



Arizona Geological Society Newsletter

JANUARY 2013

January 8, 2013 DINNER MEETING

Who: Dr. Paul G. Spry will speak on Broken Hill-type deposits. See abstract below.

Where: Sheraton Tucson Hotel and Suites, 5151 East Grant Road, (at the intersection of Grant and Rosemont on the north side of Grant in the **PIMA BALLROOM** (enter at northwest corner of the building, and go upstairs to the meeting room).

When: Cash Bar at 6 p.m.—Dinner at 7 p.m.—Talk at 8 p.m.

Cost: Members \$27, guests \$30, Student members are *free* with online reservation.

RESERVATIONS are REQUIRED: CALL 520.663.5295 by 5 p.m. by Friday, January 4 or reserve on the AGS website (www.arizonageologicalsoc.org). Please indicate regular (grilled skirt steak chimichurri and mashed potatoes), vegetarian, or cobb salad meal preference. Please cancel by Friday, January 4 at 5 p.m. if you are unable to attend—no shows and late cancellations will be invoiced.

ABSTRACT: Broken Hill-type Pb-Zn-Ag deposits: Classification and Genesis

Paul G. Spry, Professor of Economic Geology, Iowa State University

and

2012 Thayer Lindsley Lecturer (Society of Economic Geologists)

The Proterozoic Broken Hill Pb-Zn-Ag deposit in Australia is the largest massive sulfide deposit on Earth. It occurs in the southern part of the Proterozoic Curnamona Province in the Willyama Supergroup, a 7 km thick package of clastic metasedimentary rocks into which bimodal (mafic and felsic) volcanic rocks were intruded. It was metamorphosed to the granulite facies (~800°C and 5-6 kb), and subjected to at least four fold events. Six ore bodies with distinctive gangue minerals, ore grades, and trace-element signatures occur over a strike length of approximately 5 miles. The main ore minerals are sphalerite, galena, and pyrrhotite, with lesser chalcopyrite. Silver occurs in galena, tetrahedrite and a variety of sulfosalts (e.g., pyrargyrite). Gangue minerals consist mainly of Fe-Mn-Ca-Fe-Si-bearing minerals (e.g., rhodonite, fluorite, quartz, calcite, bustamite, wollastonite, manganooan hedenbergite, and roepperite). The deposit is spatially associated with a wide variety of rock types, the most common being the so-called “lode horizon” rocks that consist of quartz garnetite, blue quartz-gahnite lode, garnetite, and lode pegmatite, with the first two forming part of the alteration zone. Garnetite, quartz-garnetite, and manganiferous banded iron formation are considered to be meta-exhalites. Recent studies suggest that the major and trace element composition of garnet and gahnite can be used in the exploration for Broken Hill-type mineralization.

Ore models for the formation of the Broken Hill deposit are controversial but have centered on syngenetic and epigenetic theories in which sulfide formation by subaqueous hydrothermal processes underwent high-grade metamorphism and deformation, or metals were introduced during peak metamorphism or post-tectonic replacement. A recent contentious model proposed wide-spread melting of the sulfides with the Zn ore bodies being restites and the Pb ore bodies being the products of sulfide melts.

Continued on Page 2

ABSTRACT—Continued from Page 1

Characteristic features of Broken Hill Hill-type Pb-Zn-Ag (BHT) deposits include: (1) high Pb+Zn+Ag values with $Pb \geq Zn$; (2) Metamorphism to amphibolite-granulite facies; (3) Paleo- to Mesoproterozoic clastic metasedimentary host rocks; (4) Sulfides that are spatially associated with bimodal (felsic and mafic) volcanic rocks, and stratabound meta-exhalites; (5) Stacked ore bodies with characteristic Pb:Zn:Ag ratios and skarnlike Fe-Mn-Ca-F gangue assemblages, and the presence of Cu, Au, Bi, As, and Sb; and (6) Sulfur-poor assemblages.

Most BHT deposits have alteration zones despite proposals to the contrary. Deposits previously regarded in the literature as BHT deposits are Broken Hill, Cannington, Oonagalabie, Menninie Dam, Pegmont, Broken Hill (S. Africa), Swartberg, Big Syncline, and Gamsberg, Zinkgruvan, Sullivan, Cottonbelt, Foster River, and Boquira. Of these deposits, only the Broken Hill (Australia, South Africa), Pinnacles, Cannington, Pegmont, and Swartberg deposits are BHT deposits. Other BHT deposits are several occurrences in the Jervis area (NT) and central Colorado (e.g., Green Mountain). The Foster River, Cottonbelt, Gamsberg, and Sullivan deposits are SEDEX deposits with BHT affinities, and the Oonagalabie and Zinkgruvan are VMS deposits with BHT affinities. In the Broken Hill area (Australia), Corruaga-type Pb-Zn-Ag deposits occur in calc-silicate rocks and possess some BHT characteristics. The Franklin Furnace-Sterling Hill non-sulfide zinc deposits may represent an end-member of BHT deposits.

ABOUT THE SPEAKER

Paul Spry is a professor of geology at Iowa State University where he has been since 1983. He earned B.S. (Honors) and M.S. degrees in geology at the University of Adelaide (Australia) and in 1984 he earned a Ph.D. in Economic Geology at the University of Toronto. Paul has focused his research efforts on the effects of metamorphism on ore deposits, the geology, mineralogy, and geochemistry of epizonal and mesozonal gold-silver telluride deposits, and the mineralogy of ore deposits, in general. He also has conducted research on Mississippi Valley-type, porphyry-style Cu and Mo, high-temperature carbonate replacement Pb-Zn-Ag, and intrusion-related gold deposits. A particular emphasis of his research has been on the supergiant Broken Hill Pb-Zn-Ag deposit. Paul has supervised 30 M.Sc. and Ph.D. students and has published more than 85 refereed papers, book chapters, and books in economic geology and mineralogy. He is currently on the editorial boards of *Economic Geology* (where he has served the last four editors), and has served on the editorial boards of *Ore Geology Reviews*, *Canadian Mineralogist*, and *Mineralogy and Petrology*. He is on the technical advisory board for Wildcat Exploration (Winnipeg) and the Precambrian Research Center at the University of Minnesota-Duluth, and has served on or chaired several committees for the Society of Economic Geologists.

AGS Dinner Meeting Costs Going Up!

The cost for a dinner at an AGS meeting has remained at \$24 for several years. However, starting in January 2013, the cost for a dinner at AGS dinner meetings will go up to \$27 for members and \$30 for non-members. Remember, dinner reservations are REQUIRED. The hotel may be able to accommodate you without a reservation, but the cost will be \$30 and there is no guarantee of availability.

Attention Student Members: AGS is pleased to provide free meals for student members with an online dinner reservation. Please keep in mind that these meals are paid for by AGS. If you make a reservation and do not attend, AGS must still pay for the meal. Please cancel your reservation by 5 p.m. on the Friday before the meeting if you are unable to attend. The AGS Executive Committee may consider charging for unclaimed student meals, as we do for regular members, if the cost of no-shows continues to be a problem.

2012 J. Harold Courtright Scholarship Award

At the December 4, 2012 dinner meeting, the Arizona Geological Society presented the 2012 J. Harold Courtright scholarship to Samuel Wachter from Arizona State University. The scholarship is awarded annually to support M.S. or Ph.D. research in economic geology and field studies in the Northern and Southern Cordillera. Samuel is studying under Dr. Steven Reynolds, and he will use the scholarship award of \$3,000 to study structure and mineralized veins in Baja California Sur. The title of his study is "Structural Evolution of Ore Mineral Viability of the Northern Sierra de la Laguna Mountains, La Ventana, Baja California Sur." Congratulations to Samuel Wachter!

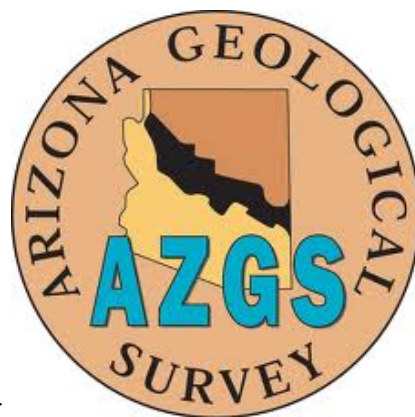


AGS President Jeff Cornoyer (left) presents the 2012 J. Harold Courtright Scholarship award to Samuel Wachter.

Arizona Geology Magazine

The Fall-Winter *Arizona Geology* magazine, produced by the Arizona Geological Survey, is now online at <http://azgeology.azgs.az.gov/>. The latest issue includes a listing of all AZGS publications since summer 2012 and several excellent articles, including:

- Landscape evolution in SE Arizona - M. Jungers
- Latest big controversy on age of Grand Canyon - W. Ranney
- Success stories from the Nat'l Geothermal Data System - K. Patten
- Post-Horseshoe 2 wildfire field trip and discussion - L. Romero
- Select blog entries from Lee Allison's Arizona Geology blog - staff
- Arizona Centennial & the Arizona Experience - Rowena Davis
- The Pirate Fault, Santa Catalina Mountains - the movie - narrated by D. Hoxie



A Message from 2012 AGS President, Jeffrey Cornoyer

Reflecting on the past year and feeling like it was gone in the blink of an eye, I could not help but remember what I'd once read. It went something along the lines of: the older you get, the faster the time flies. It then gave an explanation that more things were constant with age, while with youth everything is fresh and new, and time seemingly goes on and on. The concept seemed pretty reasonable on the surface, and not incongruent with recollections of my distant past. However 2012 seemed to fly by, and as an organization, we had a lot of positive change within the Arizona Geological Society.

The AGS has a quite large Executive Committee of 15 elected members, who make a commitment to serve the society for their term and attend a monthly Executive Committee meeting, in addition to regular dinner meetings. It's quite a time requirement and often the general Society business can be routine and not all that exciting. At our January 2012 meeting, we held a brainstorming event where each Executive Committee member laid out goals and created our wish list for guiding the Society forward. We had many excellent ideas we were able to transform into reality, making 2012 the year Arizona Geological Society renewed our commitment to our future. Here's a look at new accomplishments in the past year:

One overriding need the Executive Committee recognized was the need to appeal to and engage young geologists—undergraduate and graduate students and young, working geologists. We approached this goal in a number of different ways. The AGS successfully solicited and received a generous donation from BHP Billiton and completely subsidized all student dinners at meetings in 2012, and we will continue this into the future. In April, we held our first ever—and now annual—Student Poster Session Dinner meeting. We invited students from the University of Arizona, Arizona State University, and Northern Arizona University to participate. Cash prizes for 1st, 2nd, and 3rd place were awarded, and each participant was presented with a freshly published AZGS-AGS Centennial Edition Arizona Highway Geological Map (yet another 2012 accomplishment.) With UA in-state tuition at record levels of \$11,000 and out-of-state at \$25,500 in 2012 we increased our Courtright scholarship from \$2,000 to \$3,000. Recognizing the Courtright scholarship has geographic and subject limitations and apply only to graduate students, the Executive Committee approved an additional new scholarship, without geographic or subject restrictions, and open to undergraduate students with a research project, as well as to graduate students, and with consideration given to leadership. Finally,



ABOVE: 2012 AGS President, Jeff Cornoyer, at the Rosemont Mine field trip in October. This was one of many great field trips AGS ran in 2012.

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Continued on Page 5

Message from AGS President—continued from Page 4.

we elected a 2013 Student Councilor to serve on the Executive Committee and bring a better-rounded perspective to the committee. All of the above initiatives have increased student participation at our monthly dinner meetings between 50 and 100 percent, with overall dinner meeting attendance up 25 percent and general membership rolls up 10 percent.

2012 has been a fabulous year for AGS Field Trips. In addition to our regular Spring and Fall field trips, the idea of short Centennial Field trips, up to one a month, was conceived and brought to reality after the January brainstorming meeting. Most field trips were joint organizational trips to increase participation and awareness, although generally they were solely organized by the AGS, such as the AGS-SME Freeport Safford Sulfur Burner field trip, both pre- and post-Spring 48th Annual Geology of Industrial Minerals Conference field trips, AGS-SME Florence Copper field trip, the fall AGS-Student SEG Rosemont Copper Field trip with guidebook, the AGS Wickenburg Vulture Gold and Anderson Mine field trip, and the joint AGS-AIPG Phoenix Mountains field trip. That is likely a record for most field trips in one year for the AGS!

2012 was also a healthy year for AGS funds. After several years of operating in the red, AGS was able to move into the black. This was due to two main factors: soliciting meeting sponsorships and invoicing members who fail to cancel dinner-meeting reservations when they don't attend. Meeting sponsors were sporadic in the past, but the program got off the ground in July 2012. In fact, since July, we've had every meeting sponsored, which has brought in over \$2,000. We've also started invoicing those who make a dinner reservation but do not cancel by the deadline. Many were not aware the AGS is required by the hotel to pay for the number of reservations we make the week prior, including a cancellation after the reservation deadline. Prior to 2012, the AGS simply paid for dinner meeting no-shows out of the Society's general fund, which always amounted to several meals per meeting.

2012 was also a record year for Courtright donations. We made it possible to donate to the Courtright fund while paying for dinner online by credit card, and we received a few larger donations from very generous members. Finally, we also had one healthy member who wishes to remain anonymous, generously bequest a portion of their estate to the AGS. This member set a wonderful example that I hope others will follow.

All of these new achievements were accomplished while we continued AGS's regular business of holding monthly dinner meetings (at a new venue) with a great variety of interesting and relevant speakers, issuing a monthly newsletter, and compiling and publishing our annual membership directory.

2013 should be a genuinely exciting year in which we will build on the existing momentum. It has been a true honor being your President, and I thank each and every one of the Executive Committee members for all of their passionate hard work, through thick and thin, in making the Arizona Geological Society a better organization for us all.

—Jeff Cornoyer

ANNOUNCEMENTS

A gathering to honor and remember Doug Shakel, AGS VP of Field Trips, who passed away on November 20, will take place on Sunday, February 10, 2013. Details have not been firmed up. We will provide more information in the February AGS newsletter, which will be issued in late January.



Mine Reconciliation & Resource Estimation Summit

The Arizona Geological Society is proud to be a media partner for the Mine Reconciliation and Resource Estimation Summit, to be held in Phoenix on January 22-24, 2013. Just a few of the topics that will be presented include:

- The effective use of reconciliation for business and operational improvements,
- Strategies for successful grade modeling,
- Model generation: the differences between resource and grade models,
- Geological controls and deposit types: adapting your model to your mine's geology.

Special discount pricing is available for AGS members and student members.

Look for more details on the AGS website, and at www.MineReconciliation.com.

2013 AGS MEMBERSHIP APPLICATION OR RENEWAL FORM

Please mail check with membership form to: Arizona Geological Society, PO Box 40952, Tucson, AZ 85717. Members can renew on line at www.arizonageologicalsociety.org.

Dues (check box) 1 year: \$20; 2 years, \$35; 3 years: \$50; full-time student (membership is free)

NEW MEMBER or RENEWAL? (circle one) Date of submittal _____

Name: _____ Position: _____

Company: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Work Phone: _____ Home Phone: _____

Fax Number: _____ Cellular Phone: _____

E-mail: _____ Check this box if you do not have an email address

All newsletters will be sent by email. If you do not have an email address, we will mail a hard copy to you, but we cannot guarantee timeliness.

If registered geologist/engineer, indicate registration numbers and states: _____

Enclosed is a _____ tax-deductible contribution to the J. Harold Courtright Scholarship Fund.