Arizona Geological Society Newsletter

MARCH 2017

March 7, 2017 DINNER MEETING

Who: Derek Thorkelson 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, March 3. Please indicate Regular (Petit Filet of Beef with a Classic Demi-Glace, Roasted Potatoes, Seasonal Vegetables), Vegetarian (polenta) or Grilled Chicken Chopped Cobb Salad meal preference. Please cancel by **Friday, March 3 at 11 a.m.** if you are unable to attend - no shows and late cancellations will be invoiced. (Please call or text Alison Jones (520-270-2825) if you must cancel after the deadline. We may be able to sell your meal and you won't be billed).

ABSTRACT

The Precambrian tectonic connection between Yukon and Arizona

By Derek Thorkelson (speaker), Francesca Furlanetto, Kirsti Medig, Jacob Verbaas Alexander Nielsen, John Laughton

Yukon Territory in northwestern Canada is separated from Arizona by a distance of 3000 km, yet it has a remarkably similar Precambrian history, particularly for the late Paleoproterozoic. In Arizona, arc magmatism, deformation, metamorphism and terrane accretion occurred in two main pulses from ca. 1.75-1.65 Ga. In the southern United States, these events are called the Yavapai and Mazatzal orogenies. To the northeast, similar events in eastern Canada are called the Labradorian orogeny. Collectively, these events signify southeastward growth of ancestral North America (Laurentia) through the addition of juvenile crust.

In northwestern Canada, the Forward and Racklan orogenies span ca. 1.7-1.6 Ga and are broadly coeval with the Yavapai and Matazal events. Until recently, the cause of Forward and Racklan orogenesis was poorly understood, partly because the paleoenvironment of northwestern Canada was uncertain. Was Laurentia part of a proposed supercontinent called Columbia (or Nuna) and, if so, were the Racklan and Forward orogenies located along the margin of the supercontinent, or within its interior?

Our recent work suggests that, in the late Paleoproterozoic, northwestern Laurentia faced an open ocean to the west. The Racklan and Forward events represent craton-directed deformation of a passive margin during closure of a seaway. In our hypothesis, the orogeny was produced by colli-

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sion of Laurentia with a volcanic arc and then with Australia. Part of the arc, called Bonnetia, was obducted onto the deformed continental margin. Our model places western Laurentia in the same continental margin environment as the Yavapai-Mazatzal region, which drives the possibility that the Yavapai-Mazatzal family of orogens extended from eastern Canada, along the southern United States to Arizona, and north to Yukon.

About the March Dinner Speaker

Derek Thorkelson applies field methods, petrology, geochronology and tectonic modeling in the study of regional geological problems. He obtained his PhD from Carleton University in Ottawa, Canada, in 1992. His dissertation focused on Mesozoic volcanic successions and accreted terranes in the Canadian Cordillera. During his thesis work, Dr. Thorkelson also became interested in ridge-trench interactions and wrote the first in a series of papers on slab windows, following the seminal work of Dickinson and Snyder (1979). After a brief postdoctoral fellowship at the University of British Columbia, Dr. Thorkelson accepted a position in 1992 as a founding member of the Yukon Geological Survey. There, he led a four-year mapping program on Proterozoic assemblages and iron-oxide copper gold (IOCG) occurrences in northwestern Canada. In 1995, he accepted a faculty position at Simon Fraser University in Vancouver where he continued his research into slab windows and Proterozoic geology. Dr. Thorkelson teaches courses in field methods, petrology and tectonics, and served as department chair for five years. He is currently working cooperatively with the Arizona Geological Survey.

Tucson Gem, Mineral, and Fossil Showcase Highlights

February is Gem Show month. Some of our members sent some beautiful photos for inclusion in this newsletter.

Shown here: Wulfenite from Mammoth, AZ

Photo Credit: Jan Rasmussen

Editor's Note: The AGS Newsletter will periodically feature work being conducted by students that is considered to be of interest to our general membership. This month, we are featuring the work of Simone Runyon, who currently serves on the AGS Executive Committee.

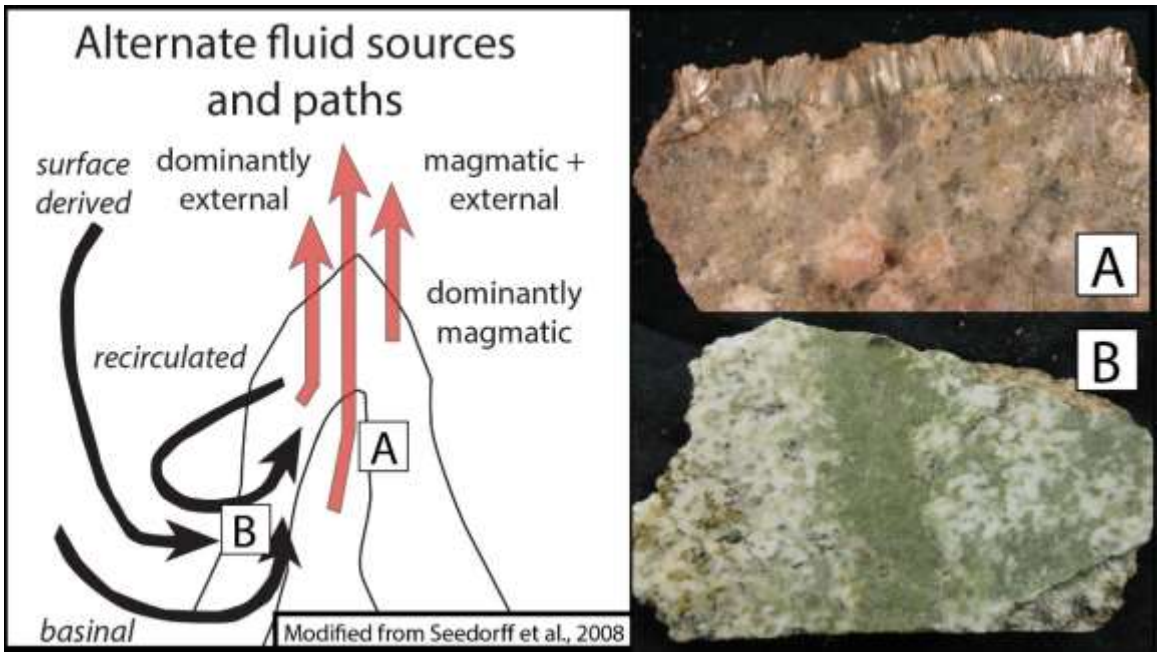
Deep Hydrothermal Alteration in Porphyry Copper Systems

Simone Runyon, Ph.D. Candidate, University of Arizona Geosciences

Advisor: Eric Seedorff

Research Summary:

My research focuses on deep hydrothermal features in porphyry copper deposits in the Laramide arc in Arizona. The objective: to better characterize deep hydrothermal alteration (typically >3 km paleodepth). I use field mapping, petrologic description, mineral composition and assemblages, fluid inclusions, stable isotopes, and trace element studies to understand how these styles of alteration form.



Porphyry copper systems are formed by shallowly emplaced intrusions. Copper mineralization and related alteration in the core of the system is the result of hydrothermal fluids that exsolve off of the crystallizing magma. Deep exposures of porphyry copper systems commonly contain greisen alteration. Greisen is characterized by coarse, pale, hydrothermal micas ± quartz-K-feldspar-albite (Panel A). Where root zones of porphyry copper systems are exposed, greisen alteration appears to be located deep (≥4km) and proximal to the deposit. Greisen alteration is a late stage hydrothermal feature predominately formed from magmatic-hydrothermal fluids, and is common in the exposed root zones of porphyry systems across Arizona.

The heat associated with magmatic intrusions commonly circulates external fluids (e.g., connate or meteorite), and can form distinct styles of hydrothermal alteration; the composition (salinity, acidity, etc.) of these fluids influences what minerals form in the alteration assemblage. In the case of circulating highly saline fluids, K and Fe are typically leached from the host rock, and Na and Ca are added. Common alteration assemblages include plagioclase-epidote-actinolite forming at the expense of original K-bearing minerals (K-feldspar-hornblende-biotite) (Panel B). Circulation of more dilute fluids typically adds volatiles to the host rock, forming propylitic alteration (epidote-chlorite-sericite). As a result, climate can have a strong influence on the style of overprinting alteration; evaporite deposits supply fluids

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that form Na-Ca alteration, whereas wetter climates with more dilute groundwater form propylitic assemblages. The wetter climate of the Laramide in Arizona yields large propylitic overprints distal to porphyry systems, while Na-Ca alteration is better developed proximal to Paleozoic sedimentary packages.

More about Simone: *Simone Runyon completed her B.S. in Geology from Illinois State University in 2011. Simone completed her M.S. at the University of Arizona with Mark Barton in 2013, working on IOCG style mineralization in the Jurassic arc. She is currently finishing up her Ph.D. at the University of Arizona, and is serving as Councilor for the Arizona Geological Society.*

(Simone (left) and fellow graduate student Lucia Profeta in the field at Kelvin-Riverside, Arizona)

M. Lee Allison Scholarship Winners

In 2016, the AGS Executive Committee voted to change the "AGS Scholarship" to the "M. Lee Allison Scholarship" in appreciation of Lee Allison's contribution to Arizona, Arizona geology, education, and the Society. The recipients of the 2016 awards were Anna Schuh and Phil McFarland. Each was awarded $3000. Bob Powell, Chair of the AGS Scholarship Committee presented their awards at the February dinner meeting. Congratulations to Anna and Phil, for this well-deserved recognition!

Arizona Geological Survey UPDATE

by Mike Conway

AZGS Director Phil Pearthree and AZGS geoscientist Joe Cook were on AZPM's Metro Week on February 17 and you can watch it here: http://playpbs.azpm.org/video/2365959699/. Phil described the research and benefits of AZGS to the broader Arizona public. His segment starts at about the 23:26 mark.

Recently Released Publications by AZGS:

- Cook, J.P., 2017, Discovery of a large earth fissure in the Southern Picacho Basin, Pinal County, Arizona. Arizona Geological Survey Open-File Report, OFR-17- 01, 7 p., 1 appendix.

Concerns, questions or comments? Contact Mike Conway at fmconway@email.arizona.edu or 520.621.2352

Tucson Gem, Mineral, and Fossil Showcase Highlights

Left: Anna and Ortrud Schuh admire a spectacular rhodochrosite specimen from the Sweet Home Mine in Alma, Colorado. Photo by Cori Hoag

Below: Machite from the Holbrook Mine in Bisbee, AZ Photo by Jan Rasmussen.

GEM SHOW!!!

Above: Wulfenite and Mimetite from the Tiger Mine in Mammoth, AZ. Photo by Jan Rasmussen.

Right: The original copper specimen used for the show's promotional material.

Left: Cori Hoag is dwarfed by a mother wooly mammoth with her two babies.

SPRING FIELD TRIP ANNOUNCMENT!!!

What: The Laramide-age Chilito Porphyry Copper Deposit, its host rocks, and styles of mineralization, Dripping Springs Range, Gila Co., Arizona

When: April 22, 2017

Who: Trip will be led by Don Applebee of ASARCO, LLC

There will be room for 60 participants. Participants will receive a guidebook. Lunch and snacks are also included. Carpooling is encouraged.

Please check our website, arizonageologicalsoc.org, for more information, including cost, and to sign up for this great trip.

SPONSOR A DINNER MEETING!!!

Company sponsorship of AGS dinner meetings is a great way to get the message out about your company. You will receive an advertisement in the newsletter, a slideshow during the social hour, and a brief presentation to the attendees of the dinner meeting. To find out more about how your company can sponsor a dinner meeting, please contact Ann Pattison at

info@arizonageologicalsoc.org

CHICXULUB IMPACT CRATER CONFERENCE

AGS Member David Kring reports, "We are about to have our first major roll-out of results from Expedition 364 to the Chicxulub impact crater during a special session for the Lunar and Planetary Science Conference. Twenty-four papers will be presented by the science team. A news conference is also being planned for the event, which is scheduled for March 21."

Here are more details:

Special Session on the IODP-ICDP Expedition 364 to the Chicxulub Impact Crater: The joint drilling expedition of the Chicxulub impact crater, organized by the International Ocean Discovery Program (IODP) and International Continental Scientific Drilling Program (ICDP), provides the first sampling of a peak ring in a large impact basin. Expedition topics to be covered in a special session include formation of peak rings, petrologic and deposition styles of impactites within a basin, correlations of subsurface geophysical and lithological properties, dramatic consequences of an impact into a target covered with water, impact-generated hydrothermal activity, and recovery of life in an impact-sterilized zone. Additional implications for structures on other planetary bodies (e.g., Moon and Mars) will also be addressed. Check out the links below for more information:

SPECIAL SESSION: IODP-ICDP Expedition 364 to the Chicxulub Impact Crater, Tuesday Morning, March 21, 8:30 a.m., Waterway Ballroom 6

SPECIAL SESSION POSTERS: IODP-ICDP Expedition 364 to the Chicxulub Impact Crater, Tuesday Evening, March 21, 5:30 p.m., Town Center Exhibit Area

Welcome New AGS Members

Beverly Braham-Durica Tariq Akif Dave Waldrop

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.

FREEPORT-McMoRan

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.