes; do not be swayed by imagined scenarios of why a previous holder dropped the ground.

- **Go for the jugular.** If you have faith in your geology and judgment of the potential of an area, do not take halfway cheap measures; take the bold strokes that make for discovery, rather than nibbling away at the data.

- **It's the drill hole, stupid!** The geologist cannot substitute his wisdom and cleverness for the drill hole. The problem here is that the scientist believes in the power of the scientific method: more work, more data ought to do the job. And, therefore more work is done because it "offends" many geologists (scientists) to just drill a hole without understanding the geology. On the other hand, there are those who believe that many prospects can be tested by indirect geophysical means. One geologist on a project with which I was associated once said (and believed!), "... but we ought to be able to model the anomalies and test them without drilling." Not so!

The authors of "In Search of Excellence" found that the difference between successful and unsuccessful exploration companies is a dramatic difference in the amount of diamond drilling they do. Although diamond or other drilling looks expensive, it is really the only way to find out what is down there.

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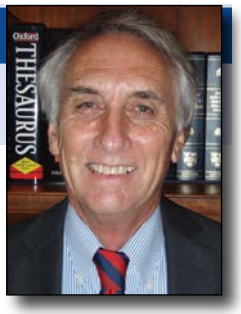

Dan Wood

(SEG 2010 F)

SEG provides tremendous support to students to become educated and trained in mining-related geological disciplines. At the same time, as we all know, periodic and rapid scaling-up and scaling-down of exploration expenditure and effort have characterized the mining industry over the past 50 years. During a scaling-down period, when there is a sudden and sharp industry downturn, budgets are cut and many geologists and related geosciences professionals who have a job become unemployed or underemployed, and many new graduates cannot find work in their chosen career. There is nothing new in this. It is an unpleasant fact of life in the mining industry; however, this knowledge is cold comfort to those SEG members who are, or will become, casualties of the present downturn.

Corporate memory is fleeting; otherwise, it would guide the present crop of mining industry leaders towards taking a more enlightened and self-interested approach, given the frequency with which the present situation re-occurs. In an ideal world, the corporate management of mining companies would realize and address the potentially negative future effects of the personnel actions they are presently taking in their exploration teams to accommodate the most recent downturn, both for their company and the industry as a whole. Because of their actions, it is the young (and not so young) exploration geologist, in the main, who pays the price with a career interrupted, ended, or, possibly worse, never even started.

Dan Wood is a retired exploration geologist with extensive experience in exploration leadership and corporate management. He worked with BHP for 24 years and with Newcrest Mining for almost 18 years, during which he led Newcrest's highly successful exploration team as Executive General Manager Exploration. He is presently an adjunct professor at the University of Queensland, Australia. Contact: W. H. Bryan Mining & Geology Research Centre, University of Queensland, St Lucia, Queensland 4072, Australia.

The companies will pay the price of missed opportunity to sustain the crucial human resources that are necessary to create wealth for shareholders. As shown by their actions, many mining company managements appear oblivious to this obvious truth.

I was recently posed a question: how does an international scientific society like the SEG, with over 1,000 student members around the world, address career opportunities in mineral exploration, given the increasingly wide swings in what is known to be a cyclic industry?

I really don't know how to answer this question. As I come from the old school that tells it like it is, I don't see any alternative other than to state the obvious—which is that there will be a lot of underemployment and unemployment among exploration professionals until the inevitable cyclic upswing begins the next—regrettably unsustainable—boom part of the cycle. Having said that, however, there are observations that can be made that may and should encourage more dedicated students—and now-unemployed geologists who entered the mineral industry in the past few years—to seek to stay the course and ride out the present downturn.

I recently gave talks to SEG student chapters in Southampton and Leicester in England where, over a beer with the students after the talks, the question of what to do when their studies were completed came up. I'm loath to offer advice, but I did suggest that if they truly believe their destiny lies with applied geology and exploration, in particular, they should consider the following.

First, it is crucially important to establish and maintain a link with the mining industry, for the very simple and practical reasons that (a) the present downturn almost certainly will be temporary and (b) there inevitably will be a shortage of applied geologists in exploration, mining, and related disciplines after the cycle turns. Barring a dramatic and unanticipated reduction in demand for mineral commodities, this shortage has to develop over the coming decade as the demographic cluster of geologists in the 50 to 60+ years age bracket retire from the industry. I don't have the numbers on this to quote, but I'm certain that there are not enough younger geologists available to adequately replace these seniors as they retire.

As regards how many exploration geologists will become unemployed or underemployed, the market inevitably will determine this. Figures I have seen for Australia suggest unemployment with exploration geologists is now at least 15%, but unemployment plus underemployment is affecting more than 30% of those who were previously in the workforce. Many of these geologists, if they have the necessary skills to change career, almost certainly will do so and quite likely will be lost to the mining industry forever. As for the geologists who are retiring, they will also retire the knowledge and experience gained over decades, which the industry can sorely afford to lose, given the increasing difficulty of discovering an orebody.

Second, it doesn't matter how this link to the mining industry is established. Establishing a link is important because it will provide evidence to a future possible employer of commitment to the industry; in addition, the geologist will have incentive to retain knowledge, which easily can be lost if one is out of the industry for an extended period. Unfortunately, it is unlikely the link will be established as an exploration geologist because these are the first people to be laid off in every cyclic downturn, due to exploration dollars being seen as discretionary spending by management. However, since most mines will continue to operate and new mines will open, there will be some employment opportunities in mining; someone who sees their future in exploration should seek to find work as a mine geologist, as a form of transitional employment. If employment can't be found as a mine geologist, then

seek employment as a field or technical assistant in a mine—even if it is only as a sampler.

In the mid-1980s, when there was one of the periodic downturns in exploration, I took on young geologists as field assistants so as to provide them with this link. They weren't expected to work as geologists, but the experience they gained working as samplers provided a useful skill and the company benefited from having samplers with geological training; some we took on as geologists when the industry picked up. Gaining mining experience for a few years is a distinct advantage to an exploration geologist, even if it is only as a sampler in a mine. Exploration is about discovering orebodies and part of the knowledge required to do this has to do with knowing what is required for mineralization to become ore. The only real place to learn this is in a mine.

Third, and finally, two of the attributes of a successful exploration geologist are resourcefulness and the ability to overcome what are often demoralizing challenges. Hard as it may sound, the apparent hopelessness of the present employment situation could and should be viewed as an opportunity to rise above this by demonstrating these qualities. To do so requires great optimism and the ability to persist when all seems lost, again admirable traits for an exploration geologist.

While these are nothing more than a whole lot of words that are easy to write when it is someone else with the problem, I hope this note is of some use and may encourage some of you who are contemplating a change of career to try to stay the course. Having said that, I think it is important to understand that exploration is not a career for the faint-hearted or for those who cannot survive hardship; it challenges the best of us and it is worthwhile seriously questioning your commitment at the start, rather than part way through your career. If this causes you to abandon your dream of a career in exploration, you may find later on that the present downturn was a blessing in disguise.

My closing words are for those exploration geologists in leadership and management roles. Where possible, I would strongly encourage you to try to provide young geologists with some sort of link into the industry, either within your exploration team or elsewhere within your company. Eventually, conditions will improve and exploration geologists will be in demand once more. The geologist you provide with work as a field assistant, or in some other role, may be your next ore finder.

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Lecture and Laboratory Instructors

Steven Scott	University of Toronto, Toronto, Canada – VMS, organizer
Joan Scott	Toronto, Canada – laboratory displays, organizer
Zhaoshan Chang	James Cook University, Australia – skarns
Huayong Chen	Guangzhou Institute of Geochemistry, CAS, China – IOCG
David Cooke	CODES, University of Tasmania, Australia – porphyries, epithermal
Richard Goldfarb	US Geological Survey, Denver, USA – gold
Dave Leach	Formerly US Geological Survey, Denver, USA – MVT, Sedex
Chusi Li	Indiana University, Bloomington, USA – magmatic Ni, Cr, Pt
Noel White	Consultant, Brisbane, Australia – ore models, iron ores
Kaihui Yang	Vice President of Zijin Mining, Toronto, Canada – exploration in China

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NEW CONCEPTS & DISCOVERIES
2015 GSN SYMPOSIUM
May 14-24, Reno Nevada

Geological Society of Nevada 2015 Symposium
May 14 – 24, 2015
John Ascuaga's Nugget Hotel and Casino in Sparks, Nevada

New Concepts and Discoveries

Even as much as the world has become available for exploration over the past decade, miners continue to return to Nevada. Why? Political stability, transparent regulatory environment, good infrastructure and GREAT GEOLOGICAL POTENTIAL. Miners return to focus on Nevada's geology and its important mineral deposit types: Carlin, epithermal and intrusion-related gold and silver, as well as other deposit types (porphyry Cu and Mo, IOCG and industrial materials) are also rising in importance.

Despite Nevada's unparalleled record, mines are getting harder to find, and the discovery rate is going down. There are plenty of reasons for this, ranging from lack of access to capital markets to the fact that the established trends are well-explored. We can improve our track record by better understanding the geologic and geochemical processes that bear on the two quintessential questions of exploration:
1) Where to look? and, once in the right location, 2) How to vector into an economic deposit?

The 2015 symposium theme, **NEW CONCEPTS AND DISCOVERIES**, emphasizes both the major deposit types and trends that have sustained the mining industry for several decades as well as other deposit types and areas that may eventually have greater influence. The focus of this meeting is exposing the attendees to new ideas that we use to find new deposits: case studies, descriptions of new (or recently reinvigorated) deposits and targets, framework geology, tectonics and metallogeny, and the latest deposit concepts and exploration technologies.

As with previous symposia, the meeting will include talks, poster and drill core presentations, numerous exhibitors, and pre- and post-meeting field trips and short courses, culminating with the popular follow-up volumes. It will be organized into morning plenary (single session) talks and afternoon concurrent sessions with an emphasis on discussion. It will be preceded on May 17 by a special joint GSN-SEG forum entitled "Carlin-like Gold Deposits: What Can We Learn Beyond the Known Trends and Nevada?" The format of this session will be modeled after the popular GSN-SEG forum "Controversies on the Origin of World-Class Gold Deposits: Carlin and Witwatersrand, which was held prior to GSN's 2005 symposium.

We invite you to join us, and more importantly to participate! Contact us if you want to contribute a paper, talk or poster, or if you have ideas about talks you would like to hear or topics to be explored.

Technical Sessions (May 18-21): Nevada, the Gift That Keeps on Giving

- Regional Geology and Metallogeny of the Great Basin
- Exploration Technology
- Case Histories of Discoveries and Exploration Update
- Intrusion-Related Cu-Au-Mo Deposits
- Northeastern Nevada: The New Frontier
- Advances in Carlin-type Gold Deposits
- Epithermal Deposits
- Diversification: Looking beyond Gold, Copper and Silver

Field Trips - Pre-Meeting (May 14-16):

- Introduction of Carlin Gold Deposits
- Epithermal Deposits of Northern Nevada
- Mining for Non-Geologists - Exploration to Reclamation

Field Trips - Post Meeting (May 21-24):

- The Pequop Trend—Nevada's Newest "Carlin" Trend
- Epithermal Deposits of Central Nevada
- Porphyry-related Deposits of Nevada
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jurisdictions perceived as less mature, often trading the technical risk of deep exploration for sovereign risk in developing countries, and (2) develop an impressive array of (mostly) geophysical tools and derived datasets aimed at inferring subsurface geology from (mostly) surface measurements.

While the latter approach has proven particularly useful for defining drill targets, our declining exploration productivity provides evidence that, alone, it is an inefficient pathway to discovery. The problem is that geophysical data acquired from the surface provide proxy measurements of the subsurface, with non-unique solutions with respect to rock type and geometry. Thus, a large proportion of targets generated by geophysical surveys are likely to be false positives. With the high cost of deep drilling, the recent trend has been to drill fewer holes into these targets, often with significant geophysical anomalies being tested by a single, wildcat drill hole. All too commonly, these isolated drill holes provide insufficient data to explain the target anomaly. As a result, exploration programs on valid targets may be curtailed too early and discoveries may be missed.

This approach to deep exploration contrasts with the "surface prospecting" style of mineral exploration, almost exclusively responsible for discovery until the middle of the 20th century. Surface prospecting has been successful because, over time, it builds a dense spatial coverage of critical observations. If combined with an understanding of geologic processes—for example, the physical and chemical processes that disperse gold in the surface environment—these observations allow prospectors to make a series of judgments that will take them progressively closer to mineralization. The key components of the prospecting approach are that (1) the critical, "explorable" aspects of the mineral system are understood, (2) the critical aspects of the system can be uniquely observed and measured (i.e., without reliance on proxies), (3) a sufficient density of observations of those critical aspects can be made to enable the system to be mapped, and (4) there is a mappable pattern within the system such as will allow vectoring toward specific targets within the system.

The emphasis on observing, measuring, and mapping the mineral system is paramount. The challenge of deep exploration is how to cost-effectively acquire a sufficient density of observations from within the deep exploration search space. Deep sampling requires drilling. Dense sampling requires that we drill often. This simple statement lies at the heart of the Deep Exploration Technologies Cooperative Research Centre (DET CRC) research strategy.

NEW TECHNOLOGY WILL PROVIDE THE SOLUTION

An analogous challenge of exploration beneath deep, barren cover was successfully tackled by the petroleum industry in the Gulf of Mexico. In 1961 there were only 80 million barrels of oil reserves recognized in the Gulf of Mexico, with little exploration activity, and the area was considered too mature for future discoveries (Appenzeller, 2004). Increasing water depth was a significant obstacle to drilling offshore, and a layer of salt precluded effective seismic exploration. By 2001, in large part due to technological developments such as subsalt seismic imaging, logging while drilling, and deep offshore (e.g., riserless) drilling, and with significant production in the interim, 1.45 billion barrels of oil reserves were recognized beneath deep offshore waters in the Gulf of Mexico. By 2010 the cumulative reserves discovered in the Gulf of Mexico were approaching 20 billion barrels of oil (PFC Energy, 2011), with exploration drilling success rates of ~50%, compared with ~25% in the 1970s and 1980s (Alfaro et al., 2007).

We contend that mineral exploration beneath cover requires a similar paradigm shift that will allow us to break free of the limitations imposed on current exploration practices by existing technology (i.e., targets inferred from proxies in relatively few geophysical datasets, expensive and sparse drilling—commonly one drill hole per target, chemistry conducted off-site long after drilling, and limited deployment for downhole wireline geophysics). The breakthrough technologies required will facilitate cost-effective, systematic sampling and imaging of the deep exploration search space beneath barren cover, in a manner similar to the prospecting style of exploration for mineral deposits with a surface expression.

At the heart of the deep exploration challenge is the necessity to systematically sample and analyze materials from the deep exploration search space. In order to do so, we must drill and we must drill often.

THE DEEP EXPLORATION TECHNOLOGIES COOPERATIVE RESEARCH CENTRE

The Deep Exploration Technologies Cooperative Research Centre has been established in order to bring together the diverse research, engineering, and operational expertise required to develop and implement these breakthrough technologies.

DET CRC arose through an industry-driven consultative process, via AMIRA International's Drilling Technology Roadmap, and was established in 2010 under the Australian government's CRC program. The CRC program provides funding to build critical mass in research ventures between end users and researchers to deliver significant benefits across Australia. There are approximately 40 CRCs in Australia, all established to address major challenges that require medium- to long-term collaborative efforts.

With $AUS120M of cash and in-kind funding from the Commonwealth Government of Australia and its participants, DET CRC is the world's best-supported independent research initiative in mineral exploration. DET CRC is managing an eight-year program funded by $28M cash from the Commonwealth Government, $27M cash (and $15M in-kind) from Industry Participants, and $50M in-kind from its research providers. Major partners include CSIRO, the University of Adelaide, Curtin University, Anglo American, Barrick, BHP Billiton, Boart Longyear, Goldfields, Imdex, Newcrest, Vale, and the South Australian government. These groups are joined by more than 30 affiliate partners, including small to medium explorers, minerals industry service providers, and government survey organizations. DET CRC's head office is located in the Boart Longyear Asia Pacific headquarters in Adelaide.

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COILED TUBING DRILLING

At the heart of the deep exploration challenge is the necessity to systematically sample and analyze materials from the deep exploration search space. In order to do so, we must drill and we must drill often. Thus, new drilling techniques are required that will significantly improve the cost efficiencies of deep drilling, while maintaining the highest standards in terms of safety and environmental impact. DET CRC's flagship project is the development of coiled tubing (CT) drilling for mineral exploration.

CT drilling rigs employ a continuous coil of drill string, which is wound from a spool while drilling and wound back onto the spool as the drill string is recovered from the hole, as opposed to drill rods, which must be connected and disconnected multiple times during the drilling process. This leads to improvements in

- cost efficiency (no rod changes—therefore, the bit is drilling a higher proportion of the time),
- safety (manual handling of drill rods is responsible for >50% of injuries in mineral exploration),
- environmental impact (smaller drill pad, fewer vehicles, rapid mobilization, and potentially fully enclosed fluid systems), and
- hole stability (no pressure variations during rod changes).

CT drilling rigs are now commonly used in coal seam gas exploration. In the Alberta gas fields, CT drilling has been able to handle up to two vertical 1,000-m wells per day, with 2- to 3-h move-in and rig-up times and penetration rates of up to 100 m/h (U.S. Department of Energy, National Energy Technology Laboratory, 2005). These drilling rates have been achieved in the context of well-characterized and relatively unconsolidated cover materials, which will rarely be the case in deep mineral exploration drilling. However, they provide a glimpse of what the future of minerals exploration drilling may hold if we can overcome the challenge of transferring CT drilling technology to hard rock environments.

DET CRC has set an ambitious target: to develop a greenfields exploration CT drilling rig, weighing less than 10 tonnes and able to drill 500-m holes at a cost of less than $50 per meter. We have recently launched the DET CRC CT drilling rig that will serve as a research platform as we develop, modify, and optimize CT drilling technology for deep mineral exploration purposes (Figure 1). The key technical challenges involved are well defined, namely, we must

- maximize coil durability (minimize fatiguing of the coil due to the winding and unwinding process),
- maximize penetration rates in hard rocks, within the constraints of low weight-on-bit (WOB) drilling,
- return a high-quality, representative sample from a measurable depth interval, and
- maintain the highest possible safety and environmental standards.

We have recently allocated $6M in cash to this work, building on $2M already spent. In addition to buying the CT drilling rig, DET CRC has commissioned a number of state-of-the-art experimental facilities, including the following:

- pultrusion equipment at Teakle Composites in Brisbane for manufacturing coiled tubing from a range of innovative composite materials,
- coiled tubing fatigue testing equipment at Curtin University to investigate the fatiguing of different coiled tubing materials,
- low WOB downhole motor and drill bit testing facility at Boart Longyear Asia-Pacific Headquarters in Adelaide to test low WOB techniques for hard rock drilling, and
- drill cuttings flow loop at Curtin University to model the return of rock cuttings by the CT rig.

Brief videos providing more information on the above can be seen on DET CRC's YouTube channel: www.youtube.com/DETCRCTV.

DET CRC has set an ambitious target: to develop a greenfields exploration CT drilling rig, weighing less than 10 tonnes and able to drill 500-m holes at a cost of less than $50 per meter.

REDUCING OUR RELIANCE ON CORE: DOWNHOLE AND LAB-AT-RIG™ SENSING

The purpose of drilling is to allow direct analysis of a volume of rock at depth, either by returning a sample to the surface or by creating access for downhole logging tools. Just as in the revolution in petroleum exploration in the Gulf of Mexico, new mineral exploration drilling techniques will need to be accompanied by complementary new logging and sensing techniques.

DET CRC believes that mineral exploration productivity can be greatly improved by rethinking the current drilling, sampling, and analytical workflow and developing technologies that allow the process to be largely carried out on-site in near real time. An important aspect of this will be a reduced reliance on recovering sample in the form of drill core. This will deliver immediate time and cost savings by removing the necessity to prepare core and ship it off-site for analyses, and will facilitate the use of different drilling techniques such as downhole motors (important for CT drilling and more efficient than top-of-hole rotation) and multilateral holes. While we recognize the value of drill core for the observation of key geologic information (rock type, mineralogy, texture, structure), we contend that much of these qualitative observations can be replaced by quantitative information, in the form of real-time geochemistry, mineralogy, and petrophysical data combined with in-hole imaging. The key is to develop real-time, at-site analytical techniques to a level of confidence that is comparable or exceeds current practice from core in terms of reliability, representativity, and reproducibility. We note that the majority of uranium reserve statements are made without reference to drill core or to laboratory-based geochemistry because the rock physics permits reliable downhole measurements with existing technology. Drill core will remain an important component of the exploration process; however, we envisage fewer cored holes drilled later in the exploration cycle in order to test specific geologic hypotheses or to calibrate real-time analytical data against observations.

DET CRC has established research programs aimed at developing at-site, near real-time analytical techniques to complement mineral exploration CT drilling technology. These include both

downhole and top-of-hole techniques, as follows:

1. We have built and trialed an autonomous sonde (Figure 2), which is pumped down inside the drill rods at the completion of drilling with the purpose of logging the hole while the rods are being pulled. The autonomous sonde provides a platform onto which a range of sensors can be mounted to provide wireline-type information without the need for separate wireline mobilization. This will reduce the cost of logging, return logging results to the explorer as soon as the hole is completed, and minimize the risk of hole collapse prior to logging. To date, the autonomous sonde includes hole orientation and natural gamma sensors; additional sensors are being added.
2. We have built and trialed a downhole geochemical tool, based on prompt-gamma neutron activation analysis (PGNAA) technology.
3. We have conducted the world's first mineral exploration drilling with a carbon fiber drill rod and have embedded sensors in that drill rod, an important step toward the goal of downhole real-time logging while drilling.
4. We have established a research partnership with Imdex and Olympus

FIGURE 2. Gordon Stewart (l) and Brett Wilkinson (r) from DET CRC affiliate Globaltech with the autonomous sonde.

in order to design and build a Lab-at-Rig™ sampling and analytical platform capable of producing near real-time geochemical and mineralogical data from drill cuttings collected at the top of the hole. Initially, we will develop a Lab-at-Rig™ system suitable to retrofit on current drilling platforms; however, the final aim will be a system capable of analyzing cuttings generated by the mineral exploration CT drilling rig. In order to be useful, the Lab-at-Rig™ system must deliver analyses that are representative of the rock mass being drilled and with detection limits required to distinguish rock types, alteration halos, and various types of mineralization (ultimately at a level of confidence sufficient for professional sign-off in JORC compliance). Preliminary results have provided proof of concept that important components of our strategy, in particular depth fidelity and representativity of the sample, can be achieved (Figure 3).

REAL ROCKS, REAL CHALLENGES

A key aspect of DET CRC's plan is to design, build, and test technologies that are capable of performing in the challenging real-world environment of mineral exploration. The technologies must be robust, hard wearing, and capable of achieving the level of performance (for example, sample quality and analytical

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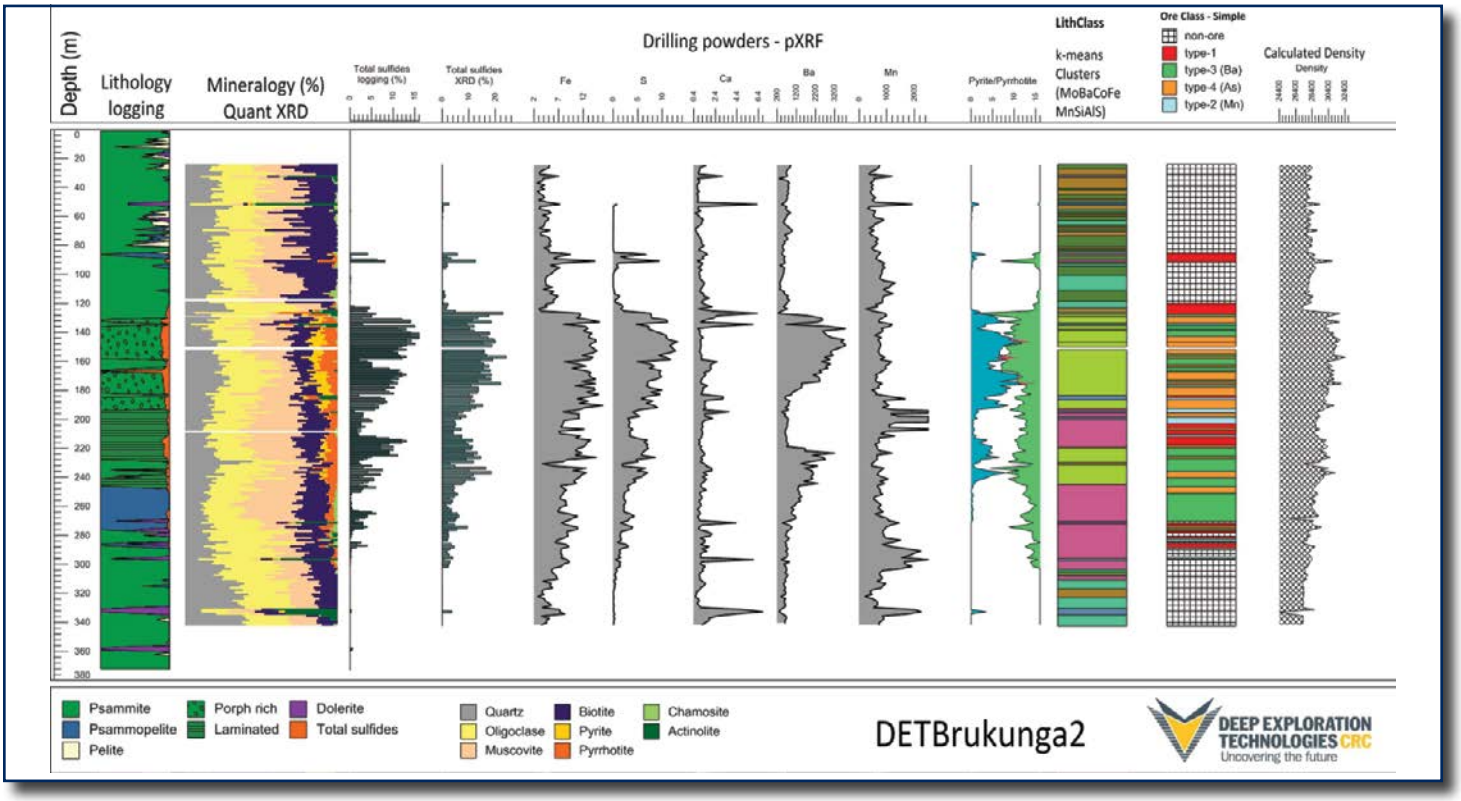

FIGURE 3. Preliminary results of real-time, on-site geochemical and mineralogical analyses of the type that will be produced by DET CRC's Lab-at-Rig system. Data are from DET Brukunga 2.

. . . from page 25 Deep Exploration Technologies Provide the Pathway to Deep Discovery *(continued)*

FIGURE 4. Boart Longyear drilling rigs and experimental apparatus, including Imdex solids recovery unit, at the Brukunga Drilling Research and Training Facility.

sensitivity) that is required for mineral exploration. To this end, DET CRC is employing a dual strategy, engaging in a number of case studies with our industry and research partners, and also establishing the Brukunga Drilling Research and Training Facility in the Adelaide Hills (Figure 4).

The Brukunga Drilling Research and Training Facility is co-located with the South Australian Country Fire Service training facility at a disused iron sulfide mine at Brukunga, about 40 km southeast of Adelaide. The sulfide horizon at Brukunga provides an excellent generic mineral exploration target for research purposes, being mineralogically distinct, geochemically anomalous, and providing a significant contrast from its host rocks in a range of physical properties. Brukunga provides a well-controlled drilling environment where DET CRC researchers can test new technologies, free from the pressures of an operating mine site. To date, DET CRC has drilled two HQ diamond research drill holes (DET Brukunga 1 and DET Brukunga 2, totaling ~700 m) and an RC hole (138 m) into the sulfide horizon at Brukunga. These holes have been the subject of extensive testing, in terms of both the operational components of the drilling platform (for example, rig performance monitoring) and the development of novel downhole and Lab-at-Rig™ sampling and analytical technologies. A key to the success of these tests is that new technologies can be readily benchmarked against existing technologies and against drill core recovered from the same hole. Our first drill hole, DET Brukunga 1, may be the most thoroughly analyzed drill hole on the Australian continent.

Following initial successful testing at Brukunga, DET CRC is currently involved in discussions for the first field deployments of its downhole and Lab-at-Rig™ sensing technologies to take place in collaboration with regional drilling by Geoscience Australia and the State Geological Surveys.

In collaboration with our industry and research partners, DET CRC has also established a number of case study localities, including operating mine sites (Telfer, Kambalda, and Beverley), exploration prospects (Yorke Peninsula iron oxide copper-gold and Nevada Carlin-style gold), and province-scale prospective regions (the eastern Gawler craton). Our largest case study, the eastern Gawler craton, being conducted in collaboration with the South Australian Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE), provides us an opportunity to test DET CRC's technologies and prospecting under cover philosophy at a regional scale. This includes defining the scale and characteristics of a crustal-scale hypogene mineralizing system (Figure 5), tracking dispersion of the components of that system within cover rocks, and determining the most appropriate exploration workflow to enable discovery within that system. Perhaps the most important aspect of this work is defining the elements, minerals, and petrophysical characteristics that can be used to map the system over a range of scales at varying levels of sensitivity, so as to enable vectoring toward mineralization in multiple drill holes. Our work on the Gawler craton indicates that critical aspects of hypogene alteration and dispersion halos within cover rocks can be recognized at 10s of kilometers from the sites of mineralization within mineral systems that can be mapped at

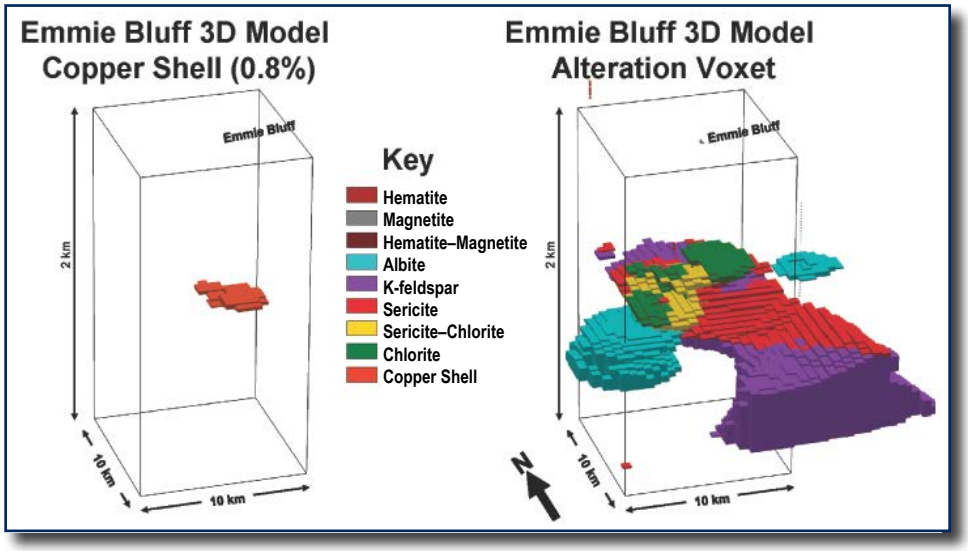

FIGURE 5. Three-dimensional kilometric alteration halo associated with the Emmie Bluff mineralizing system on the central eastern Gawler craton. The alteration system (right) can be recognized and mapped at a scale many times larger than the copper mineralization (left).

the province scale. These data provide important guidelines for the development of drilling, sampling, and analytical protocols within our research program and will ultimately provide a test case for the deployment of DET CRC technologies.

Underpinned by well-informed geologic reasoning, low-cost and rapid CT drilling technology combined with near real-time downhole and Lab-at-Rig™ sensing will reengineer the exploration workflow in challenging deep cover environments such as the eastern Gawler craton. We envisage a return to a prospecting style of exploration, whereby systematic sampling at sufficient density allows explorers to map the mineralizing system, building confidence and vectoring toward ore through the exploration cycle, rather than risking significant expenditure on a few wildcat drill holes.

COMMERCIALIZATION—THE MEASURE OF SUCCESS

In order to successfully impact the business of mineral exploration, the technologies developed by DET CRC will need to be brought to market. Although DET CRC is co-funded by mining companies, those companies do not seek to own the intellectual property (IP) generated by our research. Nor is it our intention for DET CRC or its research partners to generate spin-off companies to commercialize our IP. Instead, we seek to bring our IP rapidly to market via licensing agreements with existing service companies with appropriate technical and commercial expertise. An important aspect of DET CRC is that a range of mineral industry service provider companies are incorporated into our structure as major partners or affiliates, engaged in the research process and ready to take advantage of commercialization opportunities as they arise. Discussions are already underway with two DET CRC service provider participants (Boart Longyear and Imdex) regarding early commercializable outcomes.

CONCLUSION

Cheaper, faster, safer, and more environmentally friendly CT drilling, combined with downhole and Lab-at-Rig™ sensing technologies developed by DET CRC, has the potential to revolutionize mineral exploration, driving investment and increasing rates of discovery under deep, barren cover. These discoveries will provide the pipeline of new projects required to secure Australia's mining future.

ACKNOWLEDGMENTS

We gratefully acknowledge funding and support provided by the Australian Government's Cooperative Research Centre Programme and our major industry partners Anglo American, Barrick, BHP Billiton, Boart Longyear, Goldfields, Imdex, Newcrest, Vale, and the Government of South Australia. Our thanks to Antonio Arribas and Jon Coates, who provided helpful reviews of this contribution.

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Regional VP Lecturer Arndt at Leicester

Nicholas T. Arndt, the SEG 2013 Regional Vice President Lecturer, gave a class at the University of Leicester, UK, on November 23, 2013. In addition to offering a lecture accompanied by a slide presentation, Nick had students participate in hands-on exercises. The students, in turn, took the opportunity to share their findings.

In this group photo, Nick, in a sports jacket, is front and center.

Students enjoyed taking part in a hands-on session.

Here, Nick peers over the shoulder of a student engaged in micro-activity.

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  - Drill Core Sampling, Mineralogy and Geometallurgy in support of Resource Estimation – *June 25 - 27, 2014*
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- Geostatistics and Resource Estimation – *November 2014*

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Kyushu Volcanoes, Geothermal Systems, and Ore Deposits

JEFFREY HEDENQUIST (SEG 1986 F)

Professor Emeritus Eiji Izawa (SEG 1986 F), University of Kyushu, led a field trip of 15 participants at the end of November 2013 to visit active and extinct hydrothermal systems of Kyushu on the southern island of Japan. Trip organizers included Sachihiro Taguchi (SEG 1993 F), Professor, Fukuoka University; Tetsuya Nakanishi, Associate Professor, University of Kyushu Museum; and Jeffrey Hedenquist, Ottawa. The week included examination of geothermal systems and active volcanoes of Kyushu, plus an underground tour of Hishikari and Kushikino epithermal veins, and review of open pits at the three Nansatsu high-sulfidation deposits.

The group also enjoyed many cultural highlights, such as the 300-year-old pottery village of Onta, where all raw materials, worked by the many generations of 10 family businesses, come from the local hills (clay, water power to crush the rocks, pigments, and wood for firing), a tour of a mountain-top Buddhist temple that was initiated nearly 1,400 years ago, and sampled rotenburo (outdoor hot-spring baths) associated with the young volcanism. People were also drenched with SO_2 ejected from the crater of Aso, and witnessed ash eruptions from Sakurajima volcano. Most of the members contributed to evening presentations on ore deposits of Kyushu and around the world.

Half the participants were exploration geologists based in Chile, Brazil, the United States, and Japan; they were joined by two young professionals from GSJ and JOGMEC in Japan and two economic geology students from Kyushu and Akita universities. Future trips for geologists from industry plus young Japanese economic geologists are contemplated, to include the geothermal systems and historic Kuroko district of northern Honshu, and the ore deposits and volcanoes of Hokkaido. Tentative expressions of interest may be made to Jeffrey Hedenquist.

A group photo presents an interesting perspective on the active steam-heated alteration at Hatchobaru geothermal system.

Sakurajima volcano, southern Kyushu, in eruption. Front, left to right: co-leaders Sachihiro Taguchi and Tetsuya Nakanishi, Mihoko Hoshino (SEG 2010), Stephanie Saing (SEG 2014 S), Jeffrey Hedenquist. Back row: Masanori Yamamoto, Brian Thomson (SEG 1993 F), Kazuhiro Yonemuro (SEG 2014), Gustavo Rodriguez (SEG 2004 F), Rick Brown (SEG 2004), Eric Roth (SEG 2009), leader Eiji Izawa (SEG 1986 F), Fletcher Bourke (SEG 2005), Jack Pritting (SEG 2002), Tony Longo (SEG 2003).

Field trip participants relax over dinner after a long chilly day in the field, following a soak in the hot spring bath at Sanga Ryokan, Kurokawa.

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SEG NEWS

The 8th Ore Deposit Models and Exploration Workshop

Hefei University of Technology Geological Society of Anhui, China
Hefei, December 9–15, 2013

Taofa Zhou[1] (SEG 2011 F), Fan Yu,[1] and Steven D. Scott[2] (SEG 1974 F)

[1]Ore Deposit and Exploration Centre, Hefei University of Technology (ODEC), Hefei 230009, China
[2]Department of Earth Sciences, University of Toronto, Toronto, Canada M5S 3B1

Ore Deposits Models and Exploration, the second workshop on the topic given in 2013 and number 8 in the continuing series in China, was held with remarkable success December 9–15 in the Conference Centre of Hefei University of Technology in Hefei. The workshop was co-sponsored by Hefei University of Technology; Geological Society of Anhui, China; Society of Economic Geologists (SEG); Society for Geology Applied to Mineral Deposits (SGA); Bureau of Geology and Mineral Exploration of Anhui Province, China; Public Geological Survey Management Center of the Department of Land and Resources of Anhui Province, China; Ore Deposit and Exploration Centre, Hefei University of Technology (ODEC); and National Natural Science Foundation of China (NSFC). The organizing committee was led by Professors Steve Scott, Noel White, and Taofa Zhou.

The instructors of this workshop were Steven Scott, from the University of Toronto, Canada; Richard Goldfarb, from the U.S. Geological Survey in Denver, USA; Dave Leach, a consultant formerly from the U.S. Geological Survey in Denver, USA; David Cooke, from the University of Tasmania in Hobart, Australia; Chusi Li, from Indiana University in Bloomington, USA; Noel White, from Hefei University of Technology, China; Kaihui Yang, from Zijin Mining Group Company Limited, China; Zhaoshan Chang, from James Cook University, Australia; and Huayong Chen, from the Guangzhou Institute of Geochemistry, CAS, China. Joan Scott organized the laboratory sessions and took care of logistics. Lectures were given in English with sequential translation in Chinese and all slides were bilingual. A special session on Chinese deposits by eight Chinese scholars (Jingwen Mao, Zenqian Hou, Yanjing Chen, Jinawei Li, Yuling Xie, Shaoyong Jiang, Xieyan Song, and Taofa Zhou) was given on the last day.

Opening ceremony of the workshop with (left to right) Taofa Zhou, Director of the Ore Deposit and Exploration Centre, Hefei University of Technology; Xuewen Li, Director of the Geological Society of Anhui Province and Director of the Bureau of Geology and Mineral Exploration of Anhui Province; Congwei Xu, President of Hefei University of Technology; Steven Scott, University of Toronto; and Noel White, Hefei University of Technology.

The workshop covered a wide range of ore deposit types and topics, including volcanic-hosted massive sulfides (Steve Scott), Pb-Zn deposits in sediments (Dave Leach), BIF and other types of iron deposits (Noel White), porphyry and epithermal deposits (David Cooke), skarns (Zhaoshan Chang), orogenic

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gold deposits (Rich Goldfarb), magmatic Ni-Cu sulfide deposits (Chusi Li), iron oxide Cu-Au deposits (Huayong Chen), the importance and application of ore deposits models to exploration (Noel White), and implications for exploration and mineral potential in China (Kaihui Yang). The workshop featured a daily two-hour lab session with more than 500 representative samples as well as maps/sections/photos from typical well-known ore districts world-wide.

This workshop attracted more than 350 participants, demonstrating the continuing strong interest in China for such a presentation. Typically, the workshop attracts 250 to 300. About 200 participants in the Hefei workshop were explorers from geological surveys and mining companies. More than 150 were young researchers and students from 15 major Chinese universities across the country, researchers from institutes of both the Chinese Academy of Sciences and the Chinese Academy of Geological Sciences. Five participants were from Australia and the USA. As in previous workshops, the instructors appreciated very much the enthusiasm shown at the lectures and in the labs. The instructors were constantly surrounded, answering questions, discussing exploration/research issues, and giving advice to the students.

The next workshop, number 9 in the series, will be held November 9–14, 2014, in Fuzhou, Fujian Province. For information, contact in English or in Chinese Qianjie ("Jay") Wang, Director of Overseas Exploration Group for Jijin Mining Group, e-mail wang_quianjie@zjky.cn, telephone +86 592 293 3619.

Participants in the workshop in front of the Conference Center of Hefei University of Technology. Instructors, starting in the center front, from left: Steve Scott (in red sweater), Noel White, Dave Leach, David Cooke, Joan Scott, Chusi Li, Zhaoshan Chang, and Huayong Chen. Missing are Rich Goldfarb and Kaihui Yang.

Dave Leach lectures on lead-zinc ores in sediments in the spacious center.

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Early Registration (opens April 1) (Ends August 1, 2014)		**Late Registration** (August 2 – September 19, 2014)		**On-site Registration** (On or after September 20, 2014)	
Members	US$625	Members	US$725	Members	US$825
Non-members	US$725	Non-members	US$825	Non-members	US$925
Student Members	US$195	Student Members	US$245	Student Members	US$295
Student Non-members	US$245	Student Non-members	US$295	Student Non-members	US$345

PRELIMINARY TECHNICAL PROGRAM

INVITED KEYNOTES

Theme 1. Fundamental Advances in Economic Geology

- **Massimo Chiaradia***; coauthors U. Schaltegger and R. Spikings, Timescales of mineral systems – What have we learned in the past decade?
- **Robert Hazen***; coauthors X. Liu, R.T. Downs, J. Golden, E.S. Grew, G. Hystad, C. Estrada, and D.A. Sverjensky, Mineral evolution: Episodic metallogenesis, the supercontinent cycle, and the co-evolving geosphere and biosphere
- **Clinton Scott***; coauthors J.F. Slack and K.D. Kelley, The role of geobiology on the metallogenesis of sediment-hosted mineral deposits
- **Philipp Weis***; The physical hydrology of ore-forming magmatic-hydrothermal systems

Theme 2. Deposit Footprints

- **Ravi Anand***; coauthors M. Lintern, R. Noble, M. Aspandiar, C. MacFarlane, R. Hough, A. Stewart, S. Wakelin, B. Townley, and N. Reid, Geochemical dispersion through transported cover in regolith-dominated terrains – Towards understanding the process
- **David Cooke***; coauthors M. Baker, P. Hollings, G. Sweet, Z. Chang, L. Danyushevsky, S. Gilbert, T. Zhou, N. White, J.B. Gemmell, and S. Inglis, New advances in detecting the distal geochemical footprints of porphyry systems – Epidote mineral chemistry as a tool for vectoring and fertility assessments.
- **Anthony Williams-Jones***; coauthor A.A. Migdisov, Experimental constraints on the transport and deposition of metals in ore-forming hydrothermal systems
- **Ken Witherly***; Geophysical expressions of ore systems, not deposits – Our current understanding [Also presenting a post-conference workshop. See p. 35 for details]

Theme 3. Mineral System Science

- **Hartwig Frimmel***; A Giant Mesoarchean crustal gold-enrichment episode: Possible causes and consequences for exploration
- **T. Campbell McCuaig***; coauthor J.M.A. Hronsky, The mineral system concept: Key to exploration targeting under cover
- **John Miller**; coauthors T.C. McCuaig and M. Jessell, West Africa – Integrated mapping of a mineral system at subcontinental scale
- **John Muntean**; coauthor J. Cline, The Carlin gold system: Applications to exploration in Nevada and elsewhere

Theme 4. Innovations in Exploration Technology

- **Paul Agnew**, Micro-analytical innovation for diamonds exploration and beyond
- **Doug Bryman***; coauthors J. Bueno, K. Davis, V. Kaminski, Z. Liu, D. Oldenburg, M. Pilkington, and R. Sawyer, Muon Geotomography – Bringing new physics to ore-body imaging
- **Richard Hillis***; coauthors A. Baensch, J.S. Cleverley, D. Giles, S.W. Halley, B.D. Harris, S.M. Hill, P.A. Kanck, S.P. Soe, and G. Stewart, Coiled tubing drilling and real-time sensing – Enabling "prospecting drilling" in the 21st Century? [Also presenting a pre-conference workshop. See p. 34 for details]
- **Mark Jessell***; coauthors L. Aillères, E. de Kemp, M. Lindsay, F. Wellmann, M. Hillier, G. Laurent, T. Carmichael, R. Martin, Next generation 3D geological modelling and inversion

Theme 5. Exploration Management and Targeting

- **Randall Oliphant**, Executive Chairman, New Gold; What does the global exploration industry need to deliver in the 21st Century? – A shareholder's perspective
- **Richard Schodde**; The global shift to undercover exploration – How fast? How effective?
- **John Sykes***; coauthor A. Trench, Finding the copper mine of the 21st Century: Conceptual exploration targeting for hypothetical copper reserves
- **Kaihui Yang**; Mineral exploration industry in China

Theme 6. Case Studies of 21st Century Exploration Success

- **Graham Brown***; Anglo American Exploration – Key ingredients to a decade of success
- **David Broughton**; coauthors D. Kirwin, W. Hayden, and R.E. Flood, The Ivanhoe Group – Two decades of global discoveries
- **Mark Bennett***; coauthors M. Gollan, M. Staubmann, and J. Bartlett, Motive, means, and opportunity: Key factors in the discovery of the Nova-Bollinger magmatic Ni-Cu sulfide deposits of Western Australia

Student Mentoring Forum
Saturday, September 27, 2014

SEG Awards Presentations
Monday, September 29, 2014 (Included in technical program)

SEG Industry Outlook Dinner

Monday, September 29, 2014

Dinner Guest Speaker: **Robert M. Friedland**, Executive Chairman and Founder, Ivanhoe Mines Ltd.

Talk Title — "Urbanization and industrialization: strategies for some of this century's greatest human challenges presents opportunities for new exploration thinking and discoveries in Africa's mineral fields."

*Invited talks to be published as part of SEG Special Publication No. 18 (available at a discounted price when you register).

SEG NEWS

WORKSHOPS

The number of places available is limited for the following events. Preference will be given to SEG 2014 Conference registrants.

ADVANCED GIS TECHNIQUES – MAXIMIZING YOUR DATA

September 27, 2014
Pre-Conference Workshop
(Keystone Conference Center, Keystone, Colorado, USA)

Organizer:
- Willy Lynch (SEG 1993), Esri

Presenters:
- Willy Lynch (SEG 1993), Esri
- Mike Price, President, Natural Resources & Public Safety GIS Specialist

Description:

This one-day workshop will focus on intermediate to advanced GIS workflow solutions for mining and exploration. Specific topics will include data management, data analysis (2D & 3D), mobile GIS and online GIS.

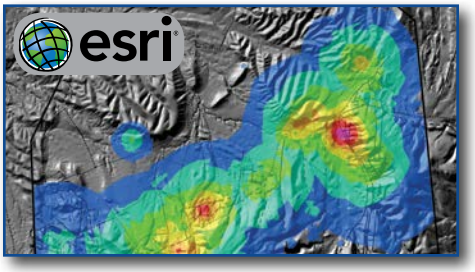
The morning will concentrate on best practices for effective data management, visualization and analysis of geology, geochemistry, geophysical and drill data in 2D & 3D. Out-of-the-box solutions from Esri and a brief summary of key business partner solutions will be reviewed and demonstrated. The afternoon will review mobile GIS options (Esri ArcPad & ArcGIS for windows mobile, smart phones and tablets) and an introduction to online GIS.

Attendees are encouraged to bring their own hardware (laptops, tablets, smart phones) and GIS software/licenses (ArcGIS for Desktop with 3D analyst extension, ArcPad, ArcGIS for Windows Mobile, ArcGIS & Collector for smart phones and tablets) and can actively participate or just observe.

Attendee Maximum: 30

Early Registration:
Members (US$395), Non-members (US$495), Student Members (US$195), Student Non-members (US$245)

Late Registration:
Members (US$495), Non-members (US$595), Student Members (US$245), Student Non-members (US$295)



APPLICATION OF MULTI-ELEMENT GEOCHEMICAL DATA: EXPLORING DATASETS FOR BETTER TARGETING AND DOMAINING

September 27, 2014
Pre-Conference Workshop
(Keystone Conference Center, Keystone, Colorado, USA)

Organizer:
- Lynda Bloom, President, Analytical Solutions Ltd.

Presenters:
- Lynda Bloom, President, Analytical Solutions Ltd.
- Pim van Geffen, Senior Geochemist, Imdex Limited
- Gervais Perron, Director of Software, Mira Geoscience
- Peter Winterburn, ACME Industrial Research Chair in Exploration Geochemistry, UBC
- Chris Benn, Benn Consulting
- Juan Carlos Ordóñez, Exploration Geochemist, Hudbay Minerals
- Réjean Girard, Géologist and President, IOS Geoscientific Services

Description:

As we seek deeper buried ore deposits, any surface techniques are subject to the "truth test"—a drill hole. Drilling is costly and deep targets are easy to miss or expensive to evaluate. Maximizing the use of all available data is essential to optimizing drill hole placement and stretching budgets.

Since the 1990s, there has been an explosion of commercially available analytical options and geochemical packages for 40 to 60 elements. This provides an opportunity to use relatively inexpensive geochemical data to improve rock classification, vector to mineralization, or identify metallurgical domains.

The caveat is that geochemical data need to be well managed and data quality needs to be "fit for purpose." The course will emphasize case histories that demonstrate visualization techniques for multi-element data and the importance of understanding the risks associated with using inappropriate data or statistical methods.

Attendee Maximum: 40

Early Registration:
Members (US$395), Non-members (US$495), Student Members (US$195), Student Non-members (US$245)

Late Registration:
Members (US$495), Non-members (US$595), Student Members (US$245), Student Non-members (US$295)

FUTURE OF MINERAL EXPLORATION DRILLING & SAMPLING

September 27, 2014
Pre-Conference Workshop
(Keystone Conference Center, Keystone, Colorado, USA)

Presenters:
- James S. Cleverley (SEG 2002), Principal Geochemist at CSIRO & Deep Exploration Technologies CRC, Perth, W. Australia
- Richard Hillis, CEO, Deep Exploration Technologies CRC, Perth, W. Australia

Description:

This one-day workshop will provide exploration geologists and researchers with a background to the current challenges of undercover exploration and the new drilling and sampling technology being developed in the Deep Exploration Technologies Cooperative Research Centre (DET CRC) that will drive change in our exploration industry in the next 10 years. The workshop will provide a state-of-the-art synopsis of drilling for non-drillers followed by an exploration of three developing technology pillars: the drill rig, real-time downhole sensing and real-time top-of-hole sensing. The workshop will provide a mix of presentations, practical demonstrations and discussions led by geologists, engineers, geochemists and application specialists. We aim to demonstrate how geologists will be applying these new technologies in the future and how technology will be providing support to exploration targeting and decision making.

The DET CRC is an 8-year, $115M, Australian research cooperative with partnerships between the mining industry, MET sector and research providers to develop new technology in minerals exploration drilling. The core purpose of the DET CRC is to develop transformational technologies

WORKSHOPS

for successful mineral exploration through deep, barren cover rocks to be utilized and commercialized by the mineral exploration industry.

Attendee Maximum: 40

Early Registration:
Members (US$395), Non-members (US$495), Student Members (US$195), Student Non-members (US$245)

Late Registration:
Members (US$495), Non-members (US$595), Student Members (US$245), Student Non-members (US$295)

EXPLORATION IN 2025: THE TOOLS AND TECHNIQUES TO EXPLORE UNDER COVER

October 1–2, 2014
Post-Conference Workshop
(Colorado School of Mines, Golden, Colorado, USA*)

Organizer:

- Ken E. Witherly (SEG 2008), Condor Consulting, Inc.

Presenters:

- Neil Williams (SEG 1982 FL), Hon. Professorial Fellow, Univ. of Wollongong
- John R. Holliday (SEG 2004), Holliday Geoscience
- Thomas Bissig (SEG 2002 F), MDRU, University of British Columbia
- Jon A. Woodhead (SEG 2012), Condor Consulting, Inc.
- Peter L. Kowalczyk (SEG 2011), Geoscience BC
- Dianne E. Mitchinson, Mira Geoscience
- James S. Cleverley (SEG 2002), Principal Geochemist at CSIRO

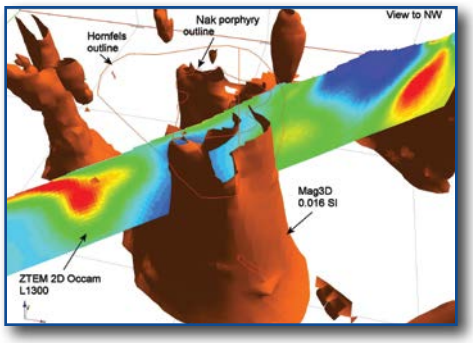
Student Coordinator:

- Douglas T. (Ty) Conner (SEG 2013), Colorado School of Mines

Description:

Exploration continues to face challenges related to identifying and defining targets beneath cover. New strategies and tactics related to area selection, technology selection, target definition, and data collection, management, and interpretation are required to improve probability of success and help our industry meet future demands for metals.

The two-day workshop will focus on the challenges and approaches to exploring under cover on day one and then work on a practical exercise using data from the Quesnel Trough on day two. The workshop is designed to improve target selection and prioritization skills of exploration geoscientists and managers responsible for exploring through cover.



Attendee Maximum: 36

Early Registration:
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Late Registration:
Members (US$695), Non-members (US$795), Student Members (US$345), Student Non-members (US$395)

*Shuttle from Keystone, Colorado, to Golden, Colorado

GETTING MORE FROM DRILL CORE – AUTOMATED, SPECTRAL-BASED MINERAL AND TEXTURE MAPPING

October 1–2, 2014
Post-Conference Workshop
(Keystone Conference Center, Keystone, Colorado, USA)

Organizer:

- Brigette A. Martini (SEG 2014), VP Business Development, Corescan Pty Ltd, USA

Presenters:

- Brigette A. Martini (SEG 2014), VP Business Development, Corescan Pty Ltd, USA
- Ronell Carey (SEG 1993), Spectral Geologist with Corescan Pty Ltd, Australia
- Pending - representatives from Leapfrog, aQuire, and exploration companies

Description:

The logging of drill core, chips and other geological samples is one of the most important aspects of mineral exploration and development. No single expenditure costs more (in both money and time) than drilling and no single piece of data is more important than fundamental rock data (mineralogy and texture). As such, advances in the accuracy, automation and consistency of logging (both mineralogical and textural) of drilled rock material are of prime concern in today's mining industry. This workshop focuses on the newest, high resolution spectroscopic methods for obtaining consistent, accurate and objective mineralogy, geochemistry and texture of both drill core and chips. We'll discuss the current methodologies (including popular, portable, point-measurement systems) and their historical and existing application and then move on to discussion and demonstration of the newest generation of automated core imaging systems (combining reflectance spectroscopy, visual imagery and 3D laser profiling) as applied to contemporary exploration programs. Numerous deposit types and specific ore systems on several continents will be showcased. We'll delve deeply into the acquisition (preparation, scanning, analysis) and ultimate application, synthesis and cloud-based storage of these data including hands-on manipulation of real core imagery data via easy-to-use online software and database portals. Further modeling and synthesis of spectrally derived, quantitative mineral data will be demonstrated in familiar statistical and modeling software (e.g., Leapfrog, aQuire). While general datasets will be provided, all registered participants are encouraged to provide personal and/or company core samples at least two months prior to the class for scanning and analysis (included in class cost), thereby rendering class instruction and demonstrations more highly applicable to the attendees' current exploration programs.

Attendee Maximum: 40

Early Registration:
Members (US$595), Non-members (US$695), Student Members (US$295), Student Non-members (US$345)

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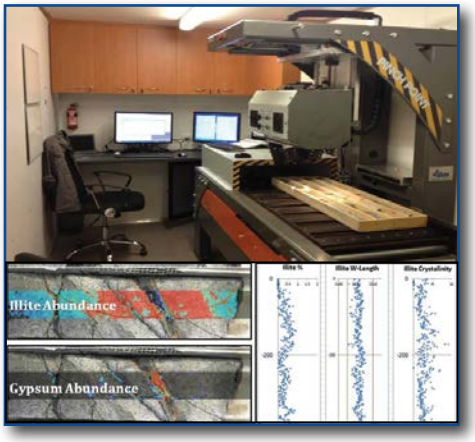
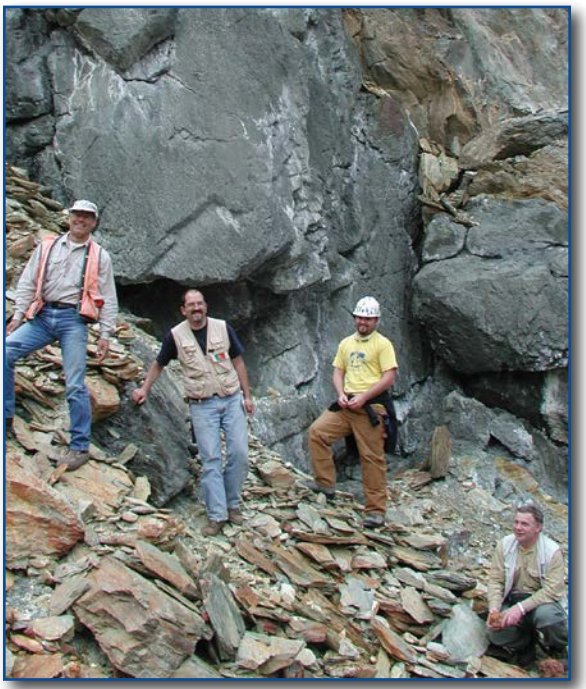


SEG NEWS

FIELD TRIPS

The number of places available is limited for the following events. Preference will be given to SEG 2014 Conference registrants.



Southwest USA

PORPHYRY AND SKARN SYSTEMS OF THE SOUTHWEST U.S.

September 21–26, 2014
Pre-Conference Field Trip

(Departs from Las Vegas, Nevada, USA and ends in Tucson, Arizona, USA)

Field Trip Leaders:

- William X. Chávez, Jr. (SEG 1990 F), Professor of Geological Engineering, New Mexico Institute of Mining and Technology, USA
- Erich U. Petersen (SEG 1986 F), Professor, University of Utah, USA

Description:

Beginning in Las Vegas, Nevada, this field-based course will examine the geologic settings and geochemical characteristics of large hydrothermal systems, with emphasis on porphyry, porphyry-related breccia "pipes," and skarn-style ore deposits. Starting in northwest Arizona, participants will visit porphyry systems showing well-developed supergene profiles and deeper, K-silicate assemblages characteristic of well-developed hydrothermal alteration-mineralization. Exposures in the Globe-Miami District and those near San Manuél, Arizona, offer the opportunity to examine early alteration-related veining styles and vein paragenesis assemblages. Skarn-type systems and their relationships to porphyry ores will be discussed at several ore deposits, allowing participants to compare and contrast porphyry and skarn geochemical features. Visits to key outcrops will reinforce discussions dealing with the importance of regional and local geologic settings for southwestern U.S. hydrothermal systems.

In-the-field and evening presentations will complement field observations and include discussions of the applications of activity and Eh-pH diagrams to exploration, mining, and geometallurgical considerations. As such, this course is designed for exploration and mining professionals who are involved with exploration and ore targeting; this course is also appropriate for graduate students and upper-division undergraduate students with interest in economic geology and the application of geochemistry to minerals exploration.

This course will be given in English and Spanish.

Anorthosite, MN

Attendee Maximum: 20

Early Registration:
Members (US$1,295), Non-members (US$1,395), Student Members (US$645), Student Non-members (US$695)

Late Registration:
Members (US$1,395), Non-members (US$1,495), Student Members (US$695), Student Non-members (US$745)

NON-FERROUS MINERALIZATION ASSOCIATED WITH THE WAWA-ABITIBI TERRANE AND DULUTH COMPLEX Cu-Ni-PGM DEPOSITS, NORTHEASTERN MINNESOTA

September 22–25, 2014
Pre-Conference Field Trip

(Field Trip departs from and returns to Duluth International Airport, MN, USA)

Field Trip Leaders:

- George Hudak (SEG 2011 F), Director, Minerals Division, NRRI, University of Minnesota, Duluth, MN, USA
- Dean Peterson, Senior Vice President – Exploration, Duluth Metals Limited, Duluth, MN, USA

Description:

After more than 100 years of iron mining, Minnesota is on the cusp of developing a new, non-ferrous mining industry. The world-class Duluth Complex mineral district ranks second in contained copper, third in contained nickel, and second in contained PGM (i.e., platinum, palladium, and gold) worldwide. Successful resource development has the potential to result in an entirely non-ferrous mining district that may be similar in scale to the region's existing taconite mining and processing industry. Additionally, recent studies indicate that Minnesota's Wawa-Abitibi Terrane may hold considerable potential for hosting additional non-ferrous and/or precious metals resources, including copper, zinc, and gold.

Attendee Maximum: 22

Early Registration:
Members (US$895), Non-members (US$995), Student Members (US$445), Student Non-members (US$495)

Late Registration:
Members (US$995), Non-members (US$1,095), Student Members (US$495), Student Non-members (US$545)

FIELD TRIPS

COLORADO PORPHYRY-MOLYBDENUM DEPOSITS AND LEADVILLE DISTRICT

September 25–27, 2014
Pre-Conference Field Trip

(Field Trip departs from and returns to Keystone Resort, Keystone, Colorado, USA*)

Climax

Field Trip Leaders:

- Ralph J. Stegen (SEG 1986), VP Exploration, Freeport-McMoRan, USA
- Tommy B. Thompson (SEG 1976 SF), Professor of Economic Geology, University of Nevada, Reno, USA

Field Trip Description:

From Keystone, Colorado, USA, visit the world-class porphyry Mo deposits at Climax and Henderson (Freeport-McMoRan Copper & Gold) and the carbonate-hosted Ag-Zn-Pb manto deposits at Leadville. These deposits have been the focus of leading research in porphyry Mo deposits and development of exploration methods. The Leadville district is noted for its long history of production, research on carbonate-hosted Ag-Zn-Pb-(Au) deposits, and the founding of the Guggenheim mining fortune, including the formation of ASARCO, Inc. The trip will include tours of the Climax and Henderson mines, with updates in geology of both, as well as numerous stops in the Leadville district.

Attendee Maximum: 28

Early Registration:
Members (US$595), Non-members (US$695), Student Members (US$245), Student Non-members (US$295)

Late Registration:
Members (US$695), Non-members (US$795), Student Members (US$295), Student Non-members (US$345)

*Two overnight stays in Keystone will be attendee's responsibility.

CRIPPLE CREEK & VICTOR GOLD MINE

September 26, 2014
Pre-Conference Field Trip

(Departs from and returns to Keystone, Colorado, USA)

Field Trip Leaders:

- Timothy R. Brown (SEG 2000), Exploration Manager, Cripple Creek & Victor Gold Mining Co., Colorado, USA
- Sergei A. Diakov (SEG 1993 F), Consultant, California, USA

Cripple Creek

Description:

From Keystone, visit the world's premier alkaline epithermal gold mine at Cripple Creek (Cripple Creek & Victor Mining Co.). The Cripple Creek diatreme complex has produced over 24 Moz gold, continues to produce approx. 250,000 oz Au per annum, and is not only a world-class gold district, but one of the defining examples of alkaline epithermal gold deposits. Field trip leaves from Keystone Resort at 7 am on September 26, returning the same evening. Registration does not include lodging.

Attendee Maximum: 50

Early Registration:
Members (US$195), Non-members (US$245), Student Members (US$95), Student Non-members (US$115)

Late Registration:
Members (US$245), Non-members (US$295), Student Members (US$115), Student Non-members (US$145)

THE VIBURNUM TREND: A WORLD-CLASS Pb-Zn-Cu MVT DISTRICT IN SE MISSOURI, USA

October 1–3, 2014
SEG 2014 Post-Conference Field Trip

(Field Trip departs from and returns to St. Louis Airport, Missouri, USA*)

Field Trip Leaders:

- Thomas G. Schott (SEG 1999 F), Senior Exploration Geologist, The Doe Run Company, Missouri, USA
- Anna A. Kutkiewicz (SEG 2013), The Doe Run Company, Missouri, USA
- Harrison J. Ingham (SEG 2013), The Doe Run Company, Missouri, USA
- Kyle Williams, The Doe Run Company, Missouri, USA

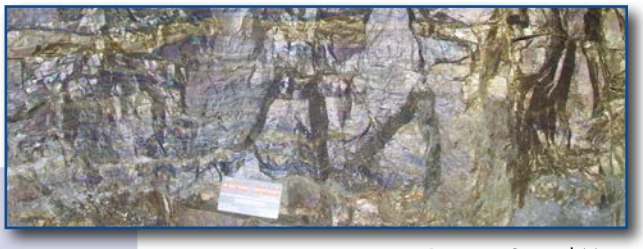
Description:

From Salem, Missouri, visit the world-class Viburnum Trend, which has been in production for more than 50 years and generates approximately 250,000 tons of lead concentrate per annum. The trip will include tours of the Casteel and RC West Fork mine and mill complexes with updates on geology. The trip will continue with a stop at the Buick Resource Recycling Division (BRRD), one of the world's largest single-site lead recycling facilities. BRRD processes more than 13.5 million lead-acid batteries per year along with various other lead scrap. The trip will conclude with tours of the Doe Run core logging facility and rotary and diamond drill rigs operating in the Viburnum Trend. Overnight stays in Salem, Missouri, are included.

Attendee Maximum: 16

Early Registration:
Members (US$695), Non-members (US$795), Student Members (US$345), Student Non-members (US$395)

Late Registration:
Members (US$795), Non-members (US$895), Student Members (US$395), Student Non-members (US$445)



Bornite, Casteel Mine

*Where applicable, transportation from Keystone, Colorado, USA, to St. Louis, Missouri, USA, to be arranged by participants. However, airport shuttle from St. Louis, Missouri, to Salem, Missouri, where field trip begins, is included in field trip cost.

FIELD TRIPS

Bingham Canyon

UNCOVERING THE BINGHAM AND STOCKTON Cu-Mo-Au PORPHYRIES

October 1–2, 2014
Post-Conference Field Trip
(Departs from and returns to Salt Lake City, Utah, USA*)

Field Trip Leaders:

- Kim E. Schroeder (SEG 1993), Senior Geologist, Bingham Canyon Mine, Rio Tinto
- Kenneth A. Krahulec (SEG 2002), Senior Economic Geologist, Utah Geological Survey
- Rudy Ganske, Senior Geologist, Rio Tinto Kennecott

Description:

This field trip will include a morning and early afternoon visit to the upper and lower portion of the Bingham Canyon mine and 2013 slide which filled the bottom of the pit. We will make 2 to 3 stops in the pit, followed by a presentation in the 3D room.

The second part of that day will be a trip to look at the mineral occurrences and alteration surrounding the unmined Stockton porphyry Cu system 17 km west of Bingham Canyon from an exploration perspective.

This course would benefit those wishing to view a developed Cu-Au-Mo porphyry system along with a sub-economic buried porphyry system (Stockton) from an exploration perspective.

Attendee Maximum: 20

Early Registration:
Members (US$595), Non-members (US$695), Student Members (US$295), Student Non-members (US$345)

Late Registration:
Members (US$695), Non-members (US$795), Student Members (US$345), Student Non-members ($395)

*Dinner planned for evening of October 2, 2014. Includes hotel nights on October 1–2.

GOLD AND SILVER MINES OF THE SIERRA MADRE OCCIDENTAL, MEXICO

October 1–5, 2014
Post-Conference Field Trip
(Field Trip departs from and returns to Chihuahua, Mexico*)

Field Trip Leader:

- Guillermo Gastelum-Morales (SEG 2002), Northern Mexico Exploration Sub-Director for Fresnillo plc.

Description:

The field trip is focused on visiting gold and silver mines developed on high, intermediate, and low sulphidation epithermal deposits of the Sierra Madre Occidental metallogenic belt of northwestern Mexico. This part of the world has attracted much exploration investment due to its excellent potential and historic track record of precious metals discoveries turning into successful mine operations. Explorers looking for these types of deposits in Mexico or elsewhere are encouraged to attend.

Ciénega Mine

Schedule:

Day 1: Travel from Keystone to Chihuahua
Day 2: La India and Pinos Altos mines
Day 3: Palmarejo mine and surroundings
Day 4: Ciénega District
Day 5: Travel from Ciénega to Chihuahua

Attendee Maximum: 15

Early Registration:
Members ($US1,595), Non-members (US$1,695), No student discounts

Late Registration:
Members (US$1,695), Non-members (US$1,795)

*All transportation from Keystone, Colorado, USA, to Chihuahua, Mexico, and back to be arranged by participants, as well as dinner upon arrival in Chihuahua.

SOCIETY OF ECONOMIC GEOLOGISTS
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Visit the SEG 2014 Conference website for workshop and field trip updates — www.seg2014.org

SEG 2014 CONFERENCE

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How to Reserve Exhibit Space

Quality Business Services (QBS)
SEG Conference Facilitators

Tel: +1.303.914.0694
Fax: +1.303.382.8061
Email: darline@QBSoffice.com

Booth Rental Includes:

- One complimentary full registration for each 10'x10' booth.
- Two complimentary exhibits-only registrations for each 10'x10' booth.
- 7"x44" booth sign with company name and booth number.
- 8' high back drape with 3' high draped side rails.
- General security

Booth Rate — $2500

Location

Keystone Resort & Conference Center
Keystone, Colorado, USA

FREE to Exhibitors

- Wi-fi
- Pocket Program Listing
- Link from SEG Website
- List of Registered Attendees

We have also planned . . .
Poster sessions, breaks,
3 receptions and 3 lunches in the Exhibit Hall to bring the crowd to you!

Exhibit Hours

Saturday, September 27

Set-up	8:00am – 1:00pm
Open/Reception	5:00pm – 7:00pm

Sunday, September 28

Open	10:00am – 7:00pm
Reception	5:30pm – 7:00pm

Monday, September 29

Open	10:00am – 6:30pm
Reception	5:30pm – 6:30pm

Tuesday, September 30

Open	10:00am – 1:30pm
Move Out	1:30pm – 5:00pm

Site of the highly successful SEG 2006 and 2010 Conferences!

Sponsorship Opportunities

Corporations can support student attendance and continuing education by becoming a sponsor:

- Patron
- Premier
- Gold
- Silver
- Bronze

Benefits include exhibit booth(s) at the upper sponsorship levels and complimentary registrations in all categories. Please contact Nikki Jamison, Marketing and Fundraising Coordinator, for further information: E-mail, anikajamison@segweb.org or call +1-720-981-7213.

Keep up to date at www.seg2014.org
For general meeting inquiries, contact QBS at Darline@QBSoffice.com

See next page for exhibit floor plan ↷

SEG 2014 CONFERENCE EXHIBITORS

Visit the exhibiting opportunities page to learn more and become an exhibitor.
www.seg2014.org/exhibiting-opportunities.html

Actlabs — Booth 34

ALS Minerals — Booth 44

AngloAmerican — Booth 49–50

BARRICK — Booth 47

bhpbilliton — Booth 37–38

BOLIDEN — Booth 40

BUREAU VERITAS — Booth 15

Centre for EXPLORATION TARGETING — Booth 11

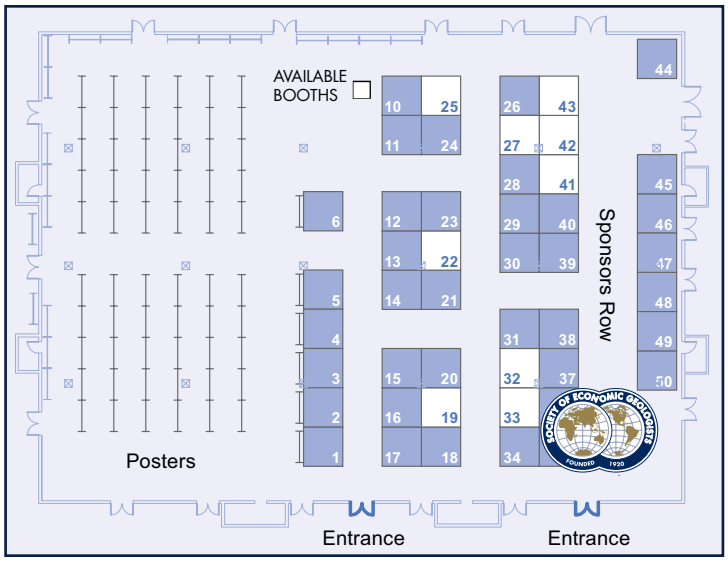
CGG Passion for Geoscience — Booth 28

CMIC-EIC FOOTPRINTS — Booth 12

CODES — Booth 20

MINES — Booth 10

corescan — Booth 14



DEEP EXPLORATION TECHNOLOGIES CRC
Uncovering the future — Booth 29

esri — Booth 16

Eurasian Minerals™ — Booth 21

FREEPORT-McMoRan COPPER & GOLD — Booth 48

GeoSpectral Imaging — Booth 24

GEOTEMPS INC. HUMAN RESOURCES FOR NATURAL RESOURCES — Booth 18

REEN REVOLUTION COOLING — Booth 1–2

KGHM INTERNATIONAL — Booth 46

MAPTEK™ — Booth 4

MDRU Mineral Deposit Research Unit — Booth 5

mti Minerals Targeting International Pty Ltd — Booth 3

OLYMPUS — Booth 30

PANalytical — Booth 6

RioTinto — Booth 39

SGS — Booth 13

SKYLINE ASSAYERS & LABORATORIES — Booth 26

SPECTRAL INTERNATIONAL INC. — Booth 17

WESTERN MINING SERVICES LLC — Booth 31

Positive Talks and Posters Require Good Illustrations

Eric S. Cheney[1] and Stephen E. Kesler[2]

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ABSTRACT

To be a positive addition to the speaker's message, images and texts used in slides for talks and for poster presentations must be legible. Almost all images and texts are now made in PowerPoint or similar software, which gives the speaker a wide range of options to make good illustrations. However, this takes time, which is in short supply for all of us. By following some simple guidelines, authors can save preparation time, produce good quality illustrations, and significantly improve the quality of our meetings.

INTRODUCTION

The major purpose of any presentation that uses illustrations should be to enhance the clarity of the speaker's message. Unfortunately, many of the illustrations at our SEG meetings do not achieve this goal. The recent SEG 2013 meeting at Whistler, British Columbia, was no exception, with disappointing illustrations from academic, industry, and government presenters. Poor-quality illustrations greatly diminish the benefit of the meeting to presenters and audiences. If we are going to get the maximum benefit from our meetings, we must improve our illustrations.

Few people, especially those in industry, most of whom make their own illustrations, have a lot of time to put into crafting illustrations. Here are some of our guidelines that might be of help to others.

The key to all illustrations is legibility. A slide must be legible from the back of the hall, and a poster from 0.7 m away. A vast literature exists on graphic design and planning, including Tufte (1990, 1997, 2006), Dutrow (2007) and Cheney (1996, 2013). For those not familiar with this literature, two empirical guidelines help. Gallagher (1965) suggested a simple rule: measure the maximum width of the original artwork (now computer image) in inches, and then step back that far in feet; if everything is legible, the slide will project well. Subsequent technological advances in projection equipment probably have reduced the ratio from 12:1 to about 10:1. At the recent Whistler meeting, about 50% of the slides and most of the posters were partly or entirely illegible at normal viewing distances.

The second guideline is the U.S. military's acronym, KISSing (Keep It Simple, Stupid). Stupid refers to the presenter, not to the message. KISSing is an acquired skill. KISSing means that slides should be simple, not complex, and that slides with only peripheral relevance (no matter how beautiful or how long they took to make) should be eliminated. Beauty, artistic frills, and fine details actually can be distracting. At the Whistler meeting, about 20% of the illustrations were much too complex to be understood at normal viewing distances. This was a particular problem for slides in the talks because most of them did not stay on the screen long enough to be deciphered. The biggest problem was caused by cramming too much information on the slides, which, in turn, left insufficient room for legible fonts.

The two main types of illustrations are analysis graphics and presentation graphics (Tufte, 1997; Dutrow, 2007). Analysis graphics range from newly generated computer plots of raw data to illustrations in engineering and scientific publications. Presentation graphics (such as PowerPoint) need not contain all the data; they should be designed to summarize or communicate a concept effectively and quickly. The best procedure is to prepare slides using Gallagher's rule. However, too often images are taken directly from a printed page or the internet, which were not designed originally as slides and therefore violate Gallagher's rule and KISSing. Some imported photographs are suitable, but almost all graphs, maps, tables, and other illustrations will be illegible unless they are modified.

The major problem for us as geologists is that we work with maps, cross sections, or large data sets and then import them directly into our slides and posters. Almost always the scales, legends, and axis labels on imported images are too small to be legible in slides. The problem is compounded when we put more than one illustration on a single slide. Two or more imported images on a single slide (a favorite procedure) are almost always illegible, even from the front of the hall. Such images (and many from other PowerPoint presentations) should be completely redrawn to become presentation slides. For presenters with limited illustrating skills, time, or budget, the remedial techniques listed below can produce positive presentation slides.

CRAFTING SLIDES

The first step in planning a slide is to eliminate trivia. Trivia, or chartjunk (Tufte, 1990; Dutrow, 2007), includes grid lines, logos, most clip art, fancy fonts, numerous small labels (where a few large ones would do), and separate legends instead of a few large labels. Busy slides of this type can be improved greatly just by eliminating chartjunk.

When presenting data, tables with only a few columns and rows and simple x–y plots are the easiest for the audience to comprehend rapidly. A general audience probably will not quickly grasp diagrams or projections that are specific to the presenter's subdiscipline (and the audience must be quick because the slide will not be on the screen for long). Complex diagrams (such as many three-dimensional representations) can generate confusion or even distrust in the audience (Dutrow, 2007). Complex (or "busy") slides can be avoided by presenting a series of simple slides that lead to the complex result. This is the "small multiples" method of Tufte (1990). An admission that a slide is "busy" is an admission of failure.

Heed Gallagher by making the image and text as large as possible. To utilize the maximum dimensions of modern projection screens, compose slides in landscape

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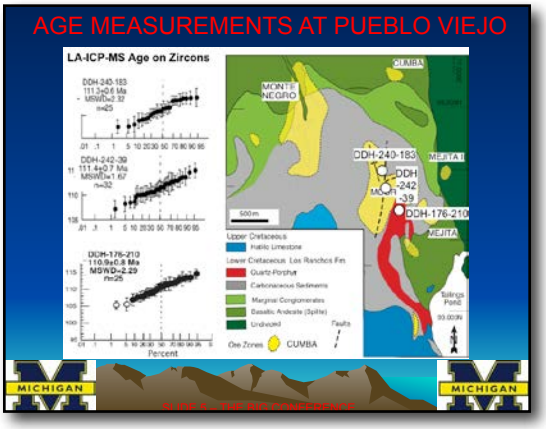
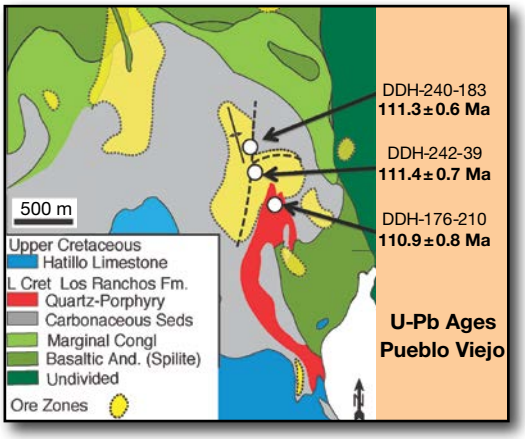
SEG NEWS

...from page 41 Positive Talks and Posters Require Good Illustrations *(continued)*



←**FIGURE 1.** A slide used in a recent talk. A quick glance shows this does not meet our criteria for a "good slide." It is too cluttered and some of the type is too small to be seen from a distance. We have made the figure even worse by creating a border that wastes a great deal of space and could be used to make the map larger. We also distracted the viewer by putting the block M in the bottom corners of the border and then using a red font (which is usually hard to read) in the unnecessarily large title. The result is a slide of a geologic map that is too small to be understood and that contains too many labels.

→**FIGURE 2.** This slide shows how Figure 1 can be improved. First, there is no border, so we can expand the map. We have also enlarged the type size in the map legend and removed other small text labels that cluttered the original. Now, it is possible to say something about the map that viewers can actually follow. The title for the map is created in a font and color that is readable. The ages are simply numbers with analytical uncertainty and the drill holes are not labeled on the map because they are labeled where we list the ages. This graphic shows how a little work will make a better slide. To view another approach to good vs bad slides, have a look at various YouTube videos by Don McMillan, which provide additional suggestions on how to make an excellent slide presentation.



configuration, not portrait. Use space wisely by making the margins of the slide as narrow as possible. Use the entire area of the slide. Artwork in the margins is distracting and provides no information. Logos of sponsoring institutions in the margins (except for obligatory introductory slides) waste precious space. Do not use overly large titles with large spaces around them; instead, use the extra space to increase the size of the image or text. Too many slides contain large margins devoted to titles or logos that result in more than 50% blank and wasted space.

All slides (even those as seemingly routine as a thin section of a rock or a SEM image of a mineral) should have a title or caption, labels, scale bars, and sources of data. Titles reinforce communication and distinguish one slide from similar ones in the presentation. Many illustrations, whether maps or graphs, have blank areas that are not important to the message; these areas can be used for titles, labels, and scales.

Color choices can help the viewer rapidly read any text. Black (or dark blue) font on a white or pastel background usually is the most legible. Pastels also show the pointer or a laser pointer better than a white background. White font on a black or colored background (including on photographs) must also be larger or bolder than normal. Lower case lettering makes words more rapidly recognizable. Use simple (not frilly) fonts throughout. Do not use less than 20 point font for even the least important labels (such as sources of data). Small fonts can be made more legible by making them bold. Font sizes over 40, even for titles, are rarely needed; instead, use the extra space to increase the size of the image or the text. One way to deal with this problem is to make all the text in a slide the same font size, or only vary fonts by two sizes or by boldness. Slides and posters with huge titles and tiny text and labels are useless. To be legible, do not use more than 12 lines of text on a slide (think twice about that). Of course, multiple slides crammed with text are boring.

Colors also matter in the design of an illustration. Because about 15% of the population is color blind, critical data and text should not be in red or green (Dutrow, 2007). Colored texts or symbols on colored backgrounds (other than pastels) commonly are illegible (except to the speaker). The use of color should not do harm (e.g., Tufte, 1990). Pastels are best because they imitate nature (Tufte, 1990); fully saturated colors are garish. Use a limited number of colors rather than forcing the audience to decode the significance (if any) of different colors. If you must be artistic, try the Gallagher rule before committing to a color scheme. Reducing the size of white areas on slides reduces the audience's eye fatigue; use pastel backgrounds. Different pastel backgrounds might be used for different portions of the presentation.

REMEDIAL TECHNIQUES

Cropping is the first, best, and simplest remedial technique when importing an illustration from a printed page or the internet. If an imported figure is in portrait dimensions, crop it to landscape by eliminating irrelevant stuff. After cropping, enlarge the remnant to fill the entire slide. If the image still is not legible, crop and enlarge again. Judicious cropping also can eliminate chartjunk. As noted above, you can maximize the size of illustrations by putting titles and other information over unimportant parts of the illustration rather than beside it.

The second most important remedial technique is to never show more than two images on one slide. Two slides with two images definitely are more legible than one slide with three or more images, and, ultimately, such multiple slides will take less time to present clearly. Carefully compose the size and configuration of text boxes to permit the maximum size of images and text. If you must put two illustrations on a single slide, be careful to eliminate unused space between them. If necessary, crop the two illustrations so that unused space is minimized. To make the images even larger, overlap parts of the illustrations if these areas contain no important information.

After importing, cropping, and enlarging, much can still be done with the remnant. PowerPoint allows you to draw lines and to cover areas of the original slide. This lets you emphasize some things and remove others. Trace over

important lines to significantly increase their width. The width of lines should be proportional to their importance. For example, on a graph, the regression line should be the boldest. Mask (cover) unimportant labels and symbols with new text boxes containing larger font, which thereby emphasize the important stuff. Use very bold arrows or leaders to promote rapid recognition of important details. Mask chartjunk with rectangles or other shapes filled with the same color as the original illustration.

A final remedial technique involves modifying contrast or brightness of imported photos or other illustrations. Doing this can make them clearer and sometimes will be sufficient to change the color of the background enough to make them blend in to the new slide.

POSTERS

Posters have much in common with PowerPoint slides. Posters generally have more detailed illustrations, more extensive figure captions, and some stand-alone textboxes, such as an abstract. To pique interest and to create an attractive layout, posters should consist mainly of a few large illustrations (and perhaps tables) and a minimum of text. Titles and subtitles should be large enough to be legible from 2 m away. All other fonts must be large enough so that the over-40 crowd (and those nursing a hangover from the night before) can easily read them from 0.7 m away. Too many of our posters contain too much text. Few viewers will spend the time necessary to read a poster consisting of paragraph after paragraph of minute text (e.g., Cooper and Galkiewicz, 2013). One moderately long abstract (of course, in large font) is better than several paragraphs of introduction, methods, results, discussion, and conclusions. If you want people to get the full message, hand out a sheet with details.

Presenters of posters (PPs) should adopt the techniques of commercial exhibitors at conferences. They use large, colorful images, large font, and a minimum of text. Exhibitors also dispense trinkets or cards with their name or logo on them. PPs should distribute abstracts or detail sheets, as well as business cards.

Instead of just loitering near the poster, PPs should proactively solicit passersby. Adopt the techniques of television advertising: a 20-second "spot" to attract passersby; if passersby show even minor interest, be ready with a commercial in the form of a one-minute tour of the poster. Then, if they express real interest, converse for five minutes or more on specific topics; significantly, this is when real feedback begins.

CONCLUSIONS

The audience deserves respect; so, illustrations presented to them should be of good quality. To produce good illustrations, put yourself in the place of the viewers. Assume that these viewers are intensely interested in what you have to say and show—so much so, in fact, that they spent their own money to come to the meeting to hear only your presentation. Unfortunately, the hall was so full when they arrived that they could only stand in the back of the room. Will they get their money's worth?

Attention to these guidelines will help viewers have a successful meeting. These guidelines will also benefit the presenters because they are more likely to receive meaningful feedback than just questions of clarification.

An informal count of illustrations at the most recent meeting suggests that most attention needs to go to appropriate font size. About half of the slides in recent talks contained text that was illegible from reasonable viewing distances. Another 10 to 20% suffered from problems of oversize margins and complexity, including too many images per slide. Maybe 2 to 5% had problems with color schemes. By paying attention to Gallagher and by KISSing we can overcome these problems and improve the quality of our meetings for presenters and viewers alike. In any case, there is no profit to be had in lousy slides and posters that make good work look bad.

ACKNOWLEDGMENTS

We thank speakers too numerous to mention at SEG 2013 for prompting this article. We also acknowledge that over the years we, too, have disregarded the above suggestions, and so we welcome advice from others on how to improve.

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SEG Field Mapping Course

Copper Creek, Arizona, USA

November 3–8, 2013

William X. Chávez, Jr. (SEG 1990F) and Erich U. Petersen (SEG 1986 F)

The Copper Creek Cu-Mo breccia-porphyry system (Redhawk Resources; www.redhawkresources.com), northeast of Tucson, Arizona, served as the mapping area for a recent SEG mapping course. Fifteen participants, representing six countries, and including two students, participated in this field course, instructed by William X. Chávez, Jr., Erich U. Petersen, and Ralph A. Gonzalez (SEG 1981 SF).

Course participants employed detailed (1:480) mapping to assess the various vein types within the Copper Creek system, and reviewed the supergene and hypogene geochemistry of porphyry systems during evening sessions that discussed the application of mineral reactions to the understanding of porphyry alteration-mineralization assemblages. A field guidebook prepared for this course described the geologic background of the Copper Creek property and included field and in-house exercises to complement field work. Review of the various rock and vein types and distributions within the Copper Creek breccia-porphyry system allowed participants to observe the many variations characteristic of a complex hydrothermal system. As with previous SEG mapping courses, integration of field observations with geochemistry-related exercises aimed at explaining the how-and-why of alteration development comprised a major part of this offering.

Mapping course participants gather in front of the mineralized American Eagle breccia pipe. Standing (l to r): Jeffrey Bickel, Wyatt Boomer Bain, Facundo Cazares, Peter Dalton, Logan Hill, Kevin Zoller, Guilherme Santos, Brock Reidel, Jeremy Vincent, Sam. Sitting (l to r) Juan del Toro, Ralph Gonzalez, Guillermo Contreras, Erich Petersen, George Gamarra U., Angela Roach, Adam Piatkowski, Cruz Paez, Aranzazu Bulnes, William Chávez.

Wrapping up discussions at Redhawk Resources Copper Creek property (l to r): Cruz Paez, Ralph Gonzalez, Facundo Cazares, Guillermo Contreras, Adam Piatkowski, Kevin Zoller, George Gamarra U., Jeffrey Bickel, Peter Dalton, Jeremy Vincent, Guilherme Santos, Juan del Toro, Logan Hill, Angela Roach, Aranzazu Bulnes, Sam, Brock Reidel, William Chávez, Erich Petersen, Wyatt Boomer Bain.

Angela Roach, Aranzazu Bulnes, Guillermo Contreras practice their mapping skills.

We are very grateful to the Redhawk Resources team for their exceptional support of this SEG course. Joe Sandberg (SEG 2003), President, CEO, and Director of Redhawk, Brock Riedell (SEG 1978 F), advisor to Redhawk, along with the Redhawk field geology team of Adam Gorecki (SEG 2014), Sam Ybarra (SEG 2012), and Jerome Lambiotte (SEG 2013), offered substantial assistance in preparing for this course, and assisted in providing in-the-field and in-office background information for the instructors and participants. Without their support and interest in our efforts, this course would not have been possible—our many thanks to the Redhawk team and to their logistical and educational support of this SEG Mapping Course.

The next SEG mapping course is to be offered in mid-2014, and will emphasize wall-rock alteration geochemistry and the structural controls of alteration-mineralization; interested potential participants should review the SEG website for additional details as they develop.

XVII PERUVIAN GEOLOGICAL CONGRESS

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SEG STUDENT CHAPTER NEWS

Round I 2014 Student Chapter Funding from the SEG Stewart R. Wallace Fund Proposal Submission Deadline is April 30, 2014!

Student Chapter funding support is available from the SEG Stewart R. Wallace Fund. Wallace was a renowned exploration geologist whose discoveries included the Cereso Ridge molybdenum deposit at the Climax and Henderson mines in Colorado. He served as the SEG President in 1992. Active Student Chapters may submit requests for funding for field-based educational activities. Well-constructed and thoughtful applications may be successful in receiving as much as US$1,500.00 (possibly more, for exceptional applications).

Visit www.segweb.org/StudentChapterGuidelines to read more.

The application can be found at:
www.segweb.org/pdf/forms/Student-Chapter-Funding-Guidelines-Form.pdf

In order for your application to be considered, your chapter

- must be an active SEG Student Chapter as per the Student Chapter Guidelines.
- must have submitted an Annual Report Form for 2013 (unless your chapter was recently established).
- application must be submitted with a copy of an up-to-date Student Chapter Membership Information Form.

We encourage all chapters to seriously consider the assessment criteria used by the Student Affairs Committee in planning your activities to ensure the best chance of receiving the highest level of funding. The assessment criteria are clearly stated on the Student Chapter Funding Form.

Contact studentprograms@segweb.org with any questions and to report chapter revisions and updates.

See the online *SEG Newsletter* supplement for more Student Chapter news, including the latest events and field trip reports:

- Colorado School of Mines Northern Nevada Field Course
- Imperial College Students into Mining 2014
- Ottawa-Carleton Universities Joint SEG Student Chapter
- Sofia University SEG Student Chapter

PRELIMINARY ANNOUNCEMENT
SEG Foundation Student Field Trip No. 13

ARCHEAN BASE AND PRECIOUS METAL DEPOSITS, SOUTHERN ABITIBI GREENSTONE BELT, CANADA

September 3–11, 2014

Leaders: Dr. Benoît Dubé, Geological Survey of Canada
Dr. Patrick Mercier-Langevin, Geological Survey of Canada with Mr. K. Howard Poulsen, Consulting Economic Geologist, and Dr. Mark Hannington, University of Ottawa

This is no. 13 in the series of SEG Foundation-sponsored student field trips. This trip will examine several economically significant base and precious metal deposits of the prolific southern extent of the Abitibi Greenstone Belt, Canada, from Timmins, Ontario, to Malartic, Quebec, and will provide an opportunity to gain firsthand knowledge of the regional and local geologic settings of select Archean gold and base metal deposits. The trip includes examination of underground and surface exposures, and a visit to a mill complex.

A chartered motor coach (the SEG "mobile classroom") will be used for all travel, facilitating interaction among trip participants.

This field trip is open to all active SEG student members who are currently enrolled at an accredited university. Participation is limited to 16 students and acceptance is competitive. Eligible SEG student members should complete and submit the Student Application Form to request SEG Foundation financial support. Selected participants will be notified by June 27, 2014.

Additionally, up to four professional mentors, who will share their experience and industry perspectives and discuss career opportunities in economic geology, may participate on the trip. Interested individuals, whether SEG members or otherwise, should e-mail their current résumé to Borden Putnam, Chair, SEGF Student Field Trip Program, at bputnam@mionecapital.com.

A detailed itinerary and the Student Application Form will soon be posted on the SEG website at www.segweb.org/StudentFieldTripProgram. Please check frequently for updates.
Please direct general inquiries to Vicky Sternicki at studentprograms@segweb.org.

Application Deadline: June 13, 2014

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See SEG post-meeting short course – Sedimentary Rock-Hosted Copper Deposits of the Central African Copperbelt on page 55.

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EXPLORATION REVIEWS

Notice: Views expressed in the Exploration Reviews do not necessarily reflect those of the Society of Economic Geologists, Inc., and columnists are solely responsible for ascertaining that information in this section is correct.

To read additional Exploration Reviews for individual countries, please go to the online *SEG Newsletter* supplement.

ALASKA

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Alaska's mining industry has experienced the taste of both vinegar and honey over the last few months. First, some vinegar: the overall mood at the recent Cordilleran Roundup mining convention in Vancouver, British Columbia, was more restrained but more realistic than in previous years, due in large part to the prolonged downturn in risk capital mining markets. It seems the industry has transitioned from the denial stage to an acceptance and determination stage that everyone hopes will precede a return to market vitality. Question is, when will we recover? In a recent public release by financial giant Ernst and Young, the magnitude of the 2013 downturn was quantified: the market capitalization of Canadian-domiciled mining companies decreased by 45% over the course of 2013. That drying up of dollars from Canada was keenly felt here, given that Alaska gets something like 80% of its mineral investment dollars from Canadian mining companies. Lack of investor confidence, sliding commodity prices, and asset write-downs all contributed to the grim tally. In addition, companies were reluctant to raise equity through stock sales because of their low stock prices and the extreme dilution that they would suffer by selling shares at what, for many, were five- and 10-year lows. As a consequence, total proceeds raised during 2013 were approximately $6.9 billion, down 49% compared to 2012. Alaska fared no better than most, with exploration expenditures—our economic canary of the mining industry—down to levels not seen since 2005. But there was some honey in the picture. Ernst and Young indicated that they expected mid-tier producers with cash flexibility to take advantage of inorganic growth opportunities and felt that junior mining companies with good quality, derisked projects will attract buyer interest. Light at the portal? Perhaps. But wait—there was more honey offered to Alaska, or should I say crack cocaine? The Alaska Dispatch reported on a recent presentation at the American Geophysical Union entitled "Critical Metals in Western Arctic Ocean Ferromanganese Mineral Deposits." The talk summarized the chemical contents of ferromanganese crusts and nodules from the world's oceans and, as it turns out, samples from the Arctic Ocean continental shelf were the only ones from the global oceans enriched in scandium. So what you say? While trade in scandium is extremely small in volume, at a little over 6 tons per year, scandium sold for $15 million per ton in 2013. That sounds like a lot and the inference was that maybe Alaska's next rush would be for scandium. Enticing as that may seem, the current scandium price equates to only $625 per troy ounce, a price that would plummet if even a few pounds more of scandium hit the market! Conclusion: don't trade in your pick and shovel for a high-definition sonar and a deep-sea suction dredge just yet.

AUSTRALASIA

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***Tony Christie** (SEG 1992) – New Zealand*
***Bianca Pietrass-Wong** – NSW*
***Steve Russell** (SEG 2009) – NT*
***Tyler Lamb** – Victoria*

SUMMARY

In spite of the fact that most discoveries these days are made by a team of highly trained and motivated explorers using state-of-the-art technologies, there is still a role for prospectors—scouring

to page 50 . . .

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...from page 49 Exploration Reviews *(continued)*

the ridges with pick and gold pan in hand, searching for that elusive bonanza. Here in Australia, a few prospectors continue to peg their claims and then sell/option them to larger companies. By far Australia's most successful prospector in recent years is Mark Creasy, who has discovered a number of very significant gold and base metal deposits in Western Australia, for which he has been handsomely rewarded. His first major windfall was his discovery and then sale of the **Bronzewing gold deposit** to mining entrepreneur Joseph Gutnick in 1990 for ~US$114M, and he has struck it rich again to the tune of a package of shares and cash valued at US$177M for the sale to **Sirius Resources** of his 30% interest in the **Nova-Bollinger nickel-copper discovery** in the Fraser Range. Mark first became interested in the area while searching for the remains of NASA's Skylab satellite after it crashed there in 1979, and became aware of some nickel-copper hits in holes drilled in the 1960s. Some years later he pegged the ground on which Sirius discovered Nova-Bollinger in July 2012. It is worth noting that before the discovery, Sirius had a market capitalization of just US$7M, compared to the current US$535M! This summary draws on an article by mining journalist Barry Fitzgerald.

The Sydney Mineral Exploration Discussion Group (SMEDG) is an informal forum for explorers to gather monthly to socialize and to enjoy technical presentations, often case studies of recent discoveries. The group was founded in 1972 and was based on the model of a similar group in Toronto, and the Sydney group includes two cruises on Sydney Harbour as part of their annual calendar. Any overseas visitors (particularly SEG members) are encouraged to attend, and even give a talk. At the most recent SMEDG meeting in late February, Dr. Paul Heithersay (Deputy Chief Executive, Resources and Energy Department, South Australia, and the SEG 2014 International Exchange Lecturer) presented a talk reviewing the future of government geoscience initiatives in Australia. He noted that although there has been strong competition between the various Australian states and territories to attract explorers through precompetitive exploration data and drilling incentive programs, the Australian jurisdictions continue to slip in their rankings in the Fraser Institute surveys. He suggested that a pooling of efforts, combined with a significantly greater level of financial support from the federal government, was needed for Australia to improve its exploration competitiveness on the international stage. In his own jurisdiction of South Australia, Paul noted that the Geological Survey was about to commence a bold program of deep stratigraphic drilling on 10- × 10-km centers to search under cover for Olympic Dam-style deposits at the eastern margin of the Gawler craton. The wide spacing selected is based on 3-D modeling of the size of the alteration/geochemical envelopes to such very large hydrothermal systems. A total of 135 km of drilling is planned at a cost of US$6M and is expected to increase the pace of exploration in that state. Readers are encouraged to visit the SMEDG website at www.smedg.org.au to access a Pandora's box of past presentations, exploration information, and fascinating trivia.

See the online version for more exciting exploration news from Down Under.

NORTHERN EURASIA

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NORTHERN EURASIA GENERAL

Governments

Rosnedra approved 133 areas and deposits for licensing in 2014, including for diamonds, emeralds, tin, tungsten, lead, coal, and potash. The gold list (hard rock and placer) includes 51 areas. Gold prospects are located Buryatia (20), Transbaikalia (7), Krasnoyarsk (2), Irkutsk (2), Kemerovo (2), Sverdlovsk (5), Chelyabinsk (3), Kamchatka (2), Chukotka (4), Primorie (2), Republic of Altai (1), and Karelia (1).

In 2014 Rosnedra will conduct an auction for exploration and mining of niobium, rare earth metals, scandium, and by-products for the Buranyi part of the **Tomtor deposit** in Sakha (Yakutia). Tomtor is considered to be the world's largest REE deposit. The starting price is $26.5 million. The B + C1 resources include 79 kt Nb_2O_5 (on balance) and 7.37 kt Nb_2O_5 (off balance); 119.3 kt (on balance) and 19.7 kt of rare earth metals (off balance); and 563 t Sc_2O_3 (on balance) and 92 t Sc_2O_3 (off balance). P1 resources include 817.7 kt Nb_2O_5, 1,640.4 kt of rare earth metals, and 7 kt Sc_2O_3.

Kazakhstan Mazhilis (Parliament) announced that the country is to become the first ex-Soviet Union state to accept a new mining code modeled on Australian, Canadian, Finnish, and Chilean principles of allocation of mineral exploration rights and contractual regulation of extraction of minerals, oil, gas, and underground water. Current legislation does not take into account differences between oil/gas and mining. To facilitate exploration, a geological exploration center will be built in Astana by 2015 at the Nazarbayev University under the partnership agreement signed on February 20 by the Ministry of Industry and New Technologies, Kazgeology National Exploration Company, and Nazarbayev University Research and Innovation System.

Companies

Russian Copper Company, the third largest copper producer in Russia, has completed construction of the plant and facilities at the **Mikheevskoye porphyry copper deposit** at a cost of ca. $800 million. The construction period was 18 months starting in May 2012. The deposit has mineral reserves of 400 Mt grading 0.4% Cu. This is the only porphyry copper deposit being mined in Russia at the moment.

Polyus Gold International decided to postpone commissioning of the Natalka processing plant until summer 2015 (instead of summer 2014). This is the second delay. The initial plan of commissioning estimated the summer of 2013.

Onexim Group, Russian billionaire Mikhail Prokhorov's investment fund, has agreed to acquire Canadian-listed **Mercator Minerals Ltd** by combining it with its **Intergeo** business and investing a sum of US$100 million into the new company. **Daselina**, an Onexim subsidiary, and 1% shareholder **Kirkland**

Intertrade will own 85% of the new entity, to be called **Intergeo Mining Ltd**, with existing Mercator holders keeping the rest. Intergeo's flagship asset is the **Ak-Sug copper project** in southern Siberia, containing an estimated 236 Mt in indicated resources at 0.67% Cu, 0.18 g/t Au, 0.02% Mo, and 0.29 g/t Re. SNC-Lavalin and AMEC are working on the prefeasibility study for the proposed open-pit mine, expected to produce an average of 120,000 t/y of copper. Mercator's **Mineral Park copper-molybdenum mine** in Arizona will also receive a portion of the funds to service its debt. The mine "is expected to become cash-flow positive and able to service its outstanding debt obligations at current spot commodity prices." Mercator's **El Pilar copper project** in Mexico is a development asset. A case study estimated average copper cathode production of nearly 36,000 t/y. Intergeo is planning to raise $1.5 billion once the cash flow from the existing operations of the merged company is established.

In Uzbekistan, **Navoi GMK** announced its exploration budget for gold and uranium in 2014. The new budget is $25 million, up 10% in comparison with 2013 plans.

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CONTIGUOUS UNITED STATES

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I have been told that there is mineral exploration and development outside of Nevada, but I was skeptical until the recent Northwest Mining Association (NWMA) meeting in Reno. One of the sessions was titled "Mining's Midwest Resurgence: Minnesota, Wisconsin and Michigan Mineral Development." What do you know—there is mineral interest outside of the Great Basin! The NWMA meeting attracted 2,500 and, surprisingly, the mood seemed somewhat optimistic. To reflect its expanding membership base and national involvement, NWMA has changed its name to the American Exploration & Mining Association.

My faith that the only place to explore is the Great Basin was again shaken with the news that **Highland Copper** has two projects in Michigan's Keweenaw and two more to the west as part of its acquisition of the old White Pine copper operations. They are becoming real UPers (you have to be from Michigan to understand that).

Following on the theme that there might be exploration activity outside of Nevada, **Midas Gold** is developing a significant gold-silver-antimony resource at its **Golden Meadows project** in Idaho's Yellow Pine mining district.

An interesting statistic that I ran across recently is that the average gold grade of producing mines is 1.18 g/t and the average gold grade of the undeveloped deposits is 0.89 g/t. At several recent meetings, I attended talks where the presenter discussed deposits that have average grades at or below 0.5 g/t Au. There must be a hope for $3,000/ounce gold just around the corner to make most of these economically attractive. The other part of the statistic is that about 69% of all deposits contain less than 5 million ounces of gold, with the very largest (>50 million ounces) constituting only about 1% of all deposits.

Along the same lines, there is an interesting dichotomy developing. The senior producers are pushing quality over quantity when considering investments in new gold deposits, as evidenced by their public communications and the delaying or canceling of many marginal projects. At the same time, in the junior exploration world money is being poured into drilling to expand deposits with grades substantially below 1.0 g/t Au. One of these groups is drastically underestimating the future price of gold. Maybe the juniors are following the adage that my broker use to regale me with, "Got a hunch, bet a bunch." Of course, he also said, "Do not commit your entire wad."

Are the discoveries starting again in Nevada? **Columbus Gold** reported significant drill results from the **Eastside property** in Esmeralda County. **Pilot Gold** has identified the new West Flank target at Kinsley in Elko County and reported initial drill results that appear very encouraging. I would be remiss not to mention **NuLegacy Gold's Iceberg discovery** in Eureka County. Or, at least, I have heard a rumor that they have made a discovery.

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Abstract Submission & Registration begins	8 February 2014
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End of Early Registration	8 April 2014
Pre-registration Closes	8 May 2014
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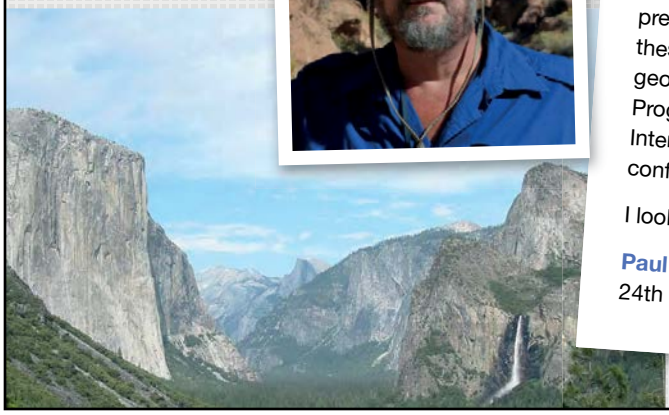

I warmly invite you and other geoscientists from around the world to attend the 24th V. M. Goldschmidt Conference, to be held June 8-14, 2014 in Sacramento, California. Sacramento is the Capital of the "Golden State" of California, so named both for the weather and for the gold deposits discovered in the mid-nineteenth century only 75 km from Sacramento. Nestled at the confluence of the Sacramento and American Rivers, the city is a gateway to many of California's natural wonders including majestic Yosemite National Park in the Sierra Nevada Batholith. The abundance of diverse geological features nearby, from ophiolites to batholiths to arc volcanoes to the classic Franciscan subduction complex, as well as mining activity and its environmental legacies, presents outstanding opportunities for field trips which will be a hallmark of the conference. Also nearby are the renowned Napa Valley, Sonoma Valley and Sierra Foothills wine regions and myriad other opportunities for cultural excursions. This venue offers excellent options for combining a high-level conference with a family vacation.

As the capital of a state with the world's ninth largest economy and significant production of agricultural and natural resources, Sacramento is a nexus of activity in these areas. The venue is thus uniquely opportune for topics such as energy, resources and environment wherein policy needs to be informed by science. As at previous Goldschmidt conferences, societally relevant topics such as these will be combined with the latest developments in all areas of geochemistry, cosmochemistry, and related fields. A Science Program comprising 25 themes has been developed by the International Program Committee, and can be viewed on the conference website **goldschmidt.info/2014/program**

I look forward to welcoming you to Goldschmidt 2014!

Paul Renne, President, Local Organizing Committee,
24th V. M. Goldschmidt Conference

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Preliminary 2014 Education & Training Curriculum

The following is a tentative list of courses and field trips scheduled for this year. SEG reserves the right to cancel courses or modify speakers, topics, and locations.

Official registration information will be available three months prior to the courses; check out our webpage at segweb.org for the latest updates on courses and events!

Date	Venue	Course	Presenters
Feb 1–2, 2014	Indaba; University of Witwatersrand	Geology of Gold Deposits-POSTPONED	Hartwig Frimmel, Richard Goldfarb, Brian Rusk, Stuart Simmons
Feb 28–March 1, 2014	PDAC	Exploration in Deeply Weathered Terrains	Simon Bolster
March 9–16, 2014	Southwestern USA	*SEGF Student-Dedicated Field Trip: Major Copper-Molybdenum Porphyry Systems	Bill Chávez, Erich Petersen
April 10–11, 2014	Denver, Colorado	CSM-SEG Short Course: Porphyry Copper Deposits	Thomas Bissig, Farhad Bouzari
May 12–17, 2014	Denver and Cripple Creek, Colorado	*Key Practical Methods in Mineral Exploration	Odie Christensen et al.
May 15–16, 2014	Simexmin, Ouro Preto, Brazil	Sedimentary Cu Deposits of the Central African Copperbelt	Murray Hitzman
May 19–22, 2014	Quito, Ecuador	UNESCO-SEG-SGA: Northern Andean Metallogeny	Massimo Chiaradia, Lluís Fontboté, Jeff Hedenquist, Richard Spikings
Aug 17, 2014	Roy Miller Symposium, Namibia	Sedimentary Cu Deposits of the Central African Copperbelt	Murray Hitzman
Aug 19–22, 2014	IAGOD, Kunming China	Classes of Mineral Deposits & Their Exploration Criteria	Rich Goldfarb et al.
Sept 3–11, 2014	Abitibi	*SEGF Student-Dedicated Field Trip	Howard Poulsen, Benoît Dubé, Patrick Mercier-Langevin
Sept 27–Oct 2, 2014	SEG Keystone; Pre & Post Conference	Short Courses at Keystone Conference	See www.seg2014.org
Sept 21–Oct 5, 2014	SEG Keystone; Pre & Post Conference	*Field Courses at Keystone Conference	See www.seg2014.org
Sept 29–Oct 3, 2014	Marrakesh, Morocco	SGA-SEG-UNESCP-IUGS African Metallogeny	TBD (2 sessions: Mining in Africa, African Metallogeny)
Oct. 10–11, 2014	Peruvian Geological Congress: Lima	Structural Geology of Gold Deposits	David Rhys
Trip dates TBD; (pre-Congress Oct. 12–15, 2014)	Peruvian Geological Congress: Southern Peru	*Epithermal Ore Deposits of Southern Peru	Valery Garcia, Jeff Hedenquist
Oct. 7–12, 2014	Peruvian Geological Congress: Southern Peru	*Porphyry Ore Deposits of Southern Peru	Bill Chávez, José Arce, Walter Tejada
October 2014, exact dates TBD	Denver, Colorado	CSM-SEG Short Course	TBD
Oct 17–18, 2014	GSA Annual Meeting, Vancouver	Structural Geology of Gold Deposits	SRK
November 2014, exact dates TBD	Southwestern USA	*Field Methods in Economic Geology: Southwest USA	Bill Chávez, Erich Petersen
December 2–5, 2014	Denver, Colorado	Senior Exploration Management	WMS

*Course includes a field trip

SEG COURSE CENTER EVENTS | segweb.org/events

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Key Practical Methods in Mineral Exploration

SEG Course Center | Littleton, CO, USA
May 12-17, 2014

DESCRIPTION

The course will be of particular value to early-career exploration geologists, advanced students, and managers coordinating multidisciplinary exploration teams. Five days of lectures and class activities culminate in a field day at the Cripple Creek and Victor gold mine. Curriculum includes reviews of important mineral deposit models, exploration program design, geochemical exploration techniques, geophysical exploration methods, drilling and sample recovery, recognition and interpretation of rock alteration, QA/QC protocols, and integrated interpretation of complementary geotechnical data sets. Case studies with a focus on "best work practices" will be highlighted. Instructors have extensive worldwide experience.

INSTRUCTORS

- **Odin Christensen (Coordinator)**
  Hardrock Mineral Exploration
- **Craig Beasley**
  NEOS GeoSolutions
- **Graham Closs**
  Colorado School of Mines
- **Jeff Jaacks**
  Geochemical Applications International
- **Dave Johnson**
  Bronco Creek Exploration
- **Dave Maher**
  Bronco Creek Exploration
- **Denis Rousseau**
  Newmont Mining Corporation
- **Tommy Thompson**
  University of Nevada, Reno
- **Lori Wickert**
  Consultant - Remote Sensing
- **Geological Team**
  Cripple Creek and Victor Gold Mine

OBJECTIVES

- Conceptual models of important mineral deposit types, with emphasis on features useful in exploration;
- Geochemical exploration methods from collection through laboratory analysis to interpretation of results;
- Selection, application, interpretation, and integration of various geophysical exploration techniques;
- Q/C and Q/A methods required to verify the integrity of geotechnical data;
- Drilling methods–why each is used; sample collection practices, environmental protection, and safety considerations;
- Brief introduction to logging of drill core and cuttings: observing, recording, communicating;
- Recognition and interpretation of rock alteration in mineral exploration;
- Integrated interpretation of multiple geotechnical data sets to focus exploration; organizing exploration information for effective interpretation and communication;
- Field trip to Cripple Creek and Victor gold mine, a giant epithermal gold deposit in an alkalic magmatic complex, with emphasis on practical skills used by exploration and mine geologists.

REGISTRATION Online at **segweb.org/events#14RPMETHOD**

Early Registration *(through April 12, 2014)*

Member: US$1,950
Non-member: US$2,100
Student Member: US$950
Student Non-member: US$1,050

Late Registration *(after April 12, 2014)*

Member: US$2,100
Non-member: US$2,300
Student Member: US$1,050
Student Non-member: US$1,150

Please note that SEG reserves the right to cancel this event should minimum attendance numbers not be met by April 12, 2014. SEG policies on dietary restrictions and event photography should be reviewed in advance at www.segweb.org/t&c.

EDUCATION & TRAINING

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Sedimentary Rock-Hosted Copper Deposits of the Central African Copperbelt

Ouro Preto, Minas Gerais, Brazil
May 15–16, 2014

A post-meeting short course following SIMEXMIN 2014

DESCRIPTION

Sedimentary rock-hosted stratiform copper deposits comprise disseminated to veinlet Cu- and Cu-Fe-sulfides in siliciclastic or dolomitic sedimentary rocks. These deposits are common, although rarely as economically significant occurrences. Yet they currently account for ~23% of the world's Cu production and known reserves and are important sources of Co and Ag.

This two-day, post-meeting short course will focus on the geology and ore deposits of the Central African Copperbelt, the world's largest and highest-grade sedimentary copper province, with ~200 Mt of contained copper and the world's largest cobalt reserves. Deposit settings, mineralization controls, and alteration styles in the Zambian Copperbelt, Congolese Copperbelt, and in the North West Province of Zambia will be covered. In analyzing why the Central African Copperbelt is so rich relative to other sedimentary Cu districts, participants will learn exploration strategies for this deposit type.

PRESENTER

- **Dr. Murray W. Hitzman** – Charles F. Fogarty Professor of Economic Geology, Department of Geology & Geological Engineering, Colorado School of Mines, Golden, Colorado; 2005 President of SEG

  Murray W. Hitzman worked in the petroleum and minerals industries from 1976 to 1993, receiving a Ph.D. in geology from Stanford in 1983, and was largely responsible for the Lisheen Zn-Pb-Ag deposit discovery in Ireland. Murray served as a policy analyst in both the U.S. Senate (1993–1994) and the White House Office of Science and Technology Policy (1994–1996). In 1996, he accepted a position at the Colorado School of Mines. Murray has been conducting research with students in the Central African Copperbelt for the past 15 years.

REGISTRATION

Online at **www.adimb.com.br/simexmin2014/programacao/cursos-pos-simposio/**

Early Registration *(through April 11, 2014)*

R$ 1000 – **Professional & Academic associates of ADIMB**
R$ 1350 – **Non-associate of ADIMB**
R$ 600 – **Students**

Late Registration *(after April 11, 2014)*

R$ 1300 – **Professional & Academic associates of ADIMB**
R$ 1700 – **Non-associate of ADIMB**
R$ 800 – **Students**

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Sedimentary Rock-Hosted Copper Deposits of the Central African Copperbelt

Windhoek, Namibia, Africa
August 17, 2014

A pre-meeting short course offered in conjunction with The Roy Miller Symposium

DESCRIPTION

Sedimentary rock-hosted stratiform copper deposits comprise disseminated to veinlet Cu- and Cu-Fe-sulfides in siliciclastic or dolomitic sedimentary rocks. These deposits are common, although rarely as economically significant occurrences. Yet they currently account for ~23% of the world's Cu production and known reserves and are important sources of Co and Ag.

This one-day, pre-meeting short course will focus on the geology and ore deposits of the Central African Copperbelt, the world's largest and highest-grade sedimentary copper province, with ~200 Mt of contained copper and the world's largest cobalt reserves. Deposit settings, mineralization controls, and alteration styles in the Zambian Copperbelt, Congolese Copperbelt, and in the North West Province of Zambia will be covered. In analyzing why the Central African Copperbelt is so rich relative to other sedimentary Cu districts, participants will learn exploration strategies for this deposit type.

PRESENTER

- **Presenter: Dr. Murray W. Hitzman** – Charles F. Fogarty Professor of Economic Geology, Department of Geology & Geological Engineering, Colorado School of Mines, Golden, Colorado; 2005 President of SEG

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REGISTRATION Online at **www.geolsocnamibia.org**

Registration Fees

Member: N$1800
Non-member: N$2800
Student Member: N$250
Student Non-member: N$400

14th Quadrennial International Association on the Genesis of Ore Deposits Symposium

Mineral Resources: Discovery and Utilization

Yunan Convention Resort
Kunming,China
19-22 August 2014

Let's Brainstorm

Plenary Talks and Thematic Sessions

Plenary talks:

Richard Sillitoe (UK)
Jingwen Mao (IAGOD president, China)
Richard Goldfarb (SEG)
Bernd Lehmann (SGA)
Nigel Cook (IAGOD)
Keiko Hattori (Canada)

Thematic sessions and keynotes:

- Mesozoic ore deposits Eurasia (N. Goryachev, W.D. Sun, G. Collins)
- Giant ore deposits (R.F. Pei, P. Laznicka)
- MVT, SEDEX and VMS deposits through geological history (D. Leach, T. Monecke)
- Black shale-hosted mineral deposits (S.Y. Jiang)
- Mineral deposits associated with mafic and ultramafic rocks (F. Pirajno, Y. Wang)
- IOCG deposits (L. Meinert, H. Hu)
- Critical metals in ore-forming systems: New perspectives (D. Sinclair, A. Williams-Jones, Y.L. Xie)
- Porphyry Cu (±Au, Mo) deposits (D. Cooke, B. Rusk)
- Gold deposits: epithermal, orogenic, and Carlin-like (J. Hedenquist, R.Z. Hu)
- Mineral deposit systems of active continental margins (R. Seltmann)
- Metallogenesis in the Eastern Tethysian System (Z.Q. Hou, J. Richards)
- Geochronological constraints on ore-forming processes (C. McFarlane, D. Selby)
- Geochemistry of hydrothermal fluids (R. Bodnar, H.R. Fan)
- Mineral exploration and extraction (R. Feng, N.Reynolds)
- Uranium deposits (M. Cuney, Z.Y. Li)
- Ore mineralogy and geometallurgy (C. Ciobanu)
- Proterozoic and Paleozoic Igneous activities and metallogeny (J. Kolb, F.J. Nie)
- Traditional and non-traditional isotopes applied to ore deposits (D. Ishiyama, X.K. Zhu)
- Tectono-Magmatic Activity and Associated Metallogeny (W.M. Fan, G.X. Chi, L. Maslov, A. Ord)

Pre-Conference Workshops and Short Courses

SEG workshop:

Classes of Minerals Deposits and their Exploration Criteria

Short course:

1. Significant Metal Deposits of the World:Today and Tomorrow
2. EXPLORE: new software for mineral assessment, prospecting, and exploration
3. LA-ICP-MS: Geochemistry, Geochronology, and Ore Genesis

Post-Conference Field Trips

1. Beiya porphyry-skarn Au-Pb-Zn and Jinding Pb-Zn deposits, Yunnan Province
2. Polymetallic tin deposits and related intrusions, Gejiu, SW Yunnan Province
3. Huize MVT-type Pb-Zn deposit, Yunnan Province
4. Carlin-like gold deposits in western Guizhou Province
5. Ban Phuc PGE, Quy Xa iron, Cam Duong phosphorus and Sin Quyen IOCG deposits, Vietnam
6. Phapon Au, Phu Kham porphyry Cu-Au, and a major potash deposit, Laos
7. Black-shale hosted Cambrian Tianzhushan barite and Zhijin phosphorus deposits and Neoproterozoic Mn deposit in western Guizhou Province
8. Au deposits in Jiaodong area, Shandong Province
9. Dexing Cu-Au deposits, Yinshan epithermal Pb-Zn-Ag and Yongping deposit, Jiangxi Province

Important Dates

Registration opens	15th Dec 2013
Early bird registration closes	15th May 2014
Submission of abstracts opens	15th Dec 2013
Abstract submissions deadline	15th May 2014
Student application for support closes	15th May 2014
Online registration closes	15th Jul 2014

Association of Mineral Deposits, Geological Society of China

The China Geological Survey warmly invites you to the 14th IAGOD Symposium

For more information please visit the website: www.14iagod.org

EDUCATION & TRAINING

SEG MEMBERSHIP NEWS

CANDIDATES FOR SEG FELLOWSHIP

To All SEG Fellows:

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 his/her SEG sponsors. If you have any comments, favorable or unfavorable, on any candidate, you should send them **in writing prior to May 31, 2014.** If no objections are received by that date, these candidates will be presented to Council for approval.

Address Comments To

Chair, SEG Admissions Committee
SOCIETY OF ECONOMIC GEOLOGISTS • 7811 Shaffer Parkway • Littleton, CO 80127-3732 • USA

Albayrak, Omer Koza Gold, Ankara, Turkey: Jeffrey W. Hedenquist, Ugur Kiziltepe;
Bardoux, Marc Barrick Gold Corporation, Ste. Marcelline de Kildare, Canada: François Robert, M. Stephen Enders;
Bourke, Fletcher M. GBX Consulting Ltd., Sapporo, Japan: Jeffrey W. Hedenquist, Sachihiro Taguchi;
Brown, William R. Amarillo Gold Corporation, Belo Horizonte, Brazil: Brian Thomson, Jeffrey W. Hedenquist;
Demirci, Cengiz Asia Minor Mining Company, Ankara, Turkey: Mesut Soylu, M. Stephen Enders;
Earls, Garth University College Cork, Newtownards, Northern Ireland: John A. Clifford, James Coppard;
Field, Matthew AMEC, Wells, United Kingdom: Paul Zweistra, Pamela Naidoo-Ameglio;
Lauderdale, John N. ENRC Africa, Kitwe, Zambia: Judith Kinnaird, Paul Nex;
Longo, Anthony A. Consultant–Spire Exploration LLC, Washoe Valley, Nevada: Jeffrey W. Hedenquist, Sachihiro Taguchi;
McCarthy, Matthew J. BHP Billiton Ltd., Perth, Australia: Jon Hronsky, Paul Hodkiewicz;
Meares, Russell M. Malachite Resources Ltd., Pymble, Australia: Kim Stanton-Cook, K.J. Maiden;
Roth, Eric Aegean Metal Group Inc., Santiago, Chile: Jeffrey W. Hedenquist, Sachihiro Taguchi;
Skoog, Jenny Actium Holding–Liburnian Advisors, Chomix Mont-Blanc, France: Michael Harris, Lluís Fontboté;
Wainwright, Alan Venture One Capital Corporation, Vancouver, Canada: Daniel Marinov, Steve Enns;
Walker, James A. New Brunswick Department of Energy and Mines, Bathurst, Canada: David R. Lentz, Steve McCutcheon.

The Society Welcomes The Following NEW SEG FELLOWS:

Bowles, John F.W., Creysse, France; **Braxton, David P.**, Santiago, Chile; **Carvalho, Sebastiao G.**, Rio Claro, Brazil; **Chauvet, Alain**, Montpellier, France; **Dunning, Jason K.**, Toronto, Canada; **Garay, Enrique**, Lima, Peru; **Heithersay, Paul S.**, Adelaide, Australia; **Hickson, Catherine J.**, Burnaby, Canada; **Kelly, Nigel M.**, Golden, Colorado; **Llorca, James P.**, Point Cook, Australia; **Ly, Alejandro L.**, Elko, Nevada; **Mahood, Gail A.**, Stanford, California; **Marín-Cerón, Maria I.**, Medellin, Colombia; **Miller, David R.**, Riverton, Wyoming; **Mindszenty, Andrea**, Eotvos, Hungary; **Mlynarczyk, Michael S.J.**, Krakow, Poland; **Postlethwaite, Clay E.**, Westminster, Colorado; **Redak, Stephen G.**, Boulder, Colorado; **Redmond, Patrick B.**, Vancouver, Canada; **Roa, Karl J.**, Volcano, Hawaii; **Ryan, Shawn A.**, Whitehorse, Canada; **Sadeghi, Martiya**, Uppsala, Sweden; **Stein, Gilbert**, Paris, France; **Teixeira, João Batista Guimarães**, Salvador, Brazil; **Tiberindwa, John W.**, Kampala, Uganda; **Wake, Bradley A.**, Woy Woy, Australia.

The Society Welcomes The Following NEW SEG MEMBERS:

Kelvin Cruz Abarra, Mississauga, Canada; Çaglar **Acimaz**, Tuprag-Elorado Gold, Izmir, Turkey; **Kerim Tamer Algun**, Tüprag Metal Madencilik, Ankara, Turkey; **Arda Arcasoy**, Arcasoy Danismanlik ve Muhendislik Ltd., Ankara, Turkey; **Erdem Atalar**, TAHE International Metal Mining Co., Ankara, Turkey; **Daniel R. Atkinson**, Toro Gold Ltd, Worcester, United Kingdom; **Russell H. Bailie**, University of the Western Cape, Cape Town, South Africa; **Carlos Alberto Ballivian Justiniano**, Instituto de Recursos Minerales, La Plata, Argentina; **Korin N. Barnes**, Nevada Copper, Yerington, Nevada; **Marc Battaglieri**, Montréal, Canada; **Kelly Bell**, ABM Resources NL, Perth, Australia; **Angela L. Bokuik**, Mineral Resources Authority, Port Moresby, Papua New Guinea; **Karen Wassell Calitis**, Hudbay Minerals, Flin Flon, Canada; **Oscar Cano**, Rio Alto Mining, Jesus Maria; Peru; **Pablo Carrasco**, Geoinnova Consultores, Santiago, Chile; **Shizhong Chen**, Nanjing Center of Chinese Geological Survey, Nanjing, China; **Joseph Colgan**, U.S. Geological Survey, Menlo Park, California; **Michael W. Cowell**, Two Rivers Platinum, Lydenburg, South Africa; **Mehmet Deveci**, Pontid Madencilik San Ve Tic LTD STI, Ankar, Turkey; **Bruce W. Downing**, New Carolin Gold, White Rock, Canada; **Ian K. Dreyer**, MIC S.A.C., Lima, Peru; **Benjamin K. Eggers**, Blackbird Geoscience, Tofino, Canada; **Jonathan Franco**, Goldcorp RLGM, Balmertown, Canada; **Yoshikazu Fujimoto**, Yokohama, Japan; **Tobias Fusswinke**, Helsinki, Finland; **Amber Garrett**, Spruce Grove, Canada; **Roger Allen Haskins**, Federal Mineral Lands Assistance LLC, Fairfax, Virginia; **Nicole Hoffmann**, Twin Metals Minnesota, Ely, Minnesota; **Tara J. Hutchison**, SMM Pogo, LLC, Fairbanks, Alaska; **John Carl Jackson**, JKTech, Brisbane, Australia; **Roxanne Jacobs**, Unigold Inc., Rouyn-Noranda, Canada; **Ferdinand Jumawan**, Cordillera Exploration Co., Inc., Cebu City, Philippines; **Jonathan Kaniovisi**, Mineral Resource Authority, Port Moresby, Papua New Guinea; **Haci Karakus**, Afrasia Mining and Energy, Ankara, Turkey; **Robert L. Kastelic**, Reno, Nevada; **Aaron Kelts**, Tucson, Arizona; **Yigit Salih Keskinler**, Demir Export, Ankara, Turkey; **Rodney J. King**, Teck Australia Pty. Ltd., West Perth, Australia; **Evandro Klein**, CPRM/Geological Survey of Brazil, Belem, Brazil; **Johannes F. Lambrechts**, Glencore, Mount Isa, Australia; **Graham D. Layne**, Memorial University, St. John's, Canada; **Rui M. Leal Miranda**, Colt Resources, Lisboa, Portugal; **John L. Macdonald**, Hot Chili Limited, Rivervale, Australia; **James Madson**, Freeport McMoRan, Silver City, New Mexico; **David W. Maidment**, St. Barbara Ltd., West Perth, Australia; **Jhonatan P. Mallma Espinoza**, Los Quenuales S.A., Lima, Peru; **Mervin J. McDonald**, Iron Ore Company of Canada, Labrador City, Canada; **Dylan Elek McFarlane**, University of Exeter, Penryn, United Kingdom; **Robert L. McGill**, SMM Pogo, LLC, Delta Junction, Alaska; **James D. McGuffin-Cawley**,

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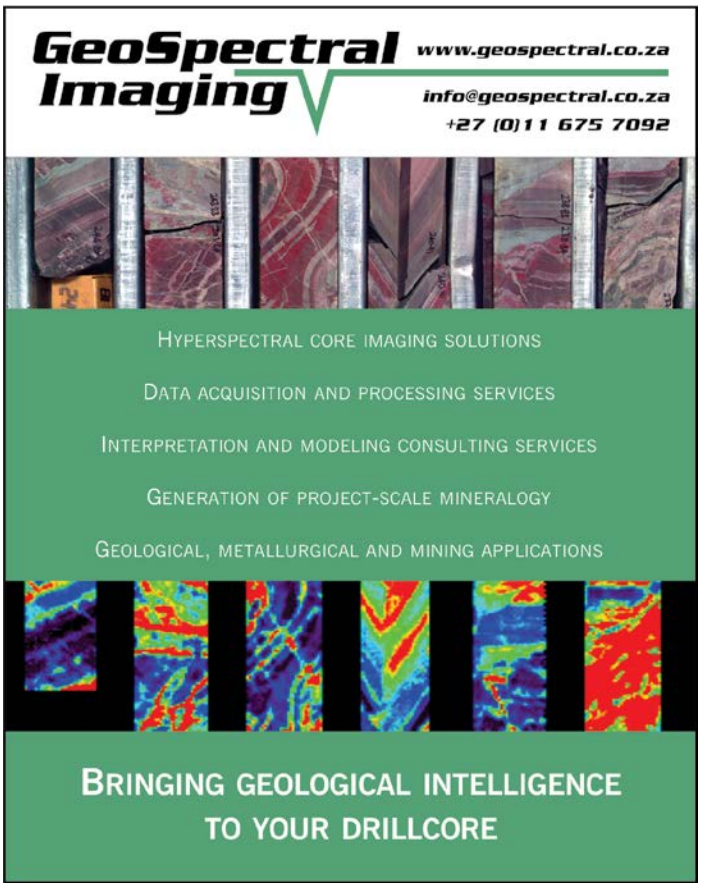
Case Western Reserve University, Cleveland, Ohio; **Cristhian J. Mendoza Gil**, La Arena S.A., Cajamarca, Peru; **Andrea Mindszenty**, Eötvös Loránd University, Budapest, Hungary; **Rasool Mohammad**, Laronge Gold-Comstock Metals Ltd., Richmond, Canada; **Regina Molloy**, Select Exploration, Strathavon, Gauteng, South Africa; **Michael James Munroe**, Endeavour Silver, Stellarton, Canada; **Loren V. Nicholls**, Newcrest Mining Limited, Gold Coast, Australia; **Alexander Nielsen**, Vancouver, Canada; **Efdal Olcer**, MNG Gold Ghana, Accra; Ghana; **Luis E. Olvera Rosas**, University of Zacatecas, Zacatecas; Mexico; **Ferda Oner**, Meta Nikel Kobalt A.S., Ankara, Turkey; **Matthew J. Orr**, Wipro Technologies, Houston, Texas; **Alexander V. Parshin**, Vinogradov Institute of Geochemistry, Irkutsk, Russia; **Jaime M. Pascoe**, Blackbird Geoscience, Tofino, Canada; **Richard P. Patterson**, Rio Tinto, Taylorsville, Utah; **Craig S. Pearman**, Midlands Minerals Corp., Bowen Island, Canada; **Philip Max Persson**, Persson Rare Minerals, Denver, Colorado; **Joshua Phillips**; Cottesloe, Australia; **Oscar J. Pinilla**, Sabre Metals Inc., Bucaramanga, Colombia; **Michael A. Pond**, Thompson Creek Mining Ltd., Fraser Lake, Canada; **Christopher John Rees**, Imperial Metals Corporation, Victoria, Canada; **Camla J. Rochat**, OZ Minerals, Port Adelaide, Australia; **Maria Cecilia Rodriguez**, Río Cuarto, Argentina; **Bernard A. Rowe**, Global Geoscience Ltd., North Sydney, Australia; **Hernando Rueda**, Agnico Eagle, Chihuahua, Mexico; **Colin W. P. Russell**, Kamloops, Canada; **Floyd F. Sabins**, Remote Sensing Enterprises, Inc., Fullerton, California; **Dulcie Saroa**, Mineral Resource Authority, Port Moresby, Papua New Guinea; **Phillip B. Schiemer**, Calgary, Canada; **Peter A. Scott**, O'Kane Consultants Pty. Ltd., Paddington, Australia; **Deniz Can Serce**, Centerra Gold (Öksüt Madencilik AS), Ankara, Turkey; **James Sinclair**, Perth, Australia; **Robert W. Smillie**, Ok Tedi Mining Ltd., Tabubil, Papua New Guinea; **Graeme Stroker**, Waterton Global Mining, Elko, Nevada; **Dan Taranik**, Exploration Mapping Group, Inc., Las Vegas, Nevada; **Niall Tomlinson**, Plutus Strategies, London, United Kingdom; **Collette U. Tsiperau**, Mineral Resources Authority, Port Moresby, Papua New Guinea; **David Tupper**, North Vancouver, Canada; **Berkin Ugurlu**, Afrasia Mining and Energy, Ankara, Turkey; **Marcelo Vega Astudillo**, Teck Resources Chile, Santiago de Chile, Chile; **Francisco T. Vilela**, Belo Horizonte, Brazil; **Javier Villegas, Sr.**, Greiphil Minas Ltda, Belem, Brazil; **Andrey V. Vishnevskiy**, VS Sobolev Institute of Geology and Mineralogy, Novosibirsk, Russia; **James A. Walker**, New Brunswick Department of Energy and Mines, Bathurst, Canada; **Arne Weissmann**, MTC Mining Technology Consulting, Goslar, Germany; **Raelene Wentz**, SMM Pogo, LLC, Delta Junction, Alaska; **Lori M. Wickert**, Consultant - Remote Sensing Geology/Spectral Geology, Greely, Canada; **Kyle E. Williams**, The Doe Run Company, Viburnum, Missouri; **Gene Yogodzinski**, University of South Carolina, Columbia, South Carolina; **Xinqi Yu**, China University of Geosciences, Beijing, China; **Dawn Zhou**, Saskatoon, Canada.

The Society Welcomes The Following

NEW SEG STUDENT MEMBERS:

Fatoni Adyahya, Padjadjaran University, Sumedang, West Java, Indonesia; **Ashley K. Anderson**, Colorado School of Mines, Golden, Colorado; **Prentiss Andrews**, Western Washington University, Bellingham, Washington; **Alisa Antropova**, Institute of Geology and Mineralogy SB of RAS, Novosibirs, Russia; **Muhammad Fakhri Auladana**, Padjadjaran University, Sumedang, Indonesia; **Arif Aydar**, Mugla Sitki Kocma University, Akhisar, Turkey; **Nuria Bach Oller**, Université de Genève, Geneva, Switzerland; **Thomas Bagley**, Acadia University, Canning, Canada; **Octavia Bath**, University of Ottawa, Ottawa, Canada; **Christopher L. Beaver**, Iowa State University, Ankeny, Iowa; **María T. Bellver-Baca**, Université de Genève, Geneva, Switzerland; **Mete T. Beltan**, Mugla Sitki Kocman University, Ankara, Turkey; **Khulan Berkh**, Friedrich-Schiller University, Jena, Germany; **Jose Bernahola Portugal**, Universidad Nacional de San Agustin, Arequipa, Peru; **Joseph Biasi**, Indiana University, Bloomington, Indiana; **Christopher Black**, James Cook University, Kuranda, Australia; **Teagan**

to page 60 . . .



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. . . from page 59 SEG Membership News *(continued)*

Blaikie, Monash University, Upwey, Australia; **Alexandre R. Boulerice**, Institut National de la Recherche Scientifique, Quebec, Canada; **Anthony Boxleiter**, Western Michigan University, Kalamazoo, Michigan; **Onur Bozdemir**, Mugla Sitki Koçman University, Mugla, Turkey; **Josh Buosi**, Lakehead University, Thunder Bay, Canada; **Alejandra Caceres Sanchez**, Universidad Nacional de San Agustin, Arequipa, Peru; **Nicolas Canaza Mamani**, Universidad Nacional de San Agustin, Arequipa, Peru; **Cesar Anthony Chavez Machaca**, Universidad Nacional de San Agustin, Arequipa, Peru; **Almaz Cholponkulov, Sr.**, Shimane University, Matsue, Japan; **Miguel Armando Coaguila López**, Universidad Nacional de San Agustin, Arequipa, Peru; **Yudith S. Coaguira Cayllahua**, Universidad Nacional de San Agustin, Arequipa, Peru; **Nicola Coffin**, University of Exeter, Falmouth, Cornwall, United Kingdom; **Natalie Cook**, University of British Columbia, Vancouver, Canada; **Felix P. Cruz Paredes**, Universidad Nacional de San Agustin, Arequipa, Peru; **Kevin A. Cueva Sandoval**, Universidad Nacional de San Agustin, Arequipa, Peru; **Huan Cui**, University of Maryland, College Park, Maryland; **Gustavo Cusi Llacma**, Universidad Nacional de San Agustin, Arequipa, Peru; **Chloe O. DesVoignes**, University of Texas at El Paso, El Paso, Texas; **Christi Diaz Salaz**, Universidad Nacional de San Agustin, Arequipa, Peru; **David Diekrup**, University of Ottawa, Ottawa, Canada; **Zachary Caleb Dodd**, Kansas State University, St. George, Kansas; **Natascha Dundon**, Centre for Exploration Targeting, Perth, Australia; **James Edwards**, University College London, Betchworth, United Kingdom; **Mary L. Encinas Aguilar**, Universidad Nacional de San Agustin, Arequipa, Peru; **Ilker Ergun**, Mugla Sitki Kocman University, Mugla, Turkey; **Esmaeil Eshaghi**, University of Tasmania, Hobart, Australia; **Gayle Febbo**, University of British Columbia, Revelstoke, Canada; **Paul M. Fix**, University of Minnesota - Duluth, Duluth, Minnesota; **Colby Ford**, Loma Linda University, Loma Linda, California; **Martin Gal**, University of Tasmania, Hobart, Australia; **Emmanouil Galanos**, University of Athens, Athens, Greece; **Stephen J. 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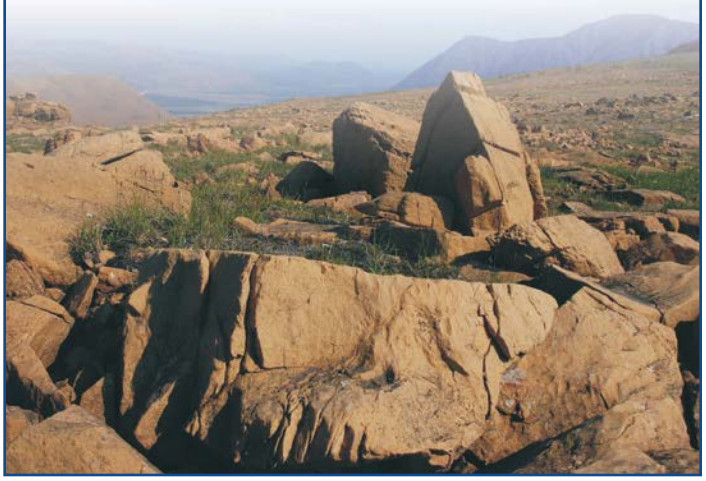

CODES SEG Student Chapter Field Trip

IBERIAN PYRITE BELT

May 18 - 30, 2014

Highlights:

- Regional volcanostratigraphic geology
- Lectures and discussions with industry-leading experts
- Knowledgeable guides (Drs. F. Tornos and J. Relvas)
- Environmental and rehabilitation concepts
- Port tasting

Mine visits:

- Neves Corvo
- Aguas Tiendas
- Tharsis
- Las Cruces
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Join us for sangria and sulfides! Spots filling fast!

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SEG Announcements & Deadlines

Regional Vice President

Dr. Antoni Camprubi (SEG 2002 F) of the Universidad Nacional Autónoma de México (UNAM) has been appointed Regional Vice President for Mexico, Central America, and the Caribbean Region for a three-year term (2014-2016).

We want to thank the outgoing Regional Vice President, Erme Enriquez (SEG 1997 F), for his work and efforts promoting the SEG in this region from 2011-2013.

Call for Nominations for Penrose, SEG Silver Medals, and Marsden Award for 2014

Nominations for the Society's Penrose Gold, Silver Medals, and the Marsden Award are due by **August 15, 2014**, for review by the SEG Council.

The SEG awards and nomination form may be obtained from the SEG website at www.segweb.org/forms. 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 / Fax: +1.720.981.7874
E-mail: seg@segweb.org

Send all nominations to:
SEG, Attn: Awards Committee
7811 Shaffer Parkway, Littleton, CO 80127-3732 U.S.A.
E-mail: seg@segweb.org **(preferred method)**

Call for Nominations for 2015 SEG Traveling Lecturers

- International Exchange Lecturer
- Thayer Lindsley Visiting Lecturer
- Regional Vice-President Lecturer

International Exchange lecturers speak at sites selected for greatest involvement of industry, academic, and government geologists. Thayer Lindsley lecturers visit colleges and universities. Regional Vice-President lecturers mainly present within one or more of the SEG global regions. Travel support is provided by SEG for those who are chosen.

To be selected, nominees must (1) have widely recognized expertise in a field of economic geology; (2) have known competence as a public speaker; and (3) be able to represent SEG as an enthusiastic and effective ambassador.

The deadline for submitting nominations is **August 15, 2014**.

Forward nominations to Christine Horrigan at SEG headquarters at christinehorrigan@segweb.org.

Call for Nominations Lindgren Award for 2014

The Lindgren Award is offered annually to a geologist whose published research represents an outstanding contribution to economic geology. The contribution shall be measured by consideration of one to three papers published by age 35. The recipient must be less than 37 years of age on January 1 of the year in which the award is presented. The award shall not be restricted as to the candidate's nationality, place of employment, or membership in the Society.

The deadline for submitting nominations is **August 15, 2014**.

Send all nominations to:
SEG, 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 SEG Distinguished Lecturer for 2015

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 2015 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. Please include the following information with your nomination: name of nominee, nominee's e-mail address, reason for nomination, brief bio of nominee, and confirmation that nominee is willing to be proposed.

The deadline for submitting nominations is **August 15, 2014**.

Send all nominations to:
SEG, Attn: Distinguished Lecturer Committee
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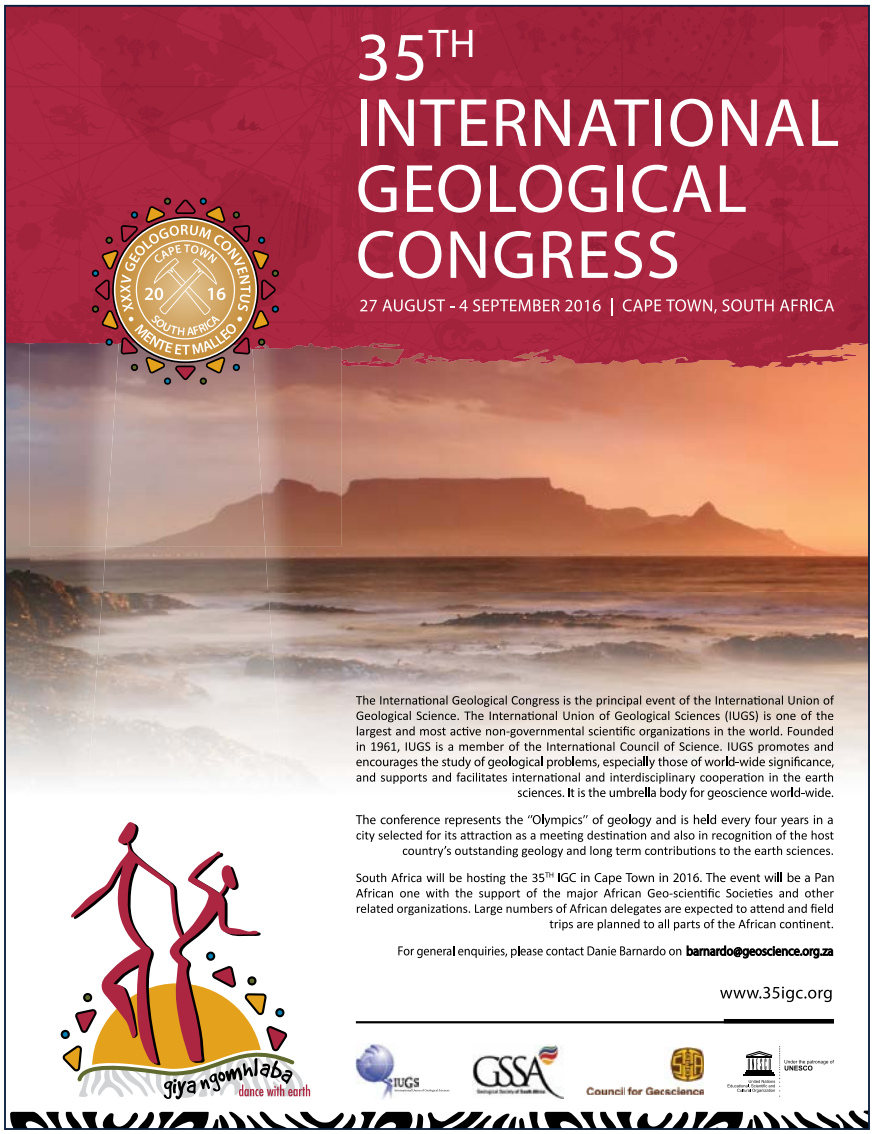
personal notes & news

AWARDS & ACCOMPLISHMENTS

Neil Williams (SEG 1982 FL) was awarded the Haddon Forrester King Medal by the Australian Academy of Science for his original and sustained scientific contributions to mineral exploration, including his leadership of Geoscience Australia and the achievements of the agency during his tenure as the CEO, from 1995 to 2010. Neil served as SEG President in 2008 and is currently a Thayer Lindsley Visiting Lecturer for the Society. He holds an honorary professorial fellowship at the University of Wollongong, Australia.

AME BC Awards

The Association for Mineral Exploration British Columbia (AME BC) announced its 2013 awards in December. Among the recipients of the H.H. "Spud" Huestis Award for excellence in prospecting and mineral exploration were **Craig Finnigan** (SEG 2008 F), **Adam Simmons** (SEG 2007), and **Alan Wainwright** (SEG 2011), of Venture One Capital Corp. They were recognized for their role in the Kaminak Gold Corporation development of the Coffee gold project. **Peter Holbek** (SEG 2013) of Copper Mountain Mining Corp. was recognized with the E.A. Scholz Award for excellence in mine development.



DEATHS

Donald L. Everhart
(SEG 1952 SF)

Donald L. (Don) Everhart died on December 17, 2013. A native of Ohio, he received his B.A. degree (summa cum laude) in geology from Denison University and his M.A. and Ph.D. degrees in geology from Harvard University. He was awarded a Distinguished Alumnus Citation and an honorary Doctor of Science degree from Denison.

Don was a Senior Fellow of both the Geological Society of America and the SEG. With SEG, he served as a trustee, from 1995 to 1998, and was SEG Foundation President from 1989 to 1992. Don was named Thayer Lindsley Lecturer for 1974 and received the 1998 Ralph W. Marsden Award for service to the SEG.

Don began his career as a geologist working for the U.S. Geological Survey, and then became the Chief of the Geologic Branch, and later the Geologic Advisor to the U.S. Atomic Energy Commission. Don subsequently spent 18 years in the private sector as chief geologist and later as division vice-president of International Minerals and Chemical Corporation, before moving to Grand Junction in 1977. There he became the project manager of the National Uranium Resource Evaluation (NURE) project under the Carter administration and later, Manager of the Grand Junction Office of the U.S. Department of Energy. Don retired in 1981 and for the next 15 years practiced as an independent consulting geologist. His career took him to many countries and during retirement he and his wife, Dorothy, continued to enjoy traveling.

Don was active in a number of civic, educational, and charitable organizations during his residency in Grand Junction. He and Dorothy were charter member cellists of the Grand Junction Symphony Orchestra and both served terms as members of the Grand Junction Musical Arts Association Board. Don was a tenor in the Western Colorado Chorale for several years and a member of the Celtic Singers.

Don is survived by his four children: Ellen Bradley of Grand Junction (Ron); Larry Everhart of Lakeland, FL; Greg Everhart of Roselle, IL (Christine); and Doug Everhart of Durango, CO (Nancy). He was preceded in death, in 2011, by Dorothy. During numerous family camping trips and hikes, he passed along to his children his love for geology and his wonder of the great outdoors.

Memorial donations will be gratefully accepted at the First Congregational Church of Grand Junction, CO.

Contributed by Ron Bradley

DEATHS

Michael J. Casselman (SEG 1994) died January 25, 2014, in Vancouver, BC, Canada, at the age of 68. A British Columbia native, Mike received his bachelor's degree from the University of British Columbia and his master's degree from Carleton University. He found and explored several deposits at Hackett River, Northwest Territories, as well as at Tulsequah Chief, BC. He was employed for more than 30 years by Cominco and had also worked at the Pebble Copper porphyry deposit in Alaska. He served as director, vice-president, and technical advisor with the Candente Group and was a board member of Savant Explorations, Ltd.

Craig S. Finnigan (SEG 2008 F) died January 30, 2014. He was 46. After receiving bachelor's and master's degrees from the University of Western Ontario, Canada, Craig earned a Ph.D. at the University of Toronto. As an exploration geolo]gist, he worked in gold, platinum, and nickel discovery projects. He was a recipient in December of the AME BC 2013 H.H. "Spud" Huestis Award.

Eberhard W.H. Theurkauf (SEG 1965 F) died August 20, 2013, in Germany. No additional information is available at this time.

Byron Berger

Contributed by Martin Goldhaber and Ian Ridley

Barney Berger, wearing his signature field hat, explains field relations in Nevada.

Byron (Barney) Berger (SEG 1987 F) died on December 10, 2013, at the age of 69. Barney, an internationally prominent economic geologist, received B.A. degrees in both geology and economics from Occidental College and an M.S. degree in geology from the University of California Los Angeles (UCLA). Although his career was heavily oriented toward geology, he maintained his interest in economics as well, which allowed him to bring this important perspective to his USGS research. His early career (1971–1977) was spent in industry at the Minerals Exploration Department of CONOCO, focusing on gold exploration in Nevada as the project chief at the Getchell gold mine. He joined the U.S. Geological Survey in September 1977.

Barney's early USGS work focused on conducting assessments for mineral deposits. He led a major effort in Montana and was later involved in similar studies in the western United States, Central America, Hungary, and Asia. As his career expanded, Barney was involved in a wide range of ore genesis research; he authored or co-authored nearly 50 papers on the geology and geochemistry of ore deposits. His most recent work, in collaboration with his Australian colleague Dick Henley, focused on vapor phase transport of ore constituents; insights that were able to clarify how fine details of ore mineral textures are linked to the geologic context of ore deposit formation. Recently, Barney was instrumental in placing USGS remotely sensed hyperspectral data from Afghanistan into an economic geology context. He also brought his combined geologic and economic expertise to the table for a materials flow project to characterize the "life-cycle" of rare earth elements from mining to utilization to disposal.

Barney Berger (left) with Phil Bethke (center) and Dick Henley (right) during a field trip to Creede, Colorado.

With the Survey, Barney served as Chief of the Exploration Geochemistry Branch and later of the Geochemistry Branch for a total of six years. His strong mentorship and vision made him an outstanding leader of economic geology research.

An extended obituary can be found in the online supplement to the *Newsletter*.

Peter A. Rona (SEG 1985 F)

Contributed by James M. Franklin

Peter Rona, a well-known oceanographer who made exceptional contributions to mineral deposits geology, died February 20, 2014, of complications from multiple myeloma. He was a professor of Earth and Planetary Sciences at Rutgers University.

Peter was a renaissance man of oceanography. His contributions to our understanding of sea-floor hydrothermal processes usually examined aspects that, as mineral deposits specialists, we may have overlooked. He is credited with the discovery of the Mid Atlantic Ridge TAG hydrothermal site, the largest and one of the deepest vent systems known in the world's active spreading ridges. His efforts to encourage others to investigate this site engendered one of the most robust set of studies of any such sites. I had several opportunities to work at sea with Peter on his pursuit of unique ways to measure geophysical parameters of these sites in real time. For example, his work on heat flow in in both the near and far field parts of an active hydrothermal system did much to improve our understanding of the mechanism for "exhalite" formation, and consequently led to the discovery of new key chemical indicators in these units that point to discharge centers and potential orebodies.

He gained his inspiration for understanding hydrothermal processes when he came to the Abitibi region of Quebec for his first visit to VMS deposits. His inquisitiveness revealed to many of us that the processes that underpinned the development of many of the attributes that we observed and accepted as part of the VMS model were actually poorly understood. His subsequent research illustrated the value of recruiting the "nonspecialist" but scientifically excellent researchers to our mineral deposits research community.

Peter also made many contributions to the advancement of research that benefitted our entire geoscience community. He mobilized a large group of geologists in China in the late 1980s to engage in modern studies of VMS deposits, resulting in many contributions from these colleagues to the Western literature. His tireless work to encourage the drilling of hydrothermal systems by the International Ocean Drilling Program allowed dozens of young scientists to further their careers in the study of all attributes of sea-floor research, from investigating hydrothermal systems to finding living fossils on the sea floor. As a professor he mentored dozens of students, challenging them to solve a myriad of geological and geophysical problems. He popularized the sea-floor vent work through his landmark descriptions in National Geographic in October 1992. He was widely recognized by his peers, including, in 1987, his being awarded the Commerce Department's gold medal for exceptional scientific contributions to the nation.

Peter Rona was predeceased in 2013 by his wife of more than 40 years, Donna. He is survived by his daughter, Jessica. He was a giant amongst marine scientists and mineral deposits geologists alike. He will be missed.

Calendar of EVENTS

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Date	SEG Calendar of Events
	Year 2014
APRIL 24–27	5th International Students Geological Conference, Budapest, Hungary. isgc2014.elte.hu.
MAY 1–7	World-Class Silver Deposits in Southern Bolivia Field Trip, Bolivia.
MAY 12–17	SEG Course—Key Practical Methods in Mineral Exploration, Littleton, CO, USA. See p. 54.
MAY 11–14	SIMEXMIN 2014, Ouro Preto, Brazil. See p. 47.
MAY 15–16	SEG Course—Sedimentary Rock-Hosted Copper Deposits of the Central African Copperbelt, Ouro Preto, Minas Gerais, Brazil. See p. 55.
MAY 18–30	CODES SEG Student Chapter Field Trip, Iberian Pyrite Belt. See p. 61.
MAY 19–26	UNESCO-SEG-SGA Latin-American Metallogeny Course, Quito, Ecuador **Sold Out**.
JUNE 8–14	Goldschmidt 2014, Sacramento, California, USA. See p. 52.
AUGUST 11–14	12th International Platinum Symposium, Yekaterinburg, Urals, Russia. See p. 61.
AUGUST 17	SEG Course—Sedimentary Rock-Hosted Copper Deposits of the Central African Copperbelt, Windhoek, Namibia, Africa. See p. 56.
AUGUST 18–20	The Roy Miller Symposium, Windhoek, Namibia. See back cover.
AUGUST 19–22	14th Quadrennial IAGOD Symposium, Kunming, China. See p. 57.
SEPTEMBER 1–5	International Mineralogical Association (IMA 2014), Sandton Convention Center, Gauteng, South Africa. See p. 27.
SEPTEMBER 11–13	GSSA Kimberley Diamond Symposium & Trade Show, Kimberley, South Africa. See p. 48.
SEPTEMBER 3–11	SEG Foundation Student-Dedicated Field Trip—Archean Base and Precious Metal Deposits, Southern Abitibi Greenstone Belt, Canada. See p. 46.
SEPTEMBER 27–30	SEG Keystone 2014—Keystone, Colorado USA. See p. 32–40.
SEPTEMBER 30–OCTOBER 3	SGA-SEG-UNESCO-IUGS Course in African Metallogeny, Marrakech, Morocco. See p. 4.
OCTOBER 12–15	XVII Peruvian Geological Congress. See p. 45.
OCTOBER 19–22	GSA 2014 Annual Meeting, Vancouver BC, Canada. www.geosociety.org
NOVEMBER 9–15	9th Annual Workshop—Ore Deposits Models and Exploration, Fujian, China. See p. 21.
NOVEMBER 30–DECEMBER 6	American Exploration and Mining Association Meeting, Reno, NV, USA (formerly Northwest Mining Association). www.miningamerica.org

Date	SEG Calendar of Events
	Year 2015
JANUARY 2015	AME BC Roundup—Vancouver BC, Canada. www.amebc.ca
MARCH 1–4	PDAC—Toronto, Canada. www.pdac.ca
MARCH 2015	PACRIM 2015 Congress, Hong Kong, China. www.pacrim2015.ausimm.com.au
APRIL 20–24	27th IAGS Meeting, Tucson, AZ, USA. www.27iags.com/about
MAY 15–23	GSN 2015, Reno, Nevada, USA. See p. 22.
AUGUST 16–21	Goldschmidt 2015, Prague, Czech Republic. www.goldschmidt.info/2015
AUGUST 24–27	SGA 13th Biennial Meeting, Nancy, France. sga2015.univ-lorraine.fr
SEPTEMBER 27–30	SEG 2015 Conference, Hobart, Tasmania. www.seg2015.org
NOVEMBER 1–4	GSA 2015 Annual Meeting, Baltimore, Maryland, USA. www.geosociety.org
NOVEMBER 29–DECEMBER 6	American Exploration and Mining Association Meeting, Spokane, WA, USA. www.miningamerica.org
	Year 2016
JANUARY 2016	AME BC Roundup—Vancouver BC, Canada. www.amebc.ca
MARCH 2016	PDAC—Toronto, Canada. www.pdac.ca
AUGUST 27–SEPTEMBER 4	35th (IGC) International Geological Congress, Cape Town, South Africa. See p. 64.
SEPTEMBER 25–28	GSA 2016 Annual Meeting, Denver, CO, USA. www.geosociety.org
SEPTEMBER 2016	SEG 2016 Conference, Izmir, Turkey.
DECEMBER 4–10	American Exploration and Mining Association Meeting, Reno, NV, USA. www.miningamerica.org

Date	Other Events
	Year 2014
JUNE 2–6	XIX Argentina Geological Congress, Córdoba, Argentina.
JUNE 23–27	International Atomic Energy Agency (IAEA), Vienna, Austria.
SEPTEMBER 21–24	11th EMAS Regional Workshop on Electron Probe Microanalysis of Materials Today—Practical Aspects, Montanuniversität Leoben, Austria. www.emas-web.net
OCTOBER 8–10	Gold '14 Symposium, Kalgoorlie, W. Australia. See p. 59.

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