



Arizona Geological Society Newsletter

ARIZONA GEOLOGICAL SOCIETY, INC., TUCSON, AZ

JUNE 2011

June 7, 2011 DINNER MEETING

Brian Conway of the Arizona Department of Water Resources InSAR program will be our featured speaker. See title and abstract below.

Location: Sheraton Four Points, Wild Cat Room: 1900 E. Speedway Blvd. in Tucson (Speedway Blvd. at Campbell Ave.).

Cash Bar at 6 pm, Dinner at 7 pm, Talk at 8 pm.

Cost: With reservation, members \$24, guests \$27, Students \$10. Without reservation, \$3 additional.

RESERVATIONS: CALL 520.663.5295 by 5 p.m. on June 3, 2011. Indicate low-salt, vegetarian, or vegan meal

ABSTRACT

Arizona Department of Water Resources Land Subsidence Monitoring Program Using Interferometric Synthetic Aperture Radar (InSAR)

by Brian Conway, Arizona Department of Water Resources

The Arizona Department of Water Resources (ADWR) land subsidence monitoring program has been greatly enhanced by the use of Interferometric Synthetic Aperture Radar (InSAR). ADWR's InSAR program started in 2002 with the awarding of a three year NASA Earth Science grant, allowing ADWR the opportunity to develop the InSAR program.

In 2005, ADWR began collecting and processing monthly SAR data from the European and Canadian Space Agency SAR satellites, producing time-series interferograms for the greater Phoenix and Tucson metropolitan areas. Since 2005 the program has developed important partnerships with numerous state, county, and local agencies, water districts and water companies who provide annual contributions to help support the data collection costs. These partnerships have provided ADWR the necessary resources to expand the data collection area for the InSAR program to include numerous groundwater basins in south-central and southern Arizona in Maricopa, Pinal, Pima, La Paz, and Cochise counties.

Through these efforts ADWR has identified more than 18 active land subsidence features and determined the spatial extent, deformation rates, and time-series history of each land subsidence feature. The process of collecting, processing, and interpreting InSAR data has resulted in ADWR producing land subsidence maps for each land subsidence feature covering different time periods.

Engineers, hydrologists, geologists, GIS professionals, and scientists involved in the fields of water resources, structural engineering, geological engineering, hydrological engineering, land planning, floodplain management, and surveying greatly benefit from the InSAR data to identify and evaluate areas of land subsidence, uplift, earth fissures, faults, and many other geologic features.

Brian Conway has worked for the Arizona Department of Water Resources since 1999 and has supervised the Hydrology Division's Geophysics/Surveying Unit since 2006. Brian received his Bachelor's Degree in Environmental Science from Creighton University in Omaha, Nebraska in 1997. He attended the University of Arizona's Masters of Hydrology program from 1998 to 2001. Brian started at ADWR as an intern and worked his way up from an entry level Hydrologist in the Geophysics/Surveying Unit to the current supervisor. The Geophysics/Surveying Unit is responsible for monitoring land subsidence in Arizona using Interferometric Synthetic Aperture Radar (InSAR), and conducting gravity surveys to monitor changes in aquifer storage and gravity modeling to determine groundwater basin depth-to-bedrock, basin geometry, and groundwater-in-storage estimates.

June Member Spotlight— Dr. Stephen J. Reynolds

Stephen J. Reynolds was born in Kellogg, Idaho and grew up in Texas. He attended the Colorado School of Mines for one year where he lettered in downhill skiing. Steve and Mines were not a good fit, so he moved to the University of Texas-El Paso (UTEP) where he thrived in their field-based geology program. After receiving a B.S. from UTEP (1974) and M.S. and Ph.D. degrees (1977 and 1982) at Arizona, he began working for the Arizona Geological Survey on a new geologic map of the state. After 10 years at AZGS, Stephen moved to Arizona State University, where he has taught and inspired students for 20 years. ASU has been good to Steve, allowing him the freedom to pursue interests such as working in Mexico and California, conducting research on how students think and learn, and writing textbooks. His love of teaching and mentoring has resulted in a series of excellent graduate students, most of whom are teaching college, doing mineral exploration, or engaged in other interesting geologic careers. He lives in Ahwatukee, close to the South Mountain detachment fault.



How did you first become interested in geology? My father, John Reynolds, was a geologist in mineral exploration. He was the exploration manager for Rare Metals Corporation in Salt Lake and for El Paso Natural Gas when they found the Lakeshore Copper Deposit south of Casa Grande. He also found minable deposits of mercury near Weiser, Idaho and of gold at Stibnite, Idaho. I took geology classes my freshman and sophomore years, but was not a geology major. The Fall of my junior year at UTEP, I took Structural Geology, taught by Earl Lovejoy. He took us out in the field on many weekends, to the Franklin Mountains and to the geology around Mount Cristo Rey. On one of these trips, I realized that a geologist could walk up a canyon, map and study the geology, and figure out what happened, and I said, "Wow, this is it!" Prior to this, my performance in early geology classes was fine, but less than stellar, but after this epiphany in the field, I never got another B in any geology class. I commonly share this story with similar "underperforming students" in the Structural Geology and Advanced Field Geology classes I teach. In retrospect, I guess I was destined to be a geologist due to my father's wonderful, steady influence. My mom was a fantastic 5th grade teacher, so teaching makes sense too. My brother, John (aka "Cowboy") also got a geology degree and has had a great career in geophysics, mostly looking for mineral deposits. Recently, for the first time, he and I were able to work together, on gold deposits in Mexico. My sister married a geologist (another John), and my sister and brother's oldest sons are both geologists. I guess we're genetically predisposed to be geologists.

What was your first job? My first job was raking the dirt in front of newly constructed houses so they would look more presentable. After that, during high school, I was a right-of-way clerk for El Paso Natural Gas, sorting out land ownership, easements, and the like. I also ran a blueprint machine for two summers, and have an odd fondness for the smell of ammonia.

What was your first job as a geologist? As a result of being the top student in Structure and Field Camp at UTEP, I was asked by Professor Spencer Shannon to accompany him to work on the Thunder Mountain Gold Property in central Idaho in 1973. Officially, I was hired by Homestake Mining Company, principally under the direction of Dr. Joseph Wargo. I got to see the whole process from mapping, collecting samples, and siting drill sites. During the summer I met Dr. Bennie Leonard of the USGS, who made sure I worked with him the following summer when I got a USGS-NAGT summer fellowship. I worked with Bennie in the same area, around Yellow Pine, Stibnite, and Thunder Mountain in central Idaho. The following summer, Homestake funded my MS thesis on Carlin gold deposits in Nevada. One of the most memorable moments from these summers was when Bennie Leonard and I, along with a cook and wrangler, packed in on horseback into the middle of the Idaho Wilderness Area, only to have the horses abandon us and return to their stable 40 miles away. Luckily, we had lots of food, including huge biscuits affectionately known as "dough-gods." I still make dough-gods today.

Do you know someone who would be an interesting subject for a "Member Spotlight" column? Email his/her name and contact information to ajones@clearcreekassociates.com.

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Dr. Stephen J. Reynolds—Continued from Page 2

What is your most memorable field experience? Two of my most memorable field experiences happened when I was mapping the Granite Wash Mountains for the Arizona Survey, with Jon Spencer, Steve Richard, and Steve Laubach. One memorable experience consisted of a series of days when I was going out each day and finding incredible things—finding a new thrust fault one day and a 10-m-thick overturned Paleozoic section the next day, and so on. The second Granite Wash experience was when graduate student Steve Laubach and I were driving out of the field and saw a sidewinder rattlesnake cross the road. The way it moved was fascinating, so we stopped the car ten feet past the snake, and Steve opened the passenger door so we could both look out. I said, wisely in retrospect, “Toss a little stone near it without hitting it so we can get it to move.” He did that and the snake did its distinctive sideways slither. So at this point, I was in the middle of the front seat, leaning over Steve and looking out the passenger door. I said, wisely again, “That was neat. Do it again.” As soon as Steve reached down for a second stone, but before he could toss it, the snake came at him full speed from ten feet away. The next thing we knew I was plastered against the driver-side door, and Steve was nearly in my lap and had closed the passenger door, and both of us were looking over the back of the seat to make sure the snake had not gotten in the car. It reminded me of my reaction in a movie theater to a certain scene in the movie *Wait Until Dark*. You probably know which scene I mean. I could also mention a different time when I got stung by a scorpion and Stan Keith kept slowing down to point out geology, as I was turning blue in the back seat on the way to the Kearny Hospital—but I won’t go there.

What do you consider your greatest professional achievement? I have been fortunate to have worked on many wonderful projects, but there are several that mean the most to me. My top achievement would probably be the Geologic Map of Arizona, and the related job of figuring out the convoluted geology of mountain ranges, like the Granite Wash Mountains and Buckskin Mountains. A more recent accomplishment, which probably has the greatest overall impact, was publishing my *Exploring Geology* textbook for introductory geology courses. This book is considered by many to be a new paradigm for science textbooks, won a major corporate award for innovation, and has influenced the geology experience for tens of thousands of geology students. In the coming years, it will have done this for hundreds of thousands of students, hopefully improving their experience with and attitude toward geology (and science in general). I concluded several years ago that doing this is a lot more important than writing a handful of GSA Bulletin articles, which I could have done instead.

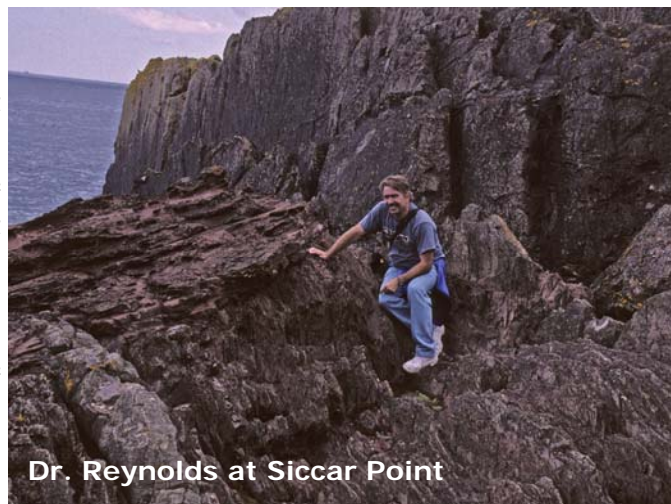
You greatest achievement EVER? I am most proud that I always try to “do the right thing” in my career or other aspects of my life. It is hard for me not to do something as well as I think it should be done. I’ve been called a perfectionist, or worse. I attribute my successful career to always “doing the right thing,” beginning with working hard in Field Camp, which led to my first job, where I also did the right thing and impressed people from the USGS and Homestake, which gave me jobs the next two summers. Because of this experience, Bill Rehrig hired me at Conoco Minerals, and he and I had fun looking for ore deposits and making a number of scientific contributions. And on it went, leading to today. Writing a new type of textbook took years of hard work, thinking deeply about what would best help students learn, and then writing, illustrating, and laying out a new type of textbook. But it was the right thing to do. At any point, I could have slacked off, done a just-good-enough job, or been a difficult employee, and that would have ended the chain of wonderful opportunities. This is another lesson I share with students.

What are your hobbies? As a geologist and textbook author, I do a lot of traveling, hiking, and photographing.

I have been lucky to go to all seven continents. I am also an active downhill skier, still entering the occasional race. I play basketball, and listen to, play, and compose diverse kinds of music. Those who know me would say I have a great fascination with all things related to computers, electronics, stereos, 3D graphics, and various combinations of these. My wife, Susie, and I have two dogs and three wonderful, snuggly cats, whose photos adorn my walls, phone, and computer screens. My students know the cats’ names, sometimes for extra credit on tests.

Water, Whiskey or Wine? Of these three, water. The smell and taste of whiskey don’t appeal to me, and most wine seems too refined for a field geologist like me. It’s like trying to dress me up in a suit—there’s some kind of a fundamental disconnect. It’s just wrong!

Thanks, Steve!



Dr. Reynolds at Siccar Point

Announcements

Thanks to members **Ted Eyde** and **Kalyn Galvez** for their recent contributions to the J. Harold Courtright Scholarship Fund.

Welcome NEW MEMBERS:

- Kenneth Hamilton, Senior Geologist, Blaes Environmental Management, Inc.
- Jessica Lopez Pearce, Geologist, US Forest Service- Kaibab National Forest

The **Arizona Hydrological Society's** 2011 Symposium on "Watersheds Near and Far" will be hosted by the AHS Flagstaff Chapter on September 18-20, 2011. The deadline for submission of abstracts is June 1, 2011!

For more information: http://www.azhydrosoc.org/2011_symposium.html

NASA to Launch New Science Mission to Asteroid in 2016

(and there is a UA Connection!)

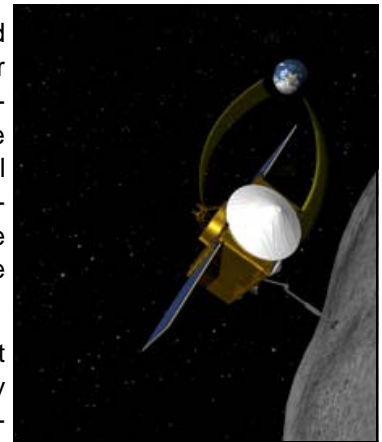
On May 25, 2011 NASA announced that they will launch a spacecraft to an asteroid in 2016 and use a robotic arm to pluck samples that could better explain our solar system's formation and how life began. The mission, called Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer, or OSIRIS-REx, will be the first U.S. mission to carry samples from an asteroid back to Earth. "This is a critical step in meeting the objectives outlined by President Obama to extend our reach beyond low-Earth orbit and explore into deep space," said NASA Administrator Charlie Bolden. "It's robotic missions like these that will pave the way for future human space missions to an asteroid and other deep space destinations."

Asteroids are leftovers formed from the cloud of gas and dust—the solar nebula—that collapsed to form our sun and the planets about 4.5 billion years ago. As such, they contain the original material from the solar nebula, which can tell us about the conditions of our solar system's birth.

After traveling four years, OSIRIS-REx will approach the primitive, near Earth asteroid designated 1999 RQ36. Once within three miles of the asteroid, the spacecraft will begin six months of comprehensive surface mapping. The science team then will pick a location from where the spacecraft's arm will take a sample. The spacecraft gradually will move closer to the site, and the arm will extend to collect more than two ounces of material for return to Earth in 2023. The mission, excluding the launch vehicle, is expected to cost approximately \$800 million.

The sample will be stored in a capsule that will land at Utah's Test and Training Range. The OSIRIS-REx sample capsule will be taken to NASA's Johnson Space Center in Houston. The material will be removed and delivered to a dedicated research facility following stringent planetary protection protocol. Precise analysis will be performed that cannot be duplicated by spacecraft-based instruments.

RQ36 is approximately 1,900 feet in diameter or roughly the size of five football fields. The asteroid, little altered over time, is likely to represent a snapshot of our solar system's infancy. The asteroid also is likely rich in carbon, a key element in the organic molecules necessary for life. Organic molecules have been found in meteorite and comet samples, indicating some of life's ingredients can be created in space. Scientists want to see if they also are present on RQ36. "This asteroid is a time capsule from the birth of our solar system and ushers in a new era of planetary exploration," said Jim Green, director, NASA's Planetary Science Division in Washington. "The knowledge from the mission also will help us to develop methods to better track the orbits of asteroids."



Conceptual image of OSIRIS-REx. Credit: NASA/Goddard/University of Arizona

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The mission will accurately measure the "Yarkovsky effect" for the first time. The effect is a small push caused by the sun on an asteroid, as it absorbs sunlight and re-emits that energy as heat. The small push adds up over time, but it is uneven due to an asteroid's shape, wobble, surface composition and rotation. For scientists to predict an Earth-approaching asteroid's path, they must understand how the effect will change its orbit. OSIRIS-REx will help refine RQ36's orbit to ascertain its trajectory and devise strategies to mitigate possible Earth impacts from celestial objects.

Michael Drake of the **University of Arizona** in Tucson is the mission's principal investigator. NASA's Goddard Space Flight Center in Greenbelt, Md., will provide overall mission management, systems engineering, and safety and mission assurance. Lockheed Martin Space Systems in Denver will build the spacecraft. The OSIRIS-REx payload includes instruments from the University of Arizona, Goddard, Arizona State University in Tempe and the Canadian Space Agency. NASA's Ames Research Center at Moffett Field, Calif., the Langley Research Center in Hampton Va., and the Jet Propulsion Laboratory in Pasadena, Calif., also are involved. The science team is composed of numerous researchers from universities, private and government agencies.

This is an abbreviated version of NASA's press release. To read NASA's press release in its entirety, go to: <http://www.nasa.gov/topics/solarsystem/features/osiris-rex.html>

From the Arizona State Geologist's Blog:

A group of six Arizona state legislators, three representatives and three senators, have formed the Arizona Legislative Mining Caucus. According to a letter sent to other legislators on May 6, 2011, "The bi-partisan Arizona Legislative Mining Caucus will be a forum to educate legislators about the value of the Arizona mining industry and to create sound legislative policies to support the continued vibrancy of the industry. As a member of the Caucus we will pledge to protect and enhance the viability of the mining industry as an economic engine to our great state."

The first meeting of the caucus is scheduled for June 9 in Tucson, with a Phoenix meeting to be scheduled then. The signers are Senators Al Melvin, Sylvia Allen, and Steve Smith, and Representatives Frank Pratt, Russ Jones, and Terri Proud.

In the invitation letter, the organizers make these points:

COPPER in 2010:

- 73,100 Arizona residents had jobs in 2010 as a result of direct and indirect contributions by the copper mining industry.
- Provided direct payments of more than \$194 million to state and local governments in taxes and fees.
- Provided 10,400 direct jobs throughout our state.
- Personal income to those workers and retirees amounted to more than \$970 million.
- Other Arizona businesses received nearly \$7.9 billion through direct and indirect payments.

AGGREGATES in 2010:

- ARPA member companies employ 6,124 workers who provide materials for an additional 112,361 workers in the Arizona construction industry.
- Payrolls totaled \$552.6 million and taxes and fees paid to state, local, and federal governments totaled \$98.9 million.
- Industry purchases of goods, services, materials, and supplies from other Arizona businesses were \$956.2 million.
- Direct output, production and deliveries of the Arizona Rock Products industry was \$1.6 billion and the total economic impact was \$2.9 billion.
- This information is based on a 61% reduction of output since 2006 due to the current economic conditions.

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COAL: The coal mining industry provides over 400 direct jobs in northeastern Arizona. The coal industry injected nearly \$109 million into Arizona in 2010. Tribal economies have benefited from \$92 million while the State of Arizona and Navajo County have received a combined \$17 million in annual taxes.

GEMSTONES: Arizona is the 3rd largest gemstone producing state (est. \$2 million).

GOLD: Copperstone Gold will restart production in 2011, and Gold Road Mine started production in August 2010.

POTASH: Although there is no active potash mining in Arizona at this time, the Holbrook Basin is estimated to have a reserve of 1 billion tons of potash.

PUMICE: Arizona is the leading producer of pumice and pumicite, leading six other states (est. value in 2009 was \$5 - \$6 million.)

URANIUM: Uranium mining resumed in late 2009 at Denison Mines Arizona-1 Mine in the world class Northern Arizona Uranium District. According to the USGS, the district contains an estimated 326 million pounds of uranium—40% of the nation's undiscovered resource. Mining this uranium would have enormous economic impacts, such as:

- 1,000+ new jobs in Coconino and Mohave Counties.
- \$40 million annually from payroll.
- \$14 billion in output over the next 20 years,
- \$952 million in federal and state corporate income taxes.
- \$80 million in state severance taxes.

The State Geologist's blog is a great way to stay informed. Check it out <http://arizonageology.blogspot.com/>

2011 AGS MEMBERSHIP APPLICATION OR RENEWAL FORM

YOU CAN NOW SIGN UP FOR MEMBERSHIP AND PAY DUES ONLINE!!!

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)

Name: _____ Position: _____

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Mailing Address: _____

Street: _____ City: _____ State: _____ Zip Code: _____

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