



AGS NEWSLETTER

ARIZONA GEOLOGICAL SOCIETY, INC., SEPTEMBER 2007

DINNER MEETING, SEPTEMBER 4, 2007

Keith R. Long

U.S. Geological Survey

Life-Cycle of a Technological System: The Inspiration Copper Mine, Miami, Arizona

ABSTRACT—

Modern theories of technology development emphasize strategies for effective innovation. Invention, far from the random inspiration of individual genius, is routinely accomplished by deliberate corporate investment to solve impediments to profitable economic activity. An historical analysis of the Inspiration copper mine at Miami, Arizona, using principles of modern management of technological innovation, illustrates the long-term success and limits of innovation when applied to mining.

The Inspiration copper mine went into production in 1915 after a period of protracted mine development. Economic mining was impeded by the lack of a suitable method for treating mixed sulfide-oxide. This was solved by the early application of flotation and invention of the ferric-cure leaching process. Another impediment was the depth of the ore, which made open-pit mining prohibitively costly. A method of underground block-cave mining was developed, followed by an early application of in-situ leaching.

Open pit mining was introduced in 1948, when commercially available machinery had advanced enough to permit economic mining with high strip ratios. At the adjacent Bluebird mine, Ranchers Exploration and Development successfully demonstrated heap-leach mining of copper-oxide ores with solvent extraction and electrowinning of

CALENDAR OF EVENTS

- September 24-30: *Ores & Orogenesis: Circum-Pacific Tectonics, Geologic Evolution, and Ore Deposits – A Symposium Honoring the Career of William R. Dickinson.*
- October 2: NO AGS Dinner Meeting
- November 6, 2007 – Ralph Stegan, Phelps-Dodge, *Climax or Cerro Verde*
- December 4, 2007 – Lee Allison, Arizona Geological Survey, *Intelligent Design and the Attack on Science*

copper from leach solutions during the middle 1960s. Inspiration subsequently applied heap leaching to the Ox Hide deposit but further developed its own ferric cure process to recover the copper.

Cyprus Mines took over the Inspiration mine in 1988, and subsequently re-engineered the entire mine as a leach-only operation. The most important change was in management of labor. Unions were decertified and rigid work rules replaced with cross-training to permit more flexible utilization of workers. Methods of employee involvement in management, particularly for cutting costs, were introduced. This improved efficiency, however, could not in

(ABSTRACT, continued on page 3)

Dinner Meeting Schedule — Inn Suites, 475 North Granada, Tucson

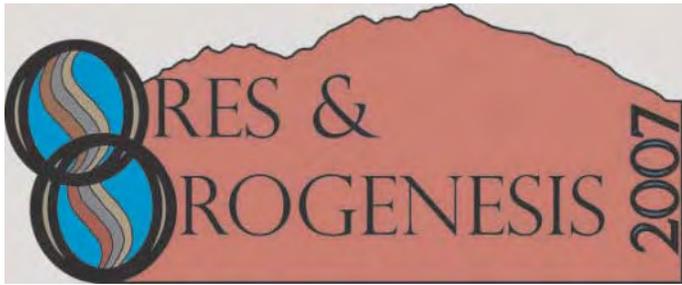
To reserve your place for dinner, please call 520-663-5295 before 5 pm, Thursday, AUGUST 30, 2007. Indicate if a low-salt or vegetarian meal is required. Please cancel if you are unable to attend.

Cost: With reservation: Members \$24, Guest \$26, Students \$10. Without a reservation, \$3 additional.

Cash Bar @ 6 pm

Dinner @ 7 pm

Talk @ 8 pm



Ores & Orogenesis Symposium Final Update

Dickinson Banquet and Reunion Night: Social Event Highlights of the *Ores and Orogenesis Symposium*

Only one month remains before the *Ores and Orogenesis* symposium. As of mid-August more than 600 people had registered. The list was plumped up by a wave of registrations right before rates increased from Regular to Late on August 15th.

A reception and banquet dinner will be held for the meeting's honoree, William R. Dickinson, Professor Emeritus in Geosciences at the University of Arizona, on Thursday night of the Symposium. The evening will include appearances by many of Bill's former students and colleagues, with photographic tributes and roasts in one of the ballrooms of the El Conquistador resort. Tickets are available on the symposium web site. If you have already registered, you can easily add this event by returning to the symposium's web site.

Friday night of the symposium is Reunion Night. Tickets to the Reunion Event, which includes a buffet dinner for all participants that will be served in the Turquoise II ballroom from 6 pm to 9 pm, are available on the symposium web site. The reunions will be held at various indoor and outdoor sites around the resort from 6 pm to midnight, with no-host bars at or near each reunion site. Please act safely and responsibly by using the designated driver system or a taxi cab if you are traveling off the resort site that evening.

Twenty different groups of exploration and mining companies (dead or alive), consultants, and vendor and support companies are holding reunions around the resort, mainly in the restaurant and patio areas south of the lobby, in the four Canyon Suites upstairs north of the lobby, around tables in the Turquoise III ballroom, and

around the periphery of the buffet area in the Turquoise II ballroom. Two groups of governmental organizations also will be gathering around tables in the Turquoise II ballroom.

The reunions for twelve universities or groups of universities will be staged around tables in the Turquoise I ballroom. Friends of Bill Dickinson will be congregating at the Poolside Courtyard.

The reunion groups are designed so everyone has at least one place where they will feel welcome, and no invitation is required to visit a reunion. Check out the Reunion page on the symposium web site for more information, and invite your friends to join you at a reunion!

We thank our corporate sponsors for keeping the cost of the *Ores and Orogenesis* symposium more affordable for individual attendees and students. Dozens of students from around the world will be attending the symposium and participating in a student mentoring event through the generosity of corporate sponsors.

(ABSTRACT, continued from page 1)

the end cope with the most intransigent impediment to profitability: exhaustion of ore reserves. Although considerable copper resources remain for innovation to make economic, better investment opportunities elsewhere occupied the efforts of the mine owner.

Managed technical innovation implies in-house inventive activity, rather than waiting for others to do the work for you. The Inspiration mine had a mixed record in this regard. Early inventive efforts by Inspiration, such as ferric cure leaching and the treatment of mixed sulfide-oxide ores, were at a higher level of risk commensurate with the risks of developing a new mine. Once Inspiration became an established mine, management tolerance to risk declined. The change to open-pit mining, for example, depended on advances in mining machinery made by their manufacturers. Participation of labor in management and cross-training were pioneered in Japan in the 1950s and were slow to find acceptance in North America. In light of this history, managed technical innovation is limited by corporate resources and the degree of risk that management is willing to take.

"WHEN THE WELL'S DRY, WE KNOW THE WORTH OF WATER"

- Benjamin Franklin (1706-1790)

Other Geoscience News

ANNOUNCEMENT Ores & Orogenesis Symposium Equipment Will Be

Available for Purchase After the Meeting

A page has been added to the AGS web site to let members sign up to indicate their interest in purchasing the equipment from the Symposium. The sign-up list carries no obligation, but requests will be filled on a first-come first-served basis. Also, the details of the equipment will be listed as they become available. Items in the list include laptop computers, monitors, projectors, and miscellaneous cables. Prices will be considerably less than if the equipment were purchased new.

S LATE OF OFFICERS

2008

President	M. Lee Allison, Arizona Geological Survey
VP Programs	Robert J. Kamilli, U.S. Geological Survey
VP Field Trips	Rich Brown, Clear Creek Associates
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Councilor 1 (08-10)	Mark Cocker, U.S. Geological Survey
Councilor 1 (08-10)	Robert Powell, U.S. Geological Survey
Councilor 2 (07-09)	Karl Sandwell-Weiss, Augusta Resources
Councilor 2 (07-09)	Corolla K Hoag, SRK Consulting
Councilor 3 (06-08)	Alyson M. Thibodeau, University of Arizona
Councilor 3 (06-08)	Jon E. Spence, Arizona Geological Survey

Election of the AGS 2008 officers will be held at the September 4 dinner meeting. The slate of officers is listed above. Please attend to cast your vote.

Member News:

Welcome to new members Michael Conway, Arizona Geological Survey; Cheri Topel, Arizona State University; Gwyn Rhys-Evans, Southwest Ground-Water Consultants; and Ronald Blackstone, ADOT

With great sadness AGS announces that long-time member, Henry A. Truebe, passed away August 13.

Many thanks are extended to our newest O&O sponsors for their generous symposium support:

ASARCO — Silver Sponsor
Galway Resources — Copper Sponsor
Bronco Creek Exploration, Inc. — Copper Sponsor

AGS Membership was 352 in mid August.

AGS LOGOS





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For information on ordering AGS
publications, visit
www.arizonageologicalsoc.org.

AGS books and maps are also sold at the dinner
meeting and by the
Arizona Geological Survey.



As always, please keep us up to date as you move, change jobs, or change your e-mail address.

2007 AGS MEMBERSHIP APPLICATION OR RENEWAL FORM

Please mail check with membership form to: Arizona Geological Society, P.O. Box 40952, Tucson, AZ 85717.
Dues (circle one): 1 year: \$15; 2 years: \$30; 3 years: \$40. Full-time students receive free membership (E-mail only).
However, a membership application form must be returned to AGS annually to remain on the membership list.

Name: _____

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Please send the newsletter by E-mail only by regular mail only by E-mail AND regular mail

If registered geologist or engineer, indicate registration number and state: _____

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

Enclosed is a _____ tax-deductible contribution for the 2007 AGS Symposium.