Arizona Geological Society Newsletter Newsletter

JUNE 2014

June 3, 2014 DINNER MEETING

Who: **Arend Meijer** will speak about "The Pinal Schist of Southern Arizona: A Paleoproterozoic Fore-Arc Complex with Evidence of Spreading Ridge-Trench Interaction and an Arc Accretion Event at ~1.65 Ga"

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, Students Members free with online reservation ($10 without).

RESERVATIONS ARE REQUIRED: CALL (520) 663-5295 or reserve on the AGS website (www.arizonageologicalsoc.org) by 11 a.m. by Friday, May 30th. Please indicate regular (Grilled Tilapia with caper butter sauce), vegetarian, or Cobb salad meal preference. Please cancel by Friday, May 30th at 11 a.m. if you are unable to attend—no shows and late cancellations will be invoiced.

The June dinner meeting is sponsored by: ASARCO LLC

AGS is grateful for ASARCO's sponsorship, which helps us to offset dinner meeting costs.

Abstract

THE PINAL SCHIST OF SOUTHERN ARIZONA: A PALEOPROTEROZOIC FORE-ARC COMPLEX WITH EVIDENCE OF SPREADING RIDGE-TRENCH INTERACTION AND AN ARC ACCRETION EVENT AT ~1.65 Ga

by Arend Meijer

The Paleoproterozoic Pinal Schist of southern Arizona shows many characteristics consistent with the hypothesis that it was part of a subduction complex associated with a Paleoproterozoic arc complex in central Arizona. In a (NW-SE) direction perpendicular to the trend of the arc complex, the Pinal Schist is exposed over a distance of at least 300 km in southeastern Arizona (from the Phoenix area to Bisbee). This distance is within the range of modern arc-trench gaps. The Pinal Schist is predominantly composed of interbedded quartz-sericite/muscovite schist and meta-wacke (interpreted as turbidite sequences) with minor meta-chert, meta-conglomerate, and rare marble. The Pinal schist/wacke sequences contain randomly distributed blocks/pods of mafic meta-volcanic rocks some of which appear to have oceanic affinities (for example, E-MORB)

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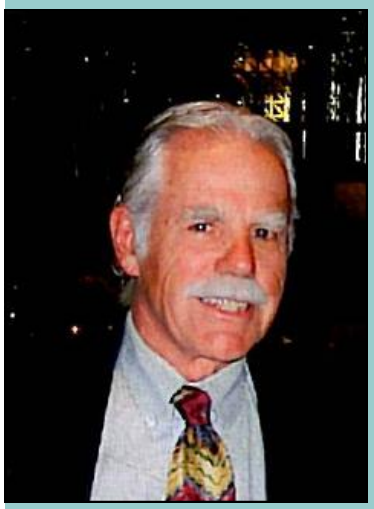
while others appear to have arc affinities based on trace element abundances. Isolated felsic flows, dikes, and hypabyssal intrusions with arc-like trace element patterns are also present. In addition, there are several larger mafic to felsic volcanic centers within the terrane. Granitoid intrusions also of Paleoproterozoic age are relatively common in the Pinal terrane and these can be divided into two groups. A "pretectonic to syntectonic" group that shows various degrees of foliation, ranges in age from 1.74 Ga to 1.65 Ga, and occurs mainly in the northern portions of the terrane. A "post-tectonic" group that is only locally foliated, shows an unusual consistency in ages clustered around 1.65 Ga, is found through much of the Pinal terrane. The metamorphic grade of non-plutonic rocks in the Pinal terrane is mostly greenschist facies although there are local occurrences of higher-grade assemblages. High P/T facies rocks (for example, blueschists) have not been identified in the Pinal terrane in over 100 years of mapping. Structural/tectonic features of Paleoproterozoic age associated with the Pinal terrane include meta-mélanges, shear zones, major thrust faults, and other structures typical of subduction complexes. The geologic and structural characteristics of the Pinal terrane suggest it reflects progressive growth of the Laurentian margin towards the southeast (present–day) between 1.74 and 1.65 Ga. The meta-volcanic rocks with arc-affinities and "post-tectonic" granitoids exposed within the Pinal terrane are here interpreted to reflect a spreading-ridge subduction event at around 1.65 Ga. The volcanic rocks with arc affinities were metamorphosed to greenschist facies assemblages not long (<10 Ma) after they were erupted onto the Pinal fore-arc. This metamorphic episode is thought to reflect an arc accretion/obduction event that buried the Pinal fore-arc beneath the fore-arc of an island arc terrane that came from the south. Most of this accreted arc terrane was eroded off the Pinal fore-arc terrane in the 300 Ma following accretion (prior to the deposition of the Neoproterozoic Apache Group). What may be remnants of this arc terrane are now exposed in northern Mexico. The creation of the Pinal terrane involved a high continental growth rate. The magmatism associated with the ridge subduction event and extensive plutonism within the terrane around 1.45 Ga likely contributed to the high continental growth rate reflected in this terrane and to the preservation of the terrane.

About the June Dinner Speaker

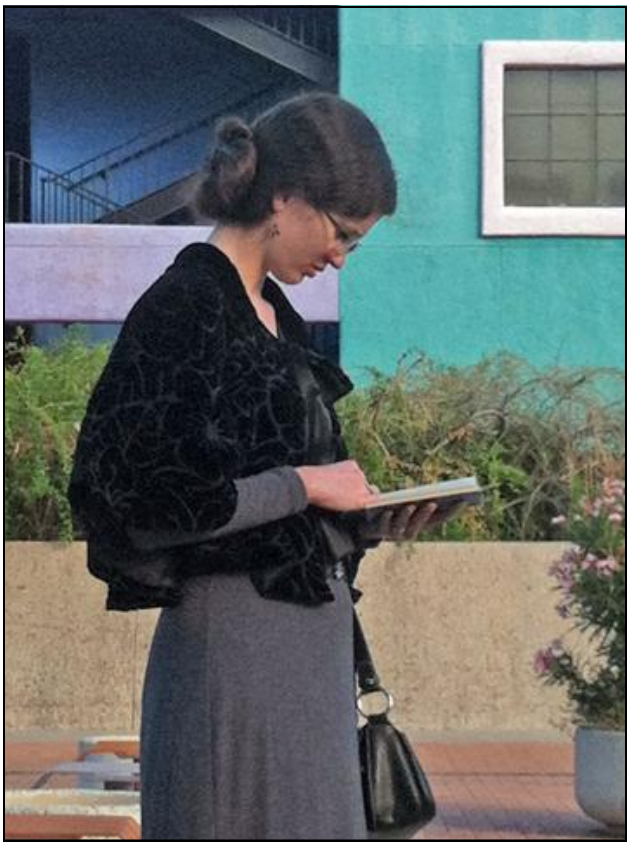


Dr. Meijer received a doctorate in geology in 1974 from the University of California at Santa Barbara. The title of his doctoral dissertation was "A Study of the Geochemistry of the Mariana Island Arc System and its Bearing on the Genesis and Evolution of Volcanic Arc Magmas". His dissertation advisors included Drs. George R. Tilton, Daniel E. Karig, and Clifford A. Hopson. Following the completion of his dissertation work, Dr. Meijer conducted post-doctoral studies with Dr. Krishna A. Sinha at Virginia Polytechnic Institute and Dr. Lee T. Silver at California Institute of Technology before joining the Geosciences faculty at the University of Arizona in 1976. In addition to teaching undergraduate and graduate courses, he conducted field and laboratory studies focused on volcanic rocks in the Mariana island arc system. In 1984, he accepted a position at Los Alamos National Laboratory in New Mexico. In addition to work on classified projects, he carried out studies of the U-Th-Pb isotope systematics of ultramafic nodules from the mantle. In 1994, Dr. Meijer started his own consulting company to provide geochemical expertise to chemical companies, mining companies, and oil companies. He retired from the company in 2008. Dr. Meijer has published over 50 papers in peer-reviewed journals in addition to several books. Although originally from southern California, he prefers the geological variety and freedom of movement available in southern Arizona.

Isabel Fay receives Ph.D. from the University of Arizona

by Bob Kamilli

One of our AGS counselors, an erstwhile graduate student in the Geosciences Department at the University of Arizona successfully, defended her Ph.D. dissertation on April 7. Her dissertation, covering two completely different academic fields (geology and the history of science) are titled "Studies of Cu-Co Mineralization at Tenke-Fungurume, D.R. Congo" and "Developments in Geology between 1550 and 1750 AD." All in all, Isabel will publish seven articles in peer-reviewed journals as a result of her Ph.D. research. If the University of Arizona were in Germany, she would have received two separate Ph.D. degrees and would be formally addressed as Frau Dr. Dr. Isabel Fay.



Isabel reading Cicero's *De Amicitia* in Latin outside the Tucson Music Hall during the intermission of an opera she was attending.

Isabel is from Alabama and the Florida Panhandle. She graduated in three years from the University of Oklahoma in 2008, where she majored in geology. Isabel actually started taking full-fledged college courses in algebra and English at the local community college, now Northwest Florida State College, at the age of thirteen.

She chose her dissertation topic, in part, because she liked the idea of studying in Africa and she was fascinated by the idea of a cobalt deposit. Her interest in the history of science also arose from economic geology: being the thorough type, she started her literature review with the earliest book written on the subject: Georgius Agricola's *De Re Metallica*. As she read it, she began to discover how much modern geology differs from the study of the earth in his time, but also how similar the two are in some respects. That led her to write a second dissertation on the history and methodology of geology.

Isabel has already received many honors. She won the top overall prize at the student-organized Geodaze symposium in 2013. She slipped a little this year and only won the second-place overall prize. Last year, she won the first-place student award from the History and Philosophy of Science Division of the Geological Society of America for her paper titled "Georgius Agricola's Contributions to Hydrogeology".

Fortunately, for AGS, she will be able to stay on as an AGS Counselor, as she will assume a research position in applied mineralogy at the University of Arizona and continue to broaden her current research and explore new areas.

For recreation, Isabel reads "anything I can get my hands on", especially books written in Latin. (See photo.) She is experimenting with new ways to show information diagrammatically and graphically. She also intends to take up quilting again, once the end of grad school (hopefully) frees up some time for it.

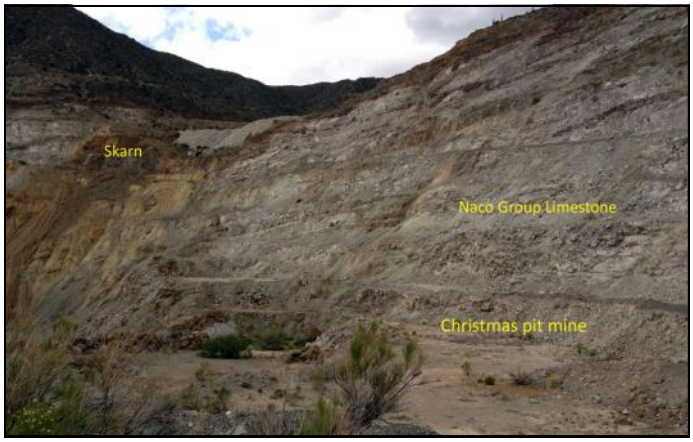
2014 AGS Spring Field Trip to Christmas

On a chilly, blustery Saturday, AGS members visited Freeport-McMoRan Copper and Gold's Christmas property. Located at the southeastern end of the Dripping Spring Mountains, Christmas is one of the last largely undeveloped deposits remaining in the prolific porphyry copper province of southeastern Arizona.

Participants had an opportunity to examine the pre-mineral McDonald rhyodacite porphyry stock, propylitically altered Williamson Canyon volcanics, garnet skarn developed in limestones of the Naco Group adjacent to the Christmas granodiorite porphyry stock and mineralized intervals in core from two deep drill holes located in the downthrown block of the Christmas and Joker faults.

The Arizona Geological Society thanks Freeport-McMoRan Copper and Gold for providing the opportunity to visit the Christmas property as well as preparing an excellent field trip guidebook and providing lunch for the field trip participants. We also thank field trip leaders, Randy White, Ralph Stegen, Robert Lee, Michele Anthony, Mark Thoman and Nick Dize for taking the time out of their busy schedules to provide us with an unique insight into this interesting porphyry copper system.

Randy White presents geological overview of the district geology



Open Pit at Christmas, showing the skarn and Naco Group Limestone

Core from one of the deep drill holes at Christmas

Guidebooks for the Arizona Geological Society 2014 Spring Field Trip to the Christmas Porphyry Copper Deposit will be available at the dinner meeting or by mail order for $15 plus postage. Contact Cori Hoag at choag@srk.com, if you wish to order a copy.

AGS members were spotted on May 17th at the Freeport-McMoRan Tyrone Operation in New Mexico attending the SME Arizona Conference Spring Field Trip. **Sarah Applebee**, **Kevin Horstman**, **Cori Hoag**, **Jeff Cornoyer**, **Bob Metz**, **Anna Domitrovic**, and **Jan Rasmussen** are shown standing in front of a 240-ton Cat 793B haul truck. Not shown: Don Applebee.

What's New from the Arizona Geological Survey

Arizona Geology E-Magazine articles – May 2014

- **The STATEMAP mapping program in Arizona: 2014 update by Jon Spencer**
- **Landslides – Mitigating a clear and present danger by Michael Conway**
- **New Mine Web Portal by Casey Brown**
- **Summary of oil and gas activity in Arizona through April 2014 by Steven Rauzi**

Arizona Mining Review e-Video Magazine – 28 May 2014

- Nyal Niemuth – Breaking news of mining in Arizona
- Eric Mears of Haley & Aldrich – NEW "Aggregate Protection Guidance" for Arizona planners
- Arizona Mine Inspector Joe Hart and Laurie Swartzbaugh – Addressing abandoned mines in Arizona

Arizona Mining Review - The May episode will be broadcast at 10:00 am MST on 28 May on LiveStream (http://new.livestream.com/accounts/2496466/azminingreview). Immediately thereafter, it will be available on our AZGS YouTube Channel (https://www.youtube.com/user/azgsweb), along with episodes from January 2013 through April 2014.

New Publications

Arizona's San Pedro River - through a geologist's eyes – A geologic map story

The San Pedro River is Arizona's last undammed river. This 122-mile map story from the US-Mexico Frontier to Winkelman, Arizona, shows the San Pedro River Valley as seen through the eyes of AZGS geologist Joe Cook. Powered by ArcGIS Online.

Other AZGS News

The National Geothermal Data System (NGDS) – a portal to geoscience data – was formally launched in April 2014. AZGS took the lead on behalf of the *Association of American State Geologists (AASG) to bring the NGDS to fruition. The U.S. Department of Energy provided more than $21 million in grant funds.*

The US Library of Congress notified AZGS Director Lee Allison that his blog "Arizona Geology" was selected for inclusion in the Library's historic collection of Science Blogs. Their message said, "We consider your website to be an important part of this collection and the historical record."

You can check out Lee's blog at http://arizonageology.blogspot.com/.

AGS Member News

In September 2014, the National Mining Hall of Fame will present a Prazen Living Legend of Mining Award to AGS member Pamela Wilkinson. This prestigious award is given annually to an individual or organization demonstrating a continuing commitment and successful efforts to educate the public on the importance of the minerals industry.

Pam is the Education Outreach Coordinator through the Lowell Institute for Mineral Resources, University of Arizona and provides interesting and engaging presentations primarily to high school students on earth sciences, minerals, and mining. Her position is funded by the Mining Foundation of the Southwest.

Obituary

AGS member, Nicholas M. Priznar, a Transportation Engineering Geologist with the Arizona Department of Transportation, passed away on Friday, May 16, 2014. Nick has been employed for over 27 years with ADOT, in the Geotechnical Section of the Materials Group.

Nick began his career with ADOT in 1986 after 10 years in mining and construction. Nick's technical knowledge and expertise had a tremendous influence on ADOT's bridge foundations, slope stability, and rock-fall projects. He will be greatly missed.

ANNOUNCEMENTS

Welcome New AGS Members

Ralph W. Alter

Rex E. Loesby

Sean I. Hovorka

Christian Rathkopf

Arizona Geological Society is grateful to Freeport-McMoRan Copper and Gold for their generous support of our student members!

Freeport-McMoRan is sponsoring student dinners for the 2014 AGS monthly meetings.

2014 AGS MEMBERSHIP APPLICATION OR RENEWAL FORM

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 Scholarship Fund.