Arizona Geological Society Newsletter

JANUARY 2019

January 8th, 2019 DINNER MEETING

Who: **John Dilles** 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 online reservation ($10 without).

RESERVATIONS ARE REQUIRED: Reserve on the AGS website (http://www.arizonageologicalsoc.org/events) by 11 am on Friday, January 4th. Please indicate Regular (Beef Fajita Tacos), Vegetarian (Stuffed Bell Pepper), or Salad (Chicken Caesar Salad) meal preference. Please cancel by **Friday, January 4th at 11 am** if you are unable to attend - no shows and late cancellations will be invoiced.

The January dinner meeting is pending a sponsor.

If you are interested in sponsoring the dinner meeting, please email:
vpmarketing@arizonageologicalsoc.org

ABSTRACT

Using the Zonation of Trace Metal Geochemistry and Hydrothermal Mineralogy for Porphyry Copper Mineral Exploration

by John Dilles,
SEG Thayer-Lindsley Distinguisted Lecturer and Professor of Geology, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

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The key zonation features of the hydrothermal mineralogy in porphyry copper deposits have been well-known since the early 1970s (USGS workers; Lowell and Guilbert, 1970) and improved by the recognition that during the ~100,000 year timescale of a single magmatic-hydrothermal system the thermal collapse leads to lower temperature veins and alteration cutting earlier high temperature veins and zones (Gustafson and Hunt, 1975).

Magmatic hydrothermal fluids produce spatial zonation from K-silicate alteration near source granitoid intrusions and porphyry dikes upward to sericitic alteration and the near-surface (<1 km) "lithocap" of advanced argillic alteration. In most porphyry Cu-Mo-Au hydrothermal systems, ore minerals and A-B-style quartz veins are deposited synchronous with K-silicate alteration (700-500°C) and locally into sericitic alteration (~500-300°C), which significantly remobilizes higher temperature ores. Lithocaps are likely produced where low density magmatic gas condenses into shallow groundwater, and these commonly lack Cu-Au unless added by later low-temperature condensed fluids. Peripheral propylitic and sodic-calcic alteration in most cases is produced by non-magmatic advecting fluids, and therefore do not generally produce porphyry Cu-Mo-Au ores.

Progress on understanding trace metal zonation has followed the development of low-cost whole-rock lithogeochemical analyses for a suite of elements (n>44) via ICP and ICP-MS with detection limits near crustal abundances. Parallel mineralogic studies make use of SWIR data from remote sensing, spot analyses, and core-scanning systems, as well as mineral compositions from EMPA and LA-ICP-MS.

Trace metal anomalies provide an excellent means of tracking the magmatic-hydrothermal plume via alkali addition in whole rocks and phyllosilicates (K, Rb, Cs, Ba, Li, Tl), from ore zones to the lithocap. Trace metals are similarly zoned in a sequence from Cu-Mo±Au, Sn, W upward to Se-Te and shallower As-Sb-Bi, where the latter five elements largely occur in pyrite as inclusions and in solid solution. In the surface environment, these elements form insoluble and immobile oxides so are useful for geochemical vectoring. Alkalis and Cu-Mo-Au-Sn-W are largely derived from the source magma, and therefore differ based on magma composition. Many of the elements deposited at lower temperature (Se-Te-As-Sb-Bi) are potentially derived from magma or via wall-rock alteration leaching at >400°C, as is the case of much of Zn, Mn, and Pb deposited in upper zones at <400°C.

Sericitic alteration associated with pyrite-rich D-type veins remain excellent prospecting tools as they may extend several kilometers upward or outward from ore. Along both these paths, formation of sericite consumes acid, and therefore mapping the pH gradient may provide a useful vector. In distal weakly sericitized rock containing relict feldspar, the pH is buffered and muscovite is pale green and phengitic (Fe-Mg-rich), whereas in proximal zones at lower pH muscovite is white and Fe-Mg-poor. These compositional differences can be mapped using the position of the SWIR 2200 nm, which increases as Fe-Mg content increases.

ABOUT THE SPEAKER

John Dilles was born in California, and earned BS and MS degrees in geology from Caltech (1975, 1976), and a PhD in geology from Stanford University (1984). During the 1980s he worked as an exploration geologist in the western USA for Hunt, Ware & Proffett and other companies, and operated small gold mines with his brother, Peter. He joined the faculty of the Oregon State University in 1986, where he is currently Professor of Geology in the College of Earth, Ocean and Atmospheric Sciences.

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He advises graduate students and teaches courses in mineralogy, petrology-geochemistry, field geology, and mineral deposits. His research has been conducted in the USA, South American, and Canadian Cordillera, and focuses on the geology of porphyry copper deposits, magmatic processes that generate metal and sulfur-bearing hydrothermal fluids, field-based structural geology, and isotopic tracers and geochronology. He has published more than 50 peer-reviewed papers and geologic maps, additional field trip guidebooks and reports. Google Scholar notes his publications have 3477 citations (h-index = 29). He has served as a Fellow, Silver Medalist (2017), and Thayer Lindsay Lecturer (2018) of the Society of Economic Geologists, Fellow of the Geological Society of America and is past-chair of the Minerals and Energy Section of the Association of Public and Land-Grant Universities, where he has advocated for federal support for US universities.

Arizona Geological Society Membership Stats (1/1/2019)

Total Membership	Professional Members	Student Members	Organizational Members
410	342	61	7

Arizona Geological Society awarded 2018 scholarships to recipients at its December dinner meeting.

2018 M. Lee Allison Scholarship Recipient: Lorraine Carnes

2018 Courtright Scholarship Recipient: Alexandra L. Wallenberg

CALL FOR VOLUNTEERS to form STAFF-STEERING COMMITTEES for Geological Society of America 2019 Conference

In Sept. 2019, the Geological Society of America (GSA) brings its annual conference to Phoenix. This is a once in a generation opportunity for AGS to perform on a national platform; GSA's annual conference was last convened in Phoenix in the mid-1980s. The AGS Executive Committee is strategizing a role for AGS at the fall 2019 meeting. AGS involvement is consistent with the role and responsibilities laid out on our website - The Arizona Geological Society promotes and encourages interest in the science of geology ... A subset of Executive Committee members met Thurs., 5 Oct., and identified four areas for AGS involvement. Our next step is to form sub-committees to address those areas, and we sorely need the active involvement of AGS members. The AGS Executive Committee simply cannot carry this off without member support.

Field Trip(s): 2019 AGS VP of Field Trips, Wolf Schuh, will direct this committee which is charged with identifying and organizing one or more field trips as part of the GSA Field Trip program. Arizona State Geologist and AGS member Phil Pearthree chairs the GSA Field Trip effort.

Technical Session(s): This committee is charged with planning one or more technical sessions showcasing the geology, economic geology, and/or tectonic setting of Arizona. ASU geoscientist and AGS member Steve Semken is chairing the GSA program and we are confident he will enthusiastically support AGS efforts here.

* If you have ideas for the topic for a technical session, please send us a note with description.

State Geological Societies ice breaker: 2019 AGS Treasurer Mike Conway will direct a committee to explore organizing and promoting an evening ice breaker/ ad hoc discussion for the officers and members of geological societies to informally address the role and challenges of geological societies going forward.

AGS booth on the Exhibit floor: This committee would explore the cost and efficacy of co-hosting an exhibit booth with our colleagues from the Utah, Nevada, and New Mexico geological societies.

There may be other areas of involvement for AGS. We welcome your ideas and your input.

Next Steps:

The clock is ticking on submitting field trips and technical sessions. We need AGS members to step forward and staff these subcommittees posthaste.This is the time for AGS members to step forward on behalf of Arizona's Earth science community to showcase Arizona's magnificent geology. Your support of Arizona's geoscience community is crucial, so please contact one of the following at your earliest convenience.

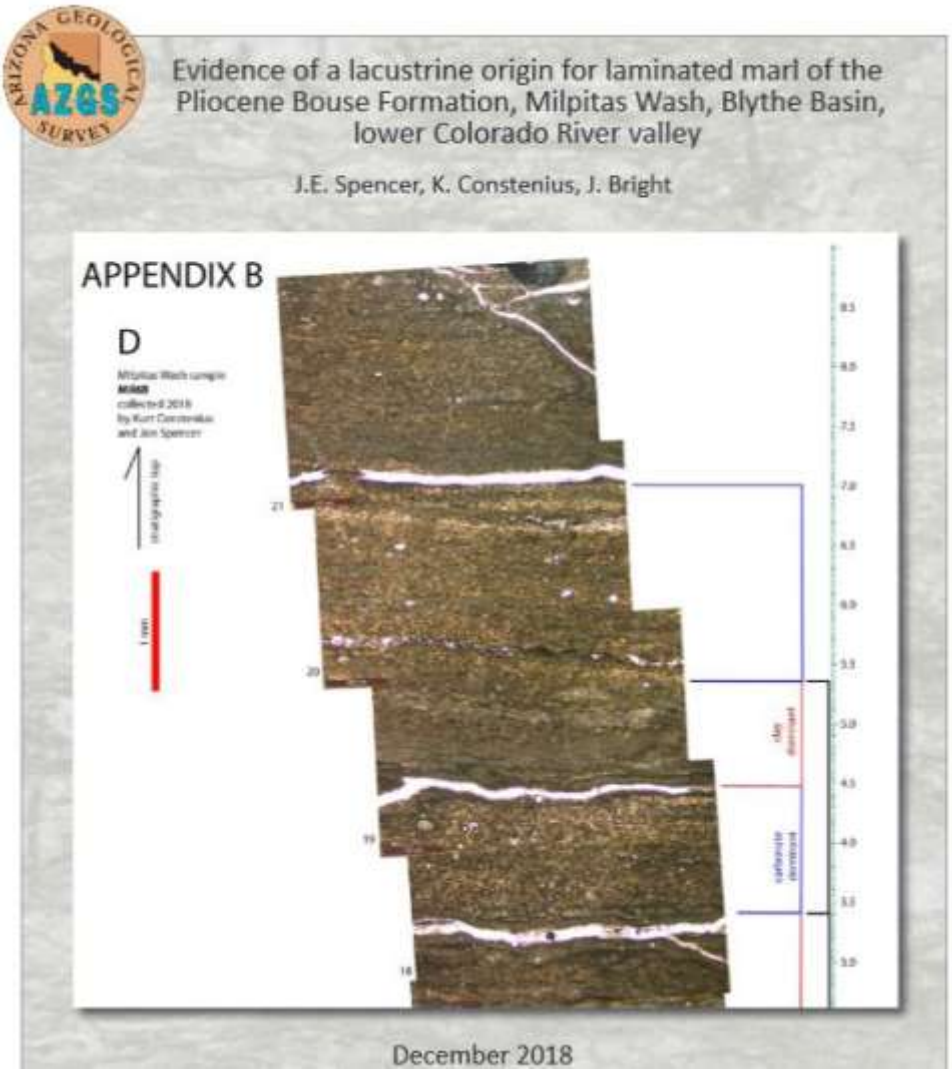
Please let us know if you have questions or concerns.

Respectfully,

Mike Conway (fmconway@email.arizona.edu<mailto:fmconway@email.arizona.edu>); Karen Wenrich (crystalsul@aol.com<mailto:crystalsul@aol.com>); Leandra Marshall (leaxsmars@gmail.com<mailto:leaxsmars@gmail.com>)

Arizona Geological Survey releases publication:

Pliocene Bouse Formation of the Lower Colorado River Valley – Marine Incursion or Lacustrine Deposits?



The initial development of the Lower Colorado River in the early Pliocene coincides with deposition of sediments comprising the Bouse Formation. The origin of the southern Bouse Formation is open to interpretation and there currently are two general schools of thought:

An origin by one or two marine incursions associated with the developing Gulf of California, supported by the paleontological and sedimentological interpretations.

Deposition of in a very large saline lake fed by the developing Colorado River in a region that formerly consisted of closed basins; supported by geochemical, paleontological, and geomorphic interpretations.

Today, the Arizona Geological Survey (AZGS) released a contributed report by Jon Spencer (formerly of the AZGS), Kurt Constenius and Jordon Bright of the University of Arizona Dept. of Geosciences arguing for a lacustrine origin for Bouse Formation sediments in the Milpitas Wash, Blythe Basin, California.

From their abstract, "The Pliocene Bouse Formation in the lower Colorado River trough locally contains laminated marl and claystone interpreted by O'Connell et al. (2017) to represent the spring-neap tide cycle during sediment deposition in an estuary. Tidal cycles, if present, should be detectable by Fourier spectral analysis of lamination thicknesses in continuous sequences of laminated sediments. To evaluate the tidal interpretation, we attempted to photograph several laminated sequences in the southern Bouse Formation (south of Blythe, California) so that thicknesses could be measured from the photographs. Only one sequence, in lower Milpitas Wash (California), was identified where thicknesses could be determined with adequate precision from field photography. Fourier analysis of that sequence failed to identify evidence of tides. Furthermore, electron-microprobe analysis determined that laminations consist of alternating claystone and marl, which is consistent with annual changes in lake chemistry and sediment sources rather than physical changes in sediment sorting

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and transport during tidal cycles. Fourier analysis of data presented by O'Connell et al. (2017) of two nearby laminated Bouse sequences interpreted as tidal rhythmites also failed to identify statistically significant evidence of tides."

To review or download the entire paper, follow the link below:

http://repository.azgs.az.gov/uri_gin/azgs/dlio/1901

Citation:

Spencer, J.E., Constenius, K. and Bright, J., 2018, Evidence of a lacustrine origin for laminated marl of the Pliocene Bouse Formation, Milpitas Wash, Blythe Basin, lower Colorado River valley. Arizona Geological Survey Contributed Report, CR-18-K, 33 p.

Please contact the AGS Secretary if your company is interested in advertising in this monthly newsletter.

Arizona Geological Society is grateful to Freeport-McMoRan, Inc. for their generous support of our student members!

Freeport-McMoRan sponsored student dinners for the 2018 AGS monthly meetings.

FREEPORT-McMoRAN

AGS MEMBERSHIP APPLICATION OR RENEWAL FORM

YOU CAN RENEW OR SIGN UP as a new member and pay online. Please go to our website, arizonageological soc.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: $35; ☐ 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.