



Arizona Geological Society Newsletter

JUNE 2017

June 6, 2017 DINNER MEETING

Who: Dan Johnson is the featured speaker. 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 **SABINO 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 \$30, Guests \$33, Students Members free with on-line reservation (\$10 without).

RESERVATIONS ARE REQUIRED: Reserve on the AGS website (www.arizonageologicalsoc.org) by **11 a.m. Friday, June 2.** Please indicate Regular (Chicken Sorrento), Vegetarian (Quinoa Roasted Vegetable Root) or Grilled Chicken Cobb Salad meal preference. Please cancel by **Friday, June 2 at 11 a.m.** if you are unable to attend - no shows and late cancellations will be invoiced. (Please call or text Alison Jones at 520-270-2825 if you must cancel after the deadline. We may be able to sell your meal and you won't be billed).

AGS is grateful to

Boart Longyear

for sponsoring the June dinner meeting.
Learn more about Boart Longyear at their
website:

www.boartlongyear.com



ABSTRACT

Introduction to the Florence Copper Project and In-Situ Copper Recovery by Dan Johnson - Vice President & General Manager, Florence Copper Inc.

The Florence Copper Project (FCP) is located in central Arizona, about 65 miles southeast of Phoenix. FCP is centered on a large copper oxide and sulfide formation, which was discovered in the late 1960s and explored by several mining companies since that time. Although conventional open pit mining techniques were initially investigated, In-Situ Copper Recovery (ISCR) has been determined to hold the best potential for developing the deposit.

In-situ techniques have been used successfully in conjunction with conventional copper mining in Arizona and in stand-alone operations to extract other minerals around the world for decades. However, FCP may be the first stand-alone ISCR facility to be developed.

The former owner of the Florence copper deposit, BHP Copper Inc.,

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obtained state and federal permits to conduct a field test in the late 1990s. This test included installation of an ISCR well field and copper recovery testing. This was followed by restoration of the water quality in the well field and permit-driven monitoring. All testing from BHP and subsequent monitoring indicates that ISCR can be conducted safely and successfully at the site.

The initial parent company of Florence Copper Inc. (FCI) purchased the property in late 2009 and continued studies to support permitting and determine the feasibility of ISCR at the site. A 2017 NI 43-101 Technical Report indicates positive economics for the development of a commercial operation. In late 2014, FCI was acquired by Taseko Mines Limited. Taseko is a publicly traded Canadian mining company based in British Columbia that operates the Gibraltar Mine, a major copper and molybdenum mine. It owns a 75% interest in Gibraltar in addition to other mining developments in British Columbia.

FCI has proposed a two-phase development plan. Phase 1 involves operation of a small-scale production test facility or “PTF” to optimize the technical and safety aspects of the project. During its operation it will produce up to 99.999% pure copper cathode. The PTF will assist in demonstrating the science and safety of the in-situ process to regulators and the local community. Results from the PTF will also be used to refine plans for the development of the full-scale commercial operation in Phase 2 while providing the data to support associated permitting requirements.

ABOUT THE SPEAKER

Dan Johnson is a resident Arizonan with a career spanning over 25 years of environmental management, hydrological engineering, and project management experience in the state's mining industry. Dan is a graduate of the University of Arizona, and is a registered Geologist, Hydrologist, and Professional Engineer.

Prior to joining Florence Copper, Dan worked with QuadraFNX, where he served as Technical Services and Environmental Manager/Director for projects in North America and Chile. He has also worked at senior levels for Phelps Dodge, Freeport-McMoran, Rio Tinto, and Montgomery Watson.



Dan joined Florence Copper in 2011, and has led the company's environmental, permitting and technical efforts with the support of the project team. He currently sits on the Arizona Mining Association Board of Directors as Secretary/Treasurer.

STUDENT RESEARCH SPOTLIGHT: Casey J.R. Jones

Spring hydrograph and recession curve analysis in deep karst R aquifer of Grand Canyon National Park

The Redwall-Muav aquifer (R aquifer) is a thick (up to 400m), well-developed karst system over 1,000m below the Kaibab Plateau of the north rim of Grand Canyon National Park (GRCA). Precipitation on the rim, in the form of snowmelt or monsoonal rain, infiltrates the subsurface through sinkholes, faults and fractures. Water then travels both vertically and horizontally through the well-known canyon stratigraphy, including the separate, perched, Coconino aquifer (C aquifer). This research focuses on the travel paths and the travel times of groundwater through this complex system. Traditional geophysical techniques in this

setting are both expensive and difficult, but recent water stage and temperature monitoring with a transducer located deep inside an R aquifer spring provides a window into the physical characteristics of the aquifer. Spring hydrograph and recession curve analysis at Roaring Springs, the sole supply of potable water for GRCA, provide a new way of understanding the hydrologic system.

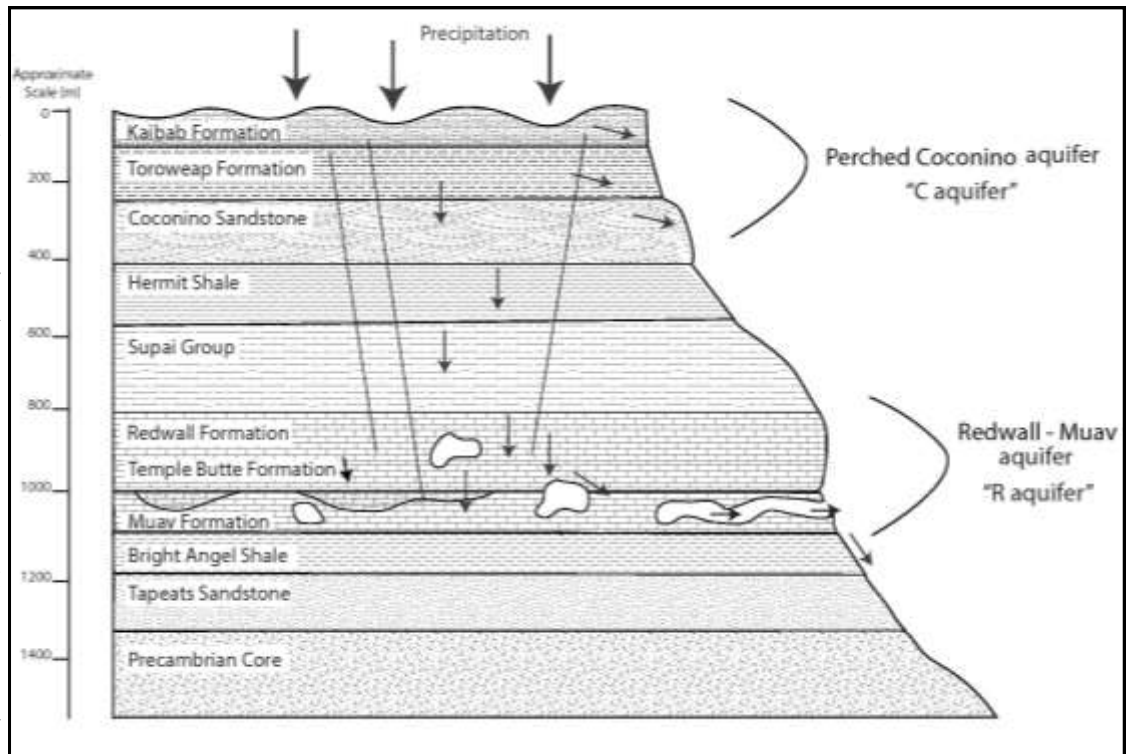


Figure 1: Conceptual model of GRCA stratigraphy showing generalized water flow paths.

The continuously recording transducer in Roaring Springs monitors stage and temperature.

With manual discharge measurements, the first comprehensive stage-discharge rating curve of Roaring Springs was used to create hydrographs for analysis. Hydrographs were used to quantify the transit time of precipitation on the rim to discharge at springs, dominant flow regimes for each recession, and the amount of recharge to the aquifer. Transit time from infiltration to spring response was estimated by comparing precipitation data to temperature low peaks in the hydrograph. Transit time was rapid (on the order of days) for monsoon events. Recession curves from monsoon and snowmelt events were quantified to separate flow into three dominant microregimes: fast-moving conduit flow, intermediate fracture flow, and the much slower intergranular flow. The length and intensity of each microregime give clues to the aquifer drainage rates and storage capacity. Winter snow,

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which is present for much of the year, recharges the aquifer slowly, and has a longer residence time than flashier, summer monsoonal precipitation. Implications of this study include prediction of aquifer behavior during a changing climate and assist with efforts to develop a more comprehensive protection plan for the karstic R aquifer.



Figure 2. Roaring Springs (photo by Sarah J. Zappitello)

Casey J.R. Jones received her B.S. in Geology from the College of Charleston in South Carolina. She is a M.S. Candidate at Northern Arizona University where she is studying Water Resources in the Environmental Science and Policy program under advisors Dr. Abraham Springer of NAU and Dr. Benjamin Tobin of the National Park Service. She is currently interning at the USGS Arizona Water Science Center and will graduate in December 2017. Her thesis research will be featured in a chapter in an upcoming book by the Geological Society of London on advances in karst research.



Photo by Ryan Lima

AGS Executive Committee Doings

The AGS Executive Committee meets monthly to conduct business on behalf of the Society. Some recent business items provided below. Please let a member of the Executive Committee know your opinion regarding these issues. We value your input.

- Bylaws revision: Carl Bowser is heading up a subcommittee to update our bylaws. A new position, President-Elect, is being considered. The Executive Committee is also considering whether or not to impose term limits. A bylaws subcommittee is being formed to prepare a draft bylaws update.
- In August, instead of our regular dinner meeting, we are planning to have an informal event at a local microbrewery. This is similar to SME's Mine-Blast event and it should be a lot of fun. Sarah Baxter has taken the lead in organizing the event. The event will be later in August to accommodate returning UA students.
- We are seeking candidates for officers and Councilors for 2018. Don Applebee, past President, is head of the nominating committee. Please let him know if you are interested. It appears as though several long-time Executive Committee Members will not be returning in 2018.
- Last year Stan Evans took on the daunting task of getting AGS set up with bookkeeping software, and upping our game as far as financial management goes. Previously we had used an outside bookkeeper, but we were not always getting timely reports. To date, Stan has put in hundreds of hours getting us up-to-date. Going forward, this will make the Treasurer's job much easier.
- Book sales: Since the Arizona Geological Survey moved to UA, they are no longer selling AGS publications. The responsibility of responding to inquiries and mailing out publications has fallen on members of the Executive Committee (and Cori Hoag, sometimes). The job involves getting the requested publication from the storage locker and mailing it to the buyer. We would like to hear from a volunteer who is willing to take on this task. Call Alison Jones if you are able to help and she can tell you what is involved.
- Mike Conway always provides an update on the Arizona Geological Survey at the monthly Executive Committee Meetings. In May, he was happy to report that SB1184 passed, thus restoring AZGS's previous budget of \$941,000. AZGS has recently hired a geoinformatics program expert, and they are looking to hire an economic geologist. They will conduct a national search and are working with the UA Lowell Institute to identify candidates.

Member News

Condolences to the family and friends of long-time AGS member **Charles (Chuck) R. Sewell**, 90, who died in Sulphur Springs, Texas on May 13, 2017. Chuck was an exploration geologist and the owner of Sewell Mineral Exploration in Tucson; he designed and conducted mineral exploration in the U.S. and abroad including C.I.S. countries. He was a member of SME and a founding member of Mining Club of the Southwest (now Mining Foundation of the Southwest).

Condolences to the family of **Francis (Frank) David MacKenzie** who died in Tucson at the age of 94 on Aug 3, 2016. He was active in AGS, serving as President in 1962-1963. He was a life member, having been a member for over 50 years.

Welcome New AGS Members

Mark Cividin

Amandeep Deswal

Jeri Jahnke

Matthew Jeanfreau

Eve McEwen

Rob McEwen

Elizabeth Tobin

Casey Jones

Arizona Geological Society is grateful to Freeport-McMoRan, Inc. for their generous support of our student members! Freeport-McMoRan sponsored student dinners for the 2017 AGS monthly meetings.



2017 AGS MEMBERSHIP APPLICATION OR RENEWAL FORM

YOU CAN RENEW OR SIGN UP as a new member and pay online. Please go to our website, arizonageologicalsoc.org. Or use the form below if you are more comfortable with the old school approach.

Please mail check with membership form to: Arizona Geological Society, PO Box 40952, Tucson, AZ 85717

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: _____

Street: _____ 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 number and State: _____

Enclosed is a _____ tax-deductible contribution to the J. Harold Courtright or the M. Lee Allison Scholarship Funds.