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Cover Photo: Flume Trail in the Granite Dells of Prescott. Photo provided by Prescott Office of Tourism.
The mission of the American Institute of Professional Geologists (AIPG) is to be an effective advocate for the profession of geology and to serve its members through establishment of a standard of excellence for the profession. Since then, more than 10,000 individuals have demonstrated their commitment to the highest levels of competence and responsibility and public service, and is the ombudsman for the geological profession. It was founded in 1963 to promote the profession of geology and to provide certification for geologists to establish a standard of excellence for the profession. Since then, more than 10,000 individuals have demonstrated their commitment to the highest levels of competence and ethical conduct and been certified by AIPG.

American Institute of Professional Geologists (AIPG) is the only national organization that certifies the competence and ethical conduct of geological scientists in all branches of the science. It adheres to the principles of professional responsibility and public service, and is the ombudsman for the geological profession. It was founded in 1963 to promote the profession of geology and to provide certification for geologists to establish a standard of excellence for the profession. Since then, more than 10,000 individuals have demonstrated their commitment to the highest levels of competence and ethical conduct and been certified by AIPG.

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2014 AIPG/AHS National Conference
Water & Rocks -
The Foundation of Life

From September 13-16, 2014, AIPG and the Arizona Hydrological Society (AHS) will host the 51st AIPG National Conference and the 27th AHS Fall Symposium at the beautiful Prescott Resort and Conference Center in Prescott, Arizona. This is the second time that AIPG and AHS have teamed up to host a national conference, the last time being in 2008. The 2008 conference was so successful and well attended, that AIPG and AHS decided to join forces again and repeat their success – this time in Prescott, Arizona, and a short distance from the 2008 conference location in Flagstaff. I am pleased to serve as the conference co-chairperson for AIPG along with Mike Tomlinson and Dana Downs-Heimes from AHS. The organizing committee includes AIPG National staff, Cathy Duran and Wendy Davidson and AIPG Arizona and AHS member Paul Lindberg. The committee has been hard at work for many months planning the events and program associated with the conference.

Arizona is a major center for mining, particularly copper mining and is, of course, in the desert southwest of the U.S. The area has also experienced agricultural development and urban growth with increased demands for water resources. The program will include an emphasis on new and important developments in mining for copper, industrial and rare earth minerals, energy resources, mine water supply and mine dewatering as well as talks that will introduce attendees to specific mining projects nationwide. The southwest U.S. has been experiencing drought conditions for much of the past 15 or 20 years making water critically important for not only mining, but also agricultural production, riparian areas, and human existence. Talks will address the many issues surrounding water supply as it applies to industries, mining, municipalities, the environment, and agriculture. We will also have sessions on professional ethics and the needs of young professionals.

Arizona is ideal for geology field trips (because rocks are everywhere!) and we have a number of exciting trips planned including:

- Glen Canyon Dam/Lake Powell - Bureau of Reclamation Tour and Antelope Canyon or Lees Ferry Geology
- Sedona Pink Jeep Tour and Page Springs Wine Tasting
- Two Grand Canyon South Rim trips which include a visit through the Trail of Time (led by author Wayne Ranney)
- Prescott Highland Center of Natural History and Sharlot Hall Arizona History Museum (Dan Campbell)
- Jerome Mining District and Verde Valley Geology Tour (Paul Lindberg)
- Geology and Hydrogeology of Upper Verde River Watershed (Ed Wolfe, Jeanmarie Haney, and Gary Beverly)
- Geology of Prescott (Beth Boyd)
- Geology of Sedona with red rock hike (Dana Downs-Heimes)
- Geology of the Bagdad Copper Mine
- Verde Canyon (Clarkdale) Railroad Roundtrip

Prescott is situated at an elevation of about 5500 feet and, as such, has a cooler climate than the desert cities of Phoenix or Tucson. It will be near perfect weather by mid-September (the average high in September is 81° and the average low is 51°). The Prescott Resort and Conference Center is located on Yavapai Apache Tribal lands and includes many amenities including a spa, pool, dining facilities, wide panoramic views of the area, and a casino. Just a short drive from the conference center is historic downtown Prescott which is very picturesque and includes many shops, museums, art galleries, restaurants, and bars. Prescott has a long history and was the territorial capital until 1867.

Please set aside a few days in September to join us for this exciting conference!

Doug Bartlett, CPG-8433
AIPG Arizona Section President 2014
Co-Chairman AIPG/AHS Conference

Photo by Prescott Office of Tourism.
On behalf of the Arizona Hydrological Society (AHS), I would like to welcome all of you to the 2014 AIPG/AHS National Conference to be held on September 13-16, 2014, at the Prescott Resort & Conference Center (PRCC) in Prescott, Arizona. AHS is pleased to be teaming once again with AIPG in what promises to be a very interesting and exciting meeting in Northern Arizona, a land of rich and diverse geology and many geological wonders, some of which required millions of years to form (e.g., the Grand Canyon) while others were formed in seconds (Meteor Crater).

AHS is a nonprofit scientific organization dedicated to advancing hydrology and water resource research, planning, and development. We not only provide an open forum for professionals to exchange information (such as this National Conference), but we also support public understanding, education, and training in the science and technology of hydrology and water resources. The AHS membership (currently with over 300 members) consists of hydrologists, hydrogeologists, geologists, geochemists, biologists, ecologists, and engineers working for consulting firms, other industries, governmental agencies, nongovernmental organizations, and educational institutions and organizations. Like AIPG, AHS is strongly committed to education and outreach. To this end, each year AHS and the AHS Foundation award three $2,000 academic scholarships and three $3,000 intern scholarships throughout Arizona.

As Doug Bartlett (AIPG Arizona Section) has said in his letter of welcome, Prescott, Arizona, is wonderful Northern Arizona city, rich in history and old west culture. In addition to a number of museums, there are a number of entertaining venues, not the least of which is historic Whiskey Row. If you want to get the feel for old west saloons, there is no better place to go than Whiskey Row. There is also a full spectrum of dining options located throughout town starting with PRCC’s own Icha Maajoh Restaurant. PRCC’s Eagle’s Nest Lounge offers light dining and beverages both in the lounge and out on their patio with breathtaking sunset views of Prescott and Thumb Butte. Interested in old west art? Go no further than the Phippen Museum just a few miles outside of Prescott. Prescott is also home to one of two campuses (Arizona and Florida) of the nationally known Embry-Riddle Aeronautical University. Other institutions of higher learning include Yavapai College and Prescott College.

We hope to see you in Prescott in September for this exciting conference with its many technical sessions, field trips, and workshops.

Michel Hulst
AHS President

Granite Dells at Watson Lake in Prescott.
Photo by Franz Rosenberger.
Field Trips

**Geology of the Grand Canyon and the Trail of Time**

- **Date:** Sunday, September 14, 2014
- **Time:** 6:45 am to 6:00 pm (bus will depart at 7:00 am)
- **Cost:** $129 Early/$149 Regular
  $40 Early/$50 Regular (Student)
  (includes box lunch, snacks and water)
- **Leader:** Wayne Ranney

The Grand Canyon is planet Earth’s most recognizable landform and the new **Trail of Time** on Grand Canyon’s South Rim is now the largest geologic exhibit anywhere. This 2+ kilometer-long trail is an expansive time line with numerous interpretive panels of the geologic events that have shaped Grand Canyon and rock specimens from every layer within it. Along the way, the story of Grand Canyon unfolds with the accretion of the Vishnu Basement rocks (a metamorphosed sedimentary and volcanic sequence), deposition of 12,000 feet of Grand Canyon Supergroup rocks, the formation of The Great Unconformity (named by John Wesley Powell), and the accumulation of a 4,000 foot stack of beautifully exposed Paleozoic sediments. Near the end of the trail, the story of how the Colorado River carved the Grand Canyon will be discussed.

Field trip participants will have the opportunity to visit the canyon and walk this relatively level rim-side trail with Wayne Ranney, a geologist and author, who has lived and worked at Grand Canyon for the last 39 years. Wayne’s two award-winning books, “Carving Grand Canyon” and “Ancient Landscapes of the Colorado Plateau” will be made available for sale to trip participants and are incredible resources to understand this world-class landform. Wayne is a wealth of knowledge about Grand Canyon and enjoys sharing his passion for his adopted home.

Field-trip focal points:
- Grand Canyon geology from A to Z, with an expert scientist and interpreter.
- Walk the Trail of Time (2+ kilometers) from Grand Canyon Village to the Yavapai Point Geology Museum. Time is allotted to explore the Museum.
- Participants will drive by bus from Prescott to Flagstaff, where the field trip leader will be met. From Flagstaff he will provide narrative and background to the geology and history of the region on our 80-mile journey from there.

**Prescott Geology and Natural History Hike**

- **Date:** Sunday, September 14, 2014
- **Time:** 8:00 am – 5:00 pm
- **Cost:** $99 Early/$119 Regular
  $30 Early/$40 Regular (Student)
  (includes box lunch, snacks and water)
- **Leader:** Dana Heimes and Beth Nichols Boyd
- **Limited:** Maximum 24 participants

Spend the day stretching your legs and taking in the local geologic and natural history wonders of the Prescott Transition Zone. The location of the hike will depend on weather conditions. If the day promises to be warm, the hike will be conducted on the Groom Creek Trail. The 9-mile Groom Trail Loop is one of the most attractive trails in the Prescott National Forest, offering a rewarding hike through the area’s forested high country. This shaded trail passes through idyllic stands of ponderosa pine and Gambel oak as it climbs to the top of Spruce Mountain populated by Douglas fir and a number of other cone-bearing species that thrive in the cool mountain conditions.

If cooler conditions prevail, the hike will be conducted in the vicinity of Watson Lake. Located approximately one mile north of the conference center, this beautiful 6-mile loop hike allows access to Watson Lake and the boulders of the Granite Dells.

*For either hike, it is strongly recommended that participants be in suitable physical condition and acclimated to exertion at elevations starting at 5,500 feet and possible temperatures in the 90s. Bring sturdy shoes/boots, appropriate clothing, hat, sunglasses, sunblock, and a backpack for your gear, including a reservoir or containers to carry at least 100 oz. of water.*
Field Trips

Jerome Precambrian Ore Deposits, Young Volcanos, Red Rocks and Modern Sinkholes

Date: Sunday, September 14, 2014
Time: 8:00 am to 6:00 pm
Cost: $99 Early/$119 Regular
$30 Early/$40 Regular (Student)
(includes box lunch, snacks and water)
Leader: Paul Lindberg, CPG-06344
Limited: Maximum 24 participants

The tour will travel east through the Precambrian Dells granite near Prescott and cross the Chino graben before viewing the Skylock fault zone that defines the western edge of the basin and range Mingus Mountain horst. Paleoproterozoic Precambrian basement rock with banded iron formation, capped by basal Paleozoic sediments and Miocene basalt lava flows and cinder cones will be examined.

At the crest of Mingus Mountain a short hike will provide an overview of the Verde Valley, a 10 million year old basin and range fault-bounded rift valley whose core has dropped more than 6100 feet.

In the Verde mining district at Jerome, some of the world’s richest volcanogenic ore deposit sites will be viewed and discussed. Between 1893 and 1953 two mines at Jerome produced 1,812,525 tons of copper metal plus significant byproduct zinc, gold and silver. A portable, interactive geologic model will be demonstrated along with a visit to the local Jerome Historic State Park where additional geology models and ore samples can be seen.

Pending sufficient time remaining, the trip may then travel across the Verde graben to visit Page Springs where groundwater from the Colorado Plateau emerges as an artesian spring. The trip will conclude with spectacular views of Sedona’s magnificent Permian Period “red rocks” on the east side of the Verde graben and include a short hike to see the Devils Kitchen sinkhole, active since the 1880s.

Geology of the Grand Canyon and the Trail of Time

Date: Monday, September 15, 2014
Time: 6:45 am to 6:00 pm (bus will depart at 7:00 am)
Cost: $129 Early/$149 Regular
$40 Early/$50 Regular (Student)
(includes box lunch, snacks and water)
Leader: Wayne Ranney

The Grand Canyon is planet Earth’s most recognizable landform and the new Trail of Time on Grand Canyon’s South Rim is now the largest geologic exhibit anywhere. This 2+ kilometer-long trail is an expansive time line with numerous interpretive panels of the geologic events that have shaped Grand Canyon and rock specimens from every layer within it. Along the way, the story of Grand Canyon unfolds with the accretion of the Vishnu Basement rocks (a metamorphosed sedimentary and volcanic sequence), deposition of 12,000 feet of Grand Canyon Supergroup rocks, the formation of The Great Unconformity (named by John Wesley Powell), and the accumulation of a 4,000 foot stack of beautifully exposed Paleozoic sediments. Near the end of the trail, the story of how the Colorado River carved the Grand Canyon will be discussed.

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Field-trip focal points:
- Grand Canyon geology from A to Z, with an expert scientist and interpreter.
- Walk the Trail of Time (2+ kilometers) from Grand Canyon Village to the Yavapai Point Geology Museum. Time is allotted to explore the Museum.
- Participants will drive by bus from Prescott to Flagstaff, where the field trip leader will be met. From Flagstaff he will provide narrative and background to the geology and history of the region on our 80-mile journey from there.
Field Trips

Glen Canyon Dam Tour and Ancient Landscapes of Northern Arizona

Date: Monday, September 15, 2014
Time: 6:45 am to 6:00 pm (bus will depart at 7:00 am)
Cost: $129 Early/$149 Regular
      $30 Early/$40 Regular (Student)
      (includes box lunch, snacks and water)
Leader: Ron Blakey
Limited: Maximum 24 participants

Glen Canyon Dam is a concrete arch dam that was constructed on the Colorado River in northern Arizona, near the town of Page. The dam was built to provide hydroelectricity and flow regulation from the upper Colorado River Basin to the lower. Its reservoir is called Lake Powell, and is the second largest artificial lake in the country, extending upriver well into Utah. The dam is named for Glen Canyon, a colorful series of gorges, most of which now lie under the reservoir.

Glen Canyon once encompassed 186 miles of the Colorado River’s main channel and nearly 200 side canyons. This vast drainage straddling the Arizona-Utah border is the heart of the Southwest’s river systems, where the Green, San Juan, Dirty Devil and Escalante rivers converge. The Colorado River, and its major tributaries are the lifeblood of the American West, serving as primary water source for seven states and more than 30 million people.

The trip will be lead by Ron Blakey, co-author of “Ancient Landscapes of the Colorado Plateau”, who has completed extensive work on the Triassic and Jurassic stratigraphy in the Four Corners region to unravel the mysteries of events and landscapes that existed long ago. Participants will travel to Page Arizona, and begin with a tour of the dam and a discussion of management of Lake Powell by representatives from the U.S. Bureau of Reclamation. Following lunch at one of the most scenic areas in the southwest, Ron will lead the trip to local exposures, both enigmatic and beautiful.

Sedona Pink Jeep Tour, Page Springs Hatchery, and Visit to Oak Creek Winery

Date: Monday, September 15, 2014
Time: 8:00 am to 6:00 pm
Cost: $139 Early/$159 Regular
      $98 Early/$108 Regular (Student)
      (lunch is on your own)
Leader: Dan Campbell
Limited: Maximum 24 participants

The AHS/AIPG team return with a command performance of the popular Pink Jeep Tour of Sedona. Experience Sedona’s unique geologic setting and learn about its cultural and natural history. The trip will include a jeep ride along the Scenic Rim for spectacular views of the Sedona red rock region. The book “Sedona Through Time” by author Wayne Ranney will be made available for sale to trip participants. This is a must-read for anyone who visits or is interested in Sedona’s landscape. After the jeep tour, participants will have a chance to browse the uptown Sedona shops and have lunch on their own.

Participants will then travel to the Page Springs Hatchery. Nestled among the cool pines of the Coconino National Forest, the Page Springs Fish Hatchery offers a cool retreat from the desert during early fall days. Participants will enjoy hiking the nature trial bordering Oak Creek, and visiting the show ponds to see the hatchery’s finest and largest trout. The hatchery includes an interpretive center and a self-guided hatchery tour. The trail is also a great place to see wildlife and view birds.

The trip will conclude at the Oak Creek Vineyard and Winery, which has been serving up fantastic area wines since 2002. Participants will be able to enjoy a sampling of Arizona wines while relaxing in their newly renovated tasting room. The winery offers a wonderful selection of wines, cheeses, salami, and olives for purchase.
2014 AIPG and AHS National Conference

Water and Rocks
the Foundations of Life

September 13-16, 2014 Prescott, AZ

Field Trips

Natural and Cultural History Tour of the Central Arizona Highlands and Prescott Area

Date: Monday, September 15, 2014
Time: 9:00 am to 3:00 pm
Cost: $89 Early/$99 Regular
$30 Early/$40 Regular (Student)
(includes box lunch, snacks and water)
Limited: Maximum 24 participants

The Central Arizona Highlands push themselves up in between the dramatic desert landscape of the Sonoran Desert to the south, and the vast Colorado Plateau to the north. This transition zone of ancient, eroded mountains lies like a sash across Arizona, from Kingman in the northwest all the way down to Safford and the Sitgreaves Apache National Forest in the southeast and beyond. The trip will begin with a visit to the Highlands Center for Natural History which is a science and ecological center that provides an educational experience with 3 miles of easy trails to discover ponderosa pine covered valleys, deeply-shaded riparian habitats, chaparral and woodland covered hillsides, remarkable geologic formations, and amazing vistas unique to the Arizona Central Highlands.

After lunch, participants will visit the Sharlot Hall Museum, which houses much of Prescott’s territorial history. Prescott is the county seat of Yavapai County. In 1864 Prescott was designated as the capital of the Arizona Territory, replacing the temporary capital at Fort Whipple. The city was named after author William H. Prescott, whose writings were popular during the Civil War. The Territorial Capital was moved to Tucson in 1867. Prescott again became the Territorial Capital in 1877, until Phoenix became the capital of Arizona in 1889. As early as 1907, Ms. Sharlot Hall saw the need to save Arizona’s history and planned to develop a museum. She began to collect both Native American and pioneer material. In 1927, she began restoring the first Territorial Governor’s residence and offices and moved her extensive collection of artifacts and documents opening it as a museum in 1928. Today, the Museum features seven historic buildings, compelling exhibits and beautiful gardens, which serve as the setting for numerous public festivals.

Geology of the Bagdad Copper Mine

Date: Tuesday, September 16, 2014
Time: 7:00 am to 6:00 pm
Cost: $99 Early/$119 Regular
$30 Early/$40 Regular (Student)
(includes box lunch, snacks and water)
Leader: Steve Maslansky, CPG-04431 and Terry Steinborn
Limited: Maximum 24 participants

Bagdad is an open-pit copper and molybdenum mining complex, and home to the world’s first commercial-scale leach processing facility and one of the longest continuously operating solution extraction/electrowinning (SX/EW) plants in the world. As an unincorporated community, Bagdad is one of two “company towns;” the other is Morenci, Arizona.

The Bagdad open pit mine is developed within and adjacent to a composite granodiorite-to quartz monzonite stock of Late Cretaceous age. Three Laramide plutons are recognized within the Bagdad Pit, representing distinct magmatic pulses that intruded predominantly middle Proterozoic granitic and metamorphic rocks. The deposit is a porphyry copper containing both sulfide and oxide mineralization. Chalcopyrite and molybdenite are the dominant primary sulfides and are the primary economic minerals in the mine. Chalcocite is the most common secondary copper sulfide mineral and the predominant oxide copper minerals are chrysocolla, malachite and azurite.

The Bagdad operation includes a 75,000 metric ton-per-day concentrator that produces copper and molybdenum concentrates, an SX/EW plant that can produce up to 25 million pounds of copper per year from solution generated by low grade stockpile leaching and a pressure leach plant to process molybdenum concentrates.
The first mine claims were staked in 1882 and the property changed ownership numerous times through first half of 20th century. The first mill began operation in 1928 to process ore from the underground mine. Transition to open-pit mining began in 1945. A $240 million expansion in 1973 included new haul trucks, shovels, nearly 400 housing units and concentrator.

Field Trips

Geology of the Prescott Area

Date: Tuesday, September 16, 2014
Time: 8:00 am to 3:00 pm
Cost: $99 Early/$119 Regular
$30 Early/$40 Regular (Student)
(includes box lunch, snacks and water)
Leader: Beth Nichols Boyd

Prescott sits on the exposed roots of an ancient mountain range formed at a convergent plate boundary, where Proterozoic foliated metamorphics, similar to the Vishnu Schist at the bottom of the Grand Canyon, and 1.7 Ga intrusives dominate the modern landscape. Overlain by Tertiary basalts and then broken by Basin and Range-style normal faults, this igneous-dominated landscape seems far removed from the flat-lying Paleozoic-age sediments of the Colorado Plateau, just a few dozen miles to the north of Prescott.

The trip will begin looking at one of the many 1.7 Ga granitic plutons which were intruded into the crust when the area once hosted an active subduction zone. At one stop, an exposure will be compared with hillsides in the distance, which are underlain by a separate intrusion, nearly identical in both age and composition, but weather to form a landscape very different in appearance.

Stepping back in time a little, trip participants will then look at the rocks into which the granitic plutons have been intruded – the oldest rocks in the area - looking for clues to their original protolith. Within these now-vertically-oriented metamorphic rocks are occasional interbedded horizons of Proterozoic conglomerates containing clasts of milky quartz, jasper and banded iron formation. These conglomerates have been deformed and compressed to such a degree that some clasts have been flattened and elongated by an order of magnitude.

Logistically close but chronologically distant, a stack of multiple Tertiary basaltic lava flows with conspicuous auto-breciated bases and a distinct baked zone where the lavas first flowed over the preexisting sediments, is well-exposed due to local construction activities. These basalts are cut by multiple small faults with clear offsets, exhibiting both normal and reverse behavior.

The final part of the trip will be spent viewing the 1.4 Ga Dells Granite, which is significant for its spheroidal weathering, radon gas and eye-catching liesegang banding. This will include a short hike to an outstanding and unusual outcrop within the Dells Granite - it is unlikely that you’ve ever seen anything quite like it!

The trip will require walking to 3 locations on relatively flat ground, with a cumulative distance for the day of about 2 miles, or less, depending upon access.

Geology, and Hydrogeology of the Upper Verde River Watershed

Date: Tuesday, September 16, 2014
Time: 8:00 am to 6:00 pm
Cost: $99 Early/$119 Regular
$30 Early/$40 Regular (Student)
(includes lunch at the Little Thumb Butte Bed and Breakfast -above the junction of Granite Creek and the Verde River Canyon.)
Leader: Ed Wolfe, Jeanmarie Haney, and Gary Beverly
Limited: Maximum 24 participants

This field trip explores the geology and hydrology of the upper Verde River watershed and its Big Chino and Little Chino sub-basins. Perennial flow of the Verde River begins where groundwater from these sub-basins discharges to a reach of the Verde River canyon near its confluence with the canyon of Granite Creek. Primary aquifer units are thick alluvial and volcanic basin-fill deposits in both sub-basins plus underlying Devonian Martin Formation in the Big Chino sub-basin.

Groundwater from the Little Chino sub-basin is the primary source of water for the City of Prescott and the Town of Chino Valley. Groundwater from the Big Chino sub-basin supports agriculture in the Big Chino Valley, plus, in the southeast end of the basin, expanding numbers of homes. In addition, the City of Prescott, the Town of Prescott Valley, and the Town of Chino Valley have legal rights that may eventually enable them to
import groundwater from the Big Chino Valley to augment their water supplies. This possibility is a source of ongoing controversy owing to the attendant implied threat of loss perennial flow in the upper part of the Verde River.

Field-trip focal points:

- Historic Del Rio Springs: former headwaters of the Verde River; briefly the site of Arizona’s first capitol; past source of water and produce for Fred Harvey hotels along the AT&SF railroad; brief source of water for Prescott; tragic example of stream flow depletion by wells.
- Geologic setting and hydrologic role of Big Chino Valley.
- Verde River canyon and the upper Verde River springs.

Field Trips

Social Events

AIPG Awards and Dinner

Date: Monday, September 15, 2014
Time: 6:45 p.m. to 8:30 p.m.
Cost: $45

Monday evening will be a pleasant one in the company of friends and colleagues. The festivities will begin with the AIPG National Awards presentation. Dinner will follow. This event is intended to be informal, relaxing, and an opportunity for all attendees to meet and socialize.

AHS Dinner

Date: Monday, September 15, 2014
Time: 6:45 p.m. to 8:30 p.m.
Cost: $45

Join AHS for this special dinner as we recognize the 2014 recipients of AHS Leonard Halpenny, Herman Bouwer and Charles Avery Intern-Scholarships, academic scholarships to students from Arizona State University, University of Arizona, and Northern Arizona University, and the Central Arizona Project Award for Water Research.

Workshops

Site Characterization-The Groundwater System

Date: Sunday, September 14, 2014
Time: 8:00 a.m. to 5:00 p.m.
Cost: $199
Leader: William Stone, MEM-2164

Whether you are involved with locating ground-water supplies, protecting ground-water quality through monitoring, defining the source and movement of contamination, an appreciation of the relationship between the ground-water system and the geologic setting is essential. This one-day course provides a meaty overview of the basic components and tasks in a sound hydrogeologic study (with case histories).
Workshops

The course includes the Role of the Geologic Framework, Relationship to the Hydrologic System, Applications, Final Suggestions with illustrated lectures, periodic short hands-on exercises to emphasize key points, discussion of case histories.

Communicating Science: Tools for Scientists

Date: Sunday, September 14, 2014
Time: 1:00 p.m. to 5:30 p.m.
Cost: $99 Early/$119 Regular
$40 Early/$50 Regular (Student)
Leaders: Christa Stratton and Justin Samuel

Effective scientist-communicators who foster information-sharing and respect between science and the public are essential for true public communication of and engagement with science. However, we currently have too few effective emissaries for science. Improving communication is also a personal career development skill — enabling better communication with scientific colleagues in your own and other disciplines and with potential funders, in addition to facilitating public outreach and engagement.

Communication is typically an acquired, not innate skill, and GSA, along with the American Association for the Advancement of Science (AAAS) maintains that scientists should be provided quality resources to help develop their communication and public outreach skills. Scientists are increasingly requested by their institutions and funding agencies to extend beyond the scientific community and communicate their research directly to public audiences, but traditional scientific training typically does not prepare scientists to be effective public communicators.

GSA trainers will deliver a program based on the AAAS model. Content will include message development, defining audiences, identifying opportunities for engaging the public, and practice with public presentations and cameras. The workshop format allows for collaborative learning through small-group discussion, resource sharing, and participation in critique of other participants’ presentations. Continuous monitoring of the program includes on-site and online surveys and evaluation.

Learning methods will include both facilitator presentations and researcher exercises, for example:

• overview of public audiences, including media and policymakers
• developing research messages for public audiences, and practice
• video practice and facilitator-led peer critique

Source Control to Passive Treatment Systems, An Engineer’s Perspective of ARD Management

Date: Tuesday, September 16, 2014
Time: 8:30 a.m. to 5:00 p.m.
Cost: $99 Early/$119 Regular
$40 Early/$50 Regular (Student)
Leaders: James J. Gusek and Paul Eger

This workshop will cover technologies and methodologies that outline a “pathway to walk away” for mine remediation sites that involve acid rock drainage (ARD).

The concept of in-perpetuity is a very long time. Perpetual treatment (either actively or passively) of ARD is unsustainable; cumulative economic burdens on mining companies and/or government agencies faced with treating ARD will certainly bankrupt future society. ARD suppression at its source is the logical strategy to avoid or lessen ARD impacts. Innovative strategic concepts have been advanced in recent years; this author has contributed to this effort.

The conventional wisdom for suppressing ARD relates to the disruption of a four-pointed biogeochemical relationship, the “ARD Tetrahedron”. From an engineering perspective, controls have two major components: the mechanisms of biogeochemical disruption and the technologies for implementing those mechanisms. The successful merging of mechanisms and technologies is required to mitigate ARD; this is the current engineering challenge. The first half of the workshop will cover the available source control strategies in the remediation engineer’s toolbox.

After implementing source controls at a given site, the long term costs of ARD treatment need to be minimized. Passive treatment systems are viewed as a low-cost and low maintenance (but not maintenance-free) technology for accomplishing this goal. The second half of the workshop will dove-tail with the first half by not only providing a “Passive Treatment 101” overview but also showing how some passive treatment technologies can be integrated into source control at the same site.
### Saturday, September 13, 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 am–12:00 noon</td>
<td>AIPG Executive Committee Meeting <em>(open to all registrants)</em></td>
</tr>
<tr>
<td>1:00 pm–4:30 pm</td>
<td>AIPG Advisory Board Meeting <em>(open to all registrants)</em></td>
</tr>
<tr>
<td>4:30 pm–5:00 pm</td>
<td>AIPG 2014-2015 Joint Executive Committee Meeting &amp; Business Meeting <em>(open to all registrants)</em></td>
</tr>
</tbody>
</table>

### Sunday, September 14, 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>6:45 am–6:00 pm</td>
<td>Field Trip — Geology of the Grand Canyon and the Trail of Time <em>(bus will depart at 7:00 am)</em></td>
</tr>
<tr>
<td>7:30 am–8:00 pm</td>
<td>Registration — Hotel <em>(near meeting space)</em></td>
</tr>
<tr>
<td>8:00 am–5:00 pm</td>
<td>Field Trip — Prescott Geology and Natural History Hike</td>
</tr>
<tr>
<td>8:00 am–6:00 pm</td>
<td>Field Trip — Jerome Precambrian Ore Deposits, Young Volcanos, Red Rocks, and Modern Sinkholes</td>
</tr>
<tr>
<td>8:00 am–5:00 pm</td>
<td>Workshop — Site Characterization - The Groundwater System</td>
</tr>
<tr>
<td>8:00 am–5:00 pm</td>
<td>Workshop — Integrated Approach to Water Resources Management</td>
</tr>
<tr>
<td>10:00 am–4:00 pm</td>
<td>Exhibitor and Poster Set-up</td>
</tr>
<tr>
<td>1:00 pm–5:30 pm</td>
<td>Workshop — Communicating Science: Tools for Scientists</td>
</tr>
<tr>
<td>4:00 pm–6:00 pm</td>
<td>AIPG Foundation Meeting</td>
</tr>
<tr>
<td>5:00 pm–6:30 pm</td>
<td>AHS Foundation Meeting</td>
</tr>
<tr>
<td>6:30 pm–8:00 pm</td>
<td>Reception — Exhibit Area Open <em>(complimentary for all registrants)</em></td>
</tr>
</tbody>
</table>

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**$119 Night - be sure to mention the 'AIPG/AHS G3986' room block for rate.**

### Monday, September 15, 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:45 am–6:00 pm</td>
<td>Field Trip — Geology of the Grand Canyon and the Trail of Time <em>(bus will depart at 7:00 am)</em></td>
</tr>
<tr>
<td>6:45 am–6:00 pm</td>
<td>Field Trip — Glen Canyon Dam Tour and Ancient Landscapes of Northern Arizona <em>(bus will depart at 7:00 am)</em></td>
</tr>
<tr>
<td>7:30 am–5:00 pm</td>
<td>Registration — Hotel <em>(near meeting space)</em></td>
</tr>
<tr>
<td>8:00 am–6:00 pm</td>
<td>Field Trip — Sedona Pink Jeep Tour, Page Springs Hatchery, and Oak Creek Winery</td>
</tr>
<tr>
<td>8:00 am–5:00 pm</td>
<td>Exhibits Open</td>
</tr>
<tr>
<td>8:30 am–10:00 am</td>
<td>Plenary Session</td>
</tr>
<tr>
<td>9:00 am–3:00 pm</td>
<td>Field Trip — Natural and Cultural History Tour of the Central Arizona Highlands and Prescott Area</td>
</tr>
<tr>
<td>10:30 am–5:00 pm</td>
<td>Technical Sessions</td>
</tr>
<tr>
<td>12:00 noon–1:30 pm</td>
<td>Luncheon with Keynote Speaker <em>(complimentary to all registrants)</em></td>
</tr>
<tr>
<td>5:00 pm–6:00 pm</td>
<td>AHS Annual Meeting</td>
</tr>
<tr>
<td>6:45 pm–8:30 pm</td>
<td>AHS Awards Dinner <em>(All attendees welcome with additional fee)</em></td>
</tr>
<tr>
<td>6:45 pm–8:30 pm</td>
<td>AIPG Awards Dinner <em>(All attendees welcome with additional fee)</em></td>
</tr>
</tbody>
</table>

### Tuesday, September 16, 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 am–6:00 pm</td>
<td>Field Trip — Geology of the Bagdad Copper Mine</td>
</tr>
<tr>
<td>7:30 am–5:00 pm</td>
<td>Registration — Hotel <em>(near meeting space)</em></td>
</tr>
<tr>
<td>8:00 am–5:00 pm</td>
<td>Technical Sessions</td>
</tr>
<tr>
<td>8:00 am–3:30 pm</td>
<td>Exhibits Open</td>
</tr>
<tr>
<td>8:00 am–3:00 pm</td>
<td>Field Trip — Geology of the Prescott Area</td>
</tr>
<tr>
<td>8:00 am–6:00 pm</td>
<td>Field Trip — Geology and Hydrogeology of the Upper Verde River Watershed</td>
</tr>
<tr>
<td>8:30 am–5:00 pm</td>
<td>Workshop — Source Control to Passive Treatment Systems, An Engineers Perspective of ARD Management</td>
</tr>
<tr>
<td>12:00 noon–1:30 pm</td>
<td>Luncheon with Keynote Speaker <em>(complimentary to all registrants)</em></td>
</tr>
</tbody>
</table>

For more information and to register online go to: [http://aipg.org/Events/2014/AIPG-AHS.html](http://aipg.org/Events/2014/AIPG-AHS.html)
# 2014 AIPG and AHS National Conference

**Water and Rocks: the Foundations of Life**

September 13-16, 2014  Prescott, AZ

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<table>
<thead>
<tr>
<th>Name (Last)</th>
<th>(First)</th>
<th>(Middle Initial)</th>
<th>✔️ if you are a member of</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPLOYER</td>
<td>NAME ON BADGE</td>
<td>AIPG</td>
<td></td>
</tr>
<tr>
<td>ADDRESS</td>
<td>CITY, STATE, ZIP CODE</td>
<td>AHS</td>
<td></td>
</tr>
<tr>
<td>PHONE</td>
<td>E-MAIL ADDRESS</td>
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</table>

*SPOUSE/GUEST NAME | NAME ON SPOUSE/GUEST BADGE | |

EMERGENCY CONTACT NAME | EMERGENCY CONTACT PHONE | |

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## Fees and Payment Information

### Annual Meeting Registration

<table>
<thead>
<tr>
<th>Event Description</th>
<th>On or by 6/30/14</th>
<th>7/1/14-8/31/14</th>
<th>After 8/31/14</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Full Registration AIPG or AHS Member</td>
<td>$325.00</td>
<td>$375.00</td>
<td>$425.00</td>
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<tr>
<td>Non-Member Full Registration</td>
<td>$375.00</td>
<td>$425.00</td>
<td>$475.00</td>
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<tr>
<td>Daily Registration (Friday, Saturday, Sunday, or Monday)</td>
<td>$220.00</td>
<td>$220.00</td>
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<tr>
<td>Spouse/Guest Full Registration (Admission to Reception, Breakfast, Lunch, Breaks, and Exhibits)</td>
<td>$175.00</td>
<td>$175.00</td>
<td>$175.00</td>
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</tr>
<tr>
<td>Student Full Registration</td>
<td>$50.00</td>
<td>$50.00</td>
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<tr>
<td>I Would Like to Support Arizona Project WET</td>
<td>$100.00</td>
<td>$100.00</td>
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<tr>
<td>I Would Like to Support Student Activities</td>
<td>$50.00</td>
<td>$50.00</td>
<td>$50.00</td>
<td>$</td>
</tr>
</tbody>
</table>

### Field Trips (Also open to guests/friends of conference attendees)

<table>
<thead>
<tr>
<th>Field Trip Description</th>
<th>On or by 6/30/14</th>
<th>7/1/14-8/31/14</th>
<th>After 8/31/14</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology of the Grand Canyon and the Trail of Time (Sun., 9/14, 9:00 am – 6:00 pm)</td>
<td>$129.00 (Students $40)</td>
<td>$129.00 (Students $40)</td>
<td>$149.00 (Students $50)</td>
<td>$</td>
</tr>
<tr>
<td>Prescott Geology and Natural History Hike (Sun., 9/14, 9:00 am – 5:00 pm)</td>
<td>$99.00 (Students $30)</td>
<td>$99.00 (Students $30)</td>
<td>$119.00 (Students $40)</td>
<td>$</td>
</tr>
<tr>
<td>Jerome Precambrian Ore Deposits, Young Volcanos, Red Rocks, and Modern Sinkholes (Sun., 9/14, 8:00 am – 6:00 pm)</td>
<td>$99.00 (Students $30)</td>
<td>$99.00 (Students $30)</td>
<td>$119.00 (Students $40)</td>
<td>$</td>
</tr>
<tr>
<td>Geology of the Grand Canyon and the Trail of Time (Mon., 9/15, 9:00 am – 6:00 pm)</td>
<td>$129.00 (Students $40)</td>
<td>$129.00 (Students $40)</td>
<td>$149.00 (Students $50)</td>
<td>$</td>
</tr>
<tr>
<td>Glen Canyon Dam Tour and Ancient Landscapes of Northern Arizona (Mon., 9/15, 6:45 am – 8:00 pm)</td>
<td>$129.00 (Students $30)</td>
<td>$129.00 (Students $30)</td>
<td>$149.00 (Students $40)</td>
<td>$</td>
</tr>
<tr>
<td>Sedona Pink Jeep Tour, Page Springs Hatchery, and Oak Creek Winery (Mon., 9/15, 8:00 am – 6:00 pm)</td>
<td>$139.00 (Students $68)</td>
<td>$139.00 (Students $68)</td>
<td>$159.00 (Students $108)</td>
<td>$</td>
</tr>
<tr>
<td>Natural and Cultural History Tour of the Central Arizona Highlands and Prescott Area (Mon., 9/15, 9:00 am – 3:00 pm)</td>
<td>$89.00 (Students $30)</td>
<td>$89.00 (Students $30)</td>
<td>$99.00 (Students $40)</td>
<td>$</td>
</tr>
<tr>
<td>Geology of the Bagdad Copper Mine (Tues., 9/16, 7:00 am – 6:00 pm)</td>
<td>$99.00 (Students $30)</td>
<td>$99.00 (Students $30)</td>
<td>$119.00 (Students $40)</td>
<td>$</td>
</tr>
<tr>
<td>Geology of the Prescott Area (Tues., 9/16, 8:00 am – 3:00 pm)</td>
<td>$99.00 (Students $30)</td>
<td>$99.00 (Students $30)</td>
<td>$119.00 (Students $40)</td>
<td>$</td>
</tr>
<tr>
<td>Geology and Hydrogeology of the Upper Verde River Watershed (Tues., 9/16, 8:00 am – 6:00 pm)</td>
<td>$99.00 (Students $30)</td>
<td>$99.00 (Students $30)</td>
<td>$119.00 (Students $40)</td>
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</table>
### WORKSHOPS

<table>
<thead>
<tr>
<th>Workshop</th>
<th>On or by 6/30/14</th>
<th>7/1/14-8/31/14</th>
<th>After 8/31/14</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop – Site Characterization-The Groundwater System (Sun., 9/14, 8:00 am – 5:00 pm)</td>
<td>$199.00 (Students $100)</td>
<td>$199.00 (Students $100)</td>
<td>$219.00 (Students $110)</td>
<td>$</td>
</tr>
<tr>
<td>Workshop – Integrated Approach to Water Resources Management (Sun., 9/14, 8:00 am – 5:00 pm)</td>
<td>$99.00 (Students $40)</td>
<td>$99.00 (Students $40)</td>
<td>$119.00 (Students $50)</td>
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<td>$99.00 (Students $40)</td>
<td>$119.00 (Students $50)</td>
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<td>$99.00 (Students $40)</td>
<td>$119.00 (Students $50)</td>
<td>$</td>
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</tbody>
</table>

### SOCIAL EVENTS (Must be Registered for Conference)

<table>
<thead>
<tr>
<th>Event</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception (Sun., 9/14, 6:30 pm – 8:00 pm)</td>
<td>Included with Registration</td>
</tr>
<tr>
<td>AHS Awards Dinner (Mon., 9/15, 6:45 pm – 8:30 pm)</td>
<td>$45.00</td>
</tr>
<tr>
<td>AIPG Awards Dinner (Mon., 9/15, 6:45 pm – 8:30 pm)</td>
<td>$45.00</td>
</tr>
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</table>

### FOUNDATION DONATIONS

<table>
<thead>
<tr>
<th>Event</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make a Donation to the AHS Foundation</td>
<td>$</td>
</tr>
<tr>
<td>Make a Donation to the Foundation of the AIPG</td>
<td>$</td>
</tr>
</tbody>
</table>

**TOTAL AMOUNT DUE $**

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**AIPG and AHS Meetings** - All registered attendees are welcome to attend (see Program for Dates and Times)

*Full Member and Non-Member Registration Includes: Reception, Technical Sessions, Student Poster Contest/Sessions, Exhibits, Registration Materials, and Continental Breakfast, Lunch and Breaks on Monday and Tuesday.*

I understand that by registering for the AIPG/AHS 2014 National Conference, I release and agree to indemnify the American Institute of Professional Geologists (AIPG), the Arizona Hydrological Society (AHS), their agents, officers, volunteers and employees from all liability for any loss, damage or injury sustained by me while involved in any way with the Conference and Exhibition except that AIPG and AHS are not released from such liability to the extent the same is caused by its actual negligence or willful misconduct. I have read and understand this waiver and release.

I also understand that submission of this registration form gives AIPG and AHS the authority to utilize any photograph taken of me at the conference for conference related publicity (e.g., photo gallery on CD, web site, TPG, etc.).

Hotel Information: Prescott Resort & Conference Center, 1500 State Route 69, Prescott, AZ 86301, Reservations (855) 892-2902, Hotel (855) 957-4637. Be sure to mention ‘AIPG/AHS G3986’ to get the group rate of $119, which will be honored until 8/22/14.

**TOTAL AMOUNT DUE $**

**METHOD OF PAYMENT**

**PLEASE CHECK METHOD OF PAYMENT**

- Check No. Enclosed (drawn in U.S. Dollars on a bank located in the US or Canada)
- International Postal Money Order (in U.S. Dollars)
- VISA Master Card American Express (Credit cards are processed in US dollar amounts only)

Card No._________________________ Expiration Date__________ CVV ______

Print name of cardholder:__________________________

REQUIRED: Credit Card Billing Address (street, city, state, and zip):

____________________________________________________________

____________________________________________________________

Authorized Signature__________________________

**Mail to:**

American Institute of Professional Geologists
12000 N. Washington Street, Suite 285, Thornton, CO 80241
or fax to (303) 253-9220 or register on-line at www.aipg.org, phone (303) 412-6205

Refund Policy: A 90% refund of total fees paid (10% withheld to cover administrative costs) will be given upon receipt of a written request until 8/13/2014. Cancellations made by written notification received between 8/14/14 and 8/6/14 will be assessed a charge of 20% (to cover administrative costs) of the total fee paid. NO refunds will be given for cancellations received after 8/6/14 or for no-shows after the meeting. Substitutions welcome. Based on the decision of AIPG and AHS field trips and workshops are subject to cancellation due to lack of participation. Notification and a full refund for field trips or workshops will be given in case of required cancellations.
AIPG 2014 National Award Recipients

Martin Van Couvering Memorial Award
Lawrence C. Weber, CPG-07120
Nashville, Tennessee

Ben H. Parker Memorial Medal
William J. Siok, CPG-04773
Tucson, Arizona

Award of Honorary Membership
Richard L. Nielsen, CPG-11459
Golden, Colorado

Outstanding Achievement Award
Simon Winchester, Sandisfield, Massachusetts

Congratulations
I am honored to be nominated for the position of 2015 AIPG National Executive Committee President-Elect. This is a three year commitment to the organization and I look forward to the challenges it brings. I see AIPG as a lead organization representing the business side of our profession. AIPG is a well-respected organization, known across the country and overseas; I am excited at the prospect of representing our organization, working together with the 2015 President and other staff and members of AIPG.

I believe the future of our organization rests on our ability to focus on developing the next generation of professional geologists and providing the tools needed for them to succeed in their chosen field. AIPG must also provide benefits to all its members and this can be accomplished by communication throughout the organization. These beliefs are the basis for the goals I would like to set for 2016, if I were elected to this position.

AIPG’s next generation of professional geologists need to be innovative. The AIPG can lead this effort by bringing our members together in new ways, which could include encouraging involvement of more university faculty in AIPG. This will help their students to transition into professional employment, while also providing faculty with an opportunity to explore funding and research opportunities with their industry counterparts.

We are at a crossroads; the leadership afforded to us for many years in the position of the Executive Director is transitioning into a new era. Bill Siok, who provided many years of leadership to the organization has retired and a new Executive Director will take his place. This is important. I look forward to welcoming our new Executive Director and will work hard to serve the AIPG’s best interests through my interactions with the staff and other officers.

Over the past few years I have served the Florida section of AIPG, or the “Florida Association of Professional Geologists (FAPG),” on the Executive Board. During this period I realized the importance of geologists being active in their profession, particularly in the legislature. I understand how important it is for geologists to maintain public visibility, so those around us know about our profession and its importance in their daily lives. Over the past few legislative sessions, FAPG successfully:

- Prevented the PG license from being rescinded in Florida (2011)
- Removed the threat that geologists can be sued personally for work-related issues, regardless of the relevance or importance of the geologist’s role in the project (2013)
- Gained recognition in the Florida Statutes as a “design professional” (2013)
- Actively supported the Florida Board of Geologists in their bid to establish an “in-training” category for the geology license (2014)
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The “in-training” program bills have already been approved by the Florida Senate and the House Bill is proceeding through the House of Representatives, on its way to approval. This program has graduating students take the first part of the PG examination at graduation and the final part five years later when they have practiced as geologists for several years.

I suggest that for states with the “in-training” category already in their licensing requirements, this provides focus for students to develop fulfilling careers in their chosen fields and for AIPG to tailor valuable support and tools for the developing young professional geologists. Interaction between professionals, students and faculty members can occur through student chapters within state sections, providing interesting and stimulating technical meetings and field trips, similar to those already implemented in Kentucky and Georgia, for example. AIPG, through its membership might also wish to consider providing additional scholarship mechanisms and internships to support promising students.

The practice of geology meets the world’s continuously changing resource needs, and is subject to economic ups and downs due to political policy or the prices of commodities. Geologists’ professional skills are always relevant and applied to solving the important issues of the day, whether they are current and future energy needs, finding minerals for new technology, predicting geologic events to prevent catastrophic natural disasters, restoring ecosystems, or developing a clean and reliable water supply. Therefore, if our profession adapts to changing requirements and our organization encourages and supports young people to become professional geologists, AIPG will grow and be around for many more generations.

I hope you see that I can benefit the organization in the role of President-Elect, then President and Past President, so I would be honored if you would consider voting for me. If you have any questions, please do not hesitate to contact me. My email address is hickmanhydro@att.net. Thank you for your consideration.
I want to thank the Nominating Committee for considering me as a candidate for the position of AIPG’s President-Elect for 2015. When Past-President Ron Wallace called and asked if I would consider running for the office, there was no hesitation in my response; I would be honored, sign me up. And then I thought, what have I done, this is not a one year commitment, but a three year commitment. And what an exciting three years it will be. As I age out of my career as a geologist, I can think of no greater opportunity and honor, than to serve my fellow geologists through AIPG.

I became a member of AIPG and CPG about ten years ago, not because I had to or because someone made me, but simply because I felt, as a professional geologist, it was the right thing to do. It was a matter of pride, letting those around me know that I had taken the extra effort to do the things I needed to do to become certified. I know I am speaking to the choir, but I believe as an organization we need to continue to promote the ideals of AIPG to our fellow geologists. That certification does mean something, whether you “need it” or not. Our membership records show a tremendous growth in student members. We have had a transition membership from student to young professional for several years and the numbers in this category are also increasing. This is great news and I strongly support these membership categories, but what have we done lately to promote membership at the professional level. Numbers of CPGs over the last years have been declining. When was the last time you asked one of your fellow geologists to join AIPG and become a CPG? As President-elect, one of my goals will be to develop a strategy to engage working professional geologists, while continuing to support our students and young professionals. In A History of AIPG, 1963-2003 Richard Proctor wrote “AIPG was founded (in 1963) to promote the profession of geology and to provide certification for geologists as a vehicle for establishing a standard of excellence for the profession.” Whether elected or not, I challenge each of you to “promote the profession of geology,” by finding one new member that can become certified, and thus elevating the standard of excellence we are all judged by.

During my tenure as an Advisory Board Member, I saw the birth of The Foundation of the American Institute of Professional Geologist (The Foundation). Painful times but with birth comes growth and great opportunity. The Foundation is a great vehicle to promote the ideals of AIPG through educational grants for students and teachers, promote field trips, and online educational opportunities for geologists and the general public. One of my goals will be to work with The Foundation’s Board to promote donations from our members and member associations and to continue the development of online educational programs.

Finally, I want to encourage and promote attendance at our annual convention. I was elected during my first convention to the Executive Board as an Advisory Board Representative and then again the next year. If you want to get involved, I guarantee you will have a good time, learn something new, and meet some great new friends. At that first convention, I met Andrew Stone with the American Groundwater Trust, which led to a water resources conference in North Carolina. I met and have become good friends with Ron Wallace in Georgia, which has led to trips to Wilmington, Asheville, and Charlotte, North Carolina to represent AIPG at regional and national GSA conventions and to Co-host a session on careers in geology at the GSA national convention. This year Ron and I will travel to Blacksburg to represent AIPG at the SE GSA conference and visit with Mike Lawless. I guarantee we will have some fun. By attending conferences, I have made new professional contacts and have made new life-long friends from Illinois, Florida, Virginia, Kentucky, Ohio, Oklahoma, New York and others.

If elected, I promise that I will continue to serve AIPG and its membership to the best of my ability. I will attend to my duties in a professional manner, attending all meetings, and represent AIPG both nationally and internationally. I will support the ideals of AIPG, both at the National and Section level. I am concerned about the plight of struggling sections, and I want AIPG to continue a strong student and young professional membership push, but not at the expense of our professional members, and I want to see our membership become more involved in the Foundation and annual convention.

Again thank you to the Nominating Committee for having faith in me and the other nominees. I look forward to serving you, the AIPG membership once again. Please contact me with questions or comments at jstewart1@ecslimited.com.

Candidate for AIPG National President-Elect

John M. Stewart, CPG-11115
Greensboro, North Carolina
My career in geology started as I contemplated an interdisciplinary course required to complete my undergraduate degree in chemistry. I was on the verge of graduating from college, but I still wasn’t sure what I wanted to do when I grew up. After spending many weekends exploring the forests and caves of south-central Kentucky, the thought of spending my days in a laboratory was not appealing. When I chose an environmental geology class as my interdisciplinary elective course, my uncertainty disappeared. My career path was defined after the first day of that class, and my only question was “How do I get from an undergraduate chemistry degree to a geology graduate degree?”

I spent the next year immersed in the geology curriculum at the University of Kentucky. Thanks to a supportive faculty staff, I was admitted to the geology program and completed my graduate degree. As many of you have experienced, when I started my first job as a practicing geologist, I wasn’t sure what to expect. I spent the next few years behind a drill rig and quickly learned what it meant to be a field geologist. However, I didn’t realize the role of professionalism in the geological community.

I joined AIPG in 2008 and upgraded to a CPG in 2010. Although field work consumed most of my time during my initial years as an AIPG member, I still remained involved with the organization on the Section level. I became the Tennessee Section President in 2013. I began to understand the importance of promoting professionalism in the geological community by completing a professional practice course through the Geoprofessional Business Association (GBA). As emphasized in the class, if a profession is to thrive, every member of the profession must be involved. This statement aligns with some of the goals of AIPG as stated in the Editor’s Corner of the September/October 2013 issue of TPG that included advancing the profession of geology and advocating for the profession before government and the general public. It is my view that a geological community that strives to constantly advance must include students and young professional members that understand the value of the profession.

As vice president I will continue to promote professionalism within the geological community with a focus on students and young professional members. I believe that engaging student members and young professionals as soon as possible in their careers will foster growth and participation in the organization on National, Section, and student chapter levels. This will include promoting the organization to university geology departments with student members and to employers of young professionals, who also need to be aware of the goals of AIPG. I will accomplish this goal by coordinating with National and state sections to support programs and initiatives to continue development of student chapters and grow young professional membership. I am currently working with the Tennessee Section to start the first student chapter in Tennessee. A first of what I hope will be many more.

I attended my first annual meeting last year in Colorado in 2013 as the Tennessee Section President. I truly enjoyed the experience of meeting other members of the organization and knew immediately that I wanted to be more involved with the organization. I was nominated and elected to the National Advisory Board for 2014. As a member of the Advisory Board, I am assisting the current vice president with contacting state Sections. This initial contact with the state Sections would serve as an ideal starting point for accomplishing my goals as vice president. I feel truly fortunate to be nominated for vice president. If I am elected, I will work with the National and Section offices with a goal of strengthening our student and young professional membership.

### Call for Abstracts

**Important Dates**

- June 2, 2014 ...Abstracts Due
- June 16, 2014 ..Authors Notified

**Call for Abstracts**

Join the American Institute of Professional Geologists (AIPG) and the Arizona Hydrological Society (AHS) for the 2014 Water and Rocks, the Foundations of Life National Conference in Prescott, Arizona.

**How to Submit Abstracts**

To have your abstract considered for a presentation or poster, please go to [http://www.aipg.org/abstract/](http://www.aipg.org/abstract/) to submit an abstract online by June 2, 2014. Abstracts must be in Word format, single spaced, 12 point Times New Roman, and should not exceed one page. No tables or pictures will be accepted. You will be notified by June 16, 2014 if your abstract has been accepted.
Candidate for AIPG National Vice President

Steven J. Stokowski, CPG-06607
Leesburg, Virginia

Candidate did not submit nomination article. See page 23 for candidate bio.
With the hindsight of 41 years, I can safely say that the choice I made in the Fall Semester of my Freshman year in college was life changing. I took my first class in geology that semester in 1973 and immediately knew that I had found my life’s work. Oh, if only the many other choices I was to make along the way could have been that simple and that flawless! I have two boys, one a junior in college and one a senior in high school. Both are at points in their young lives where they have to choose from among many options as they navigate a path toward their own passions. I envy them because of their freedom to choose a course. But to them, it is a bit daunting and confusing. So much has changed in the last 40 years, yet so many things are the same.

When someone asks me what I do for a living and I tell them “geology”, I invariably get the response “Oh!” – like “Oh, that’s interesting because I don’t know many geologists” or “Oh, that’s boring, let’s change the subject.” Either response is ok with me. It indicates just how unique our profession is and how few people in our society practice in the field of geology or have any inkling of what geology is all about. We are a unique group and we provide a vitally important service. This is why AIPG is such an important organization. Unlike some professions that have hundreds of thousands of professionals (engineers, software and hardware designers, lawyers, etc), there are relatively few geologists worldwide. We need organizations like AIPG to give us a voice and to provide structure for our profession.

I am truly honored to be nominated for the national AIPG Treasurer’s position for the years 2015 and 2016. Becoming a member of the AIPG executive committee carries with it significant responsibility for the continuing success of AIPG as an organization and the profession of geology as a career path for those that follow us. I have been an owner of a consulting practice (Clear Creek Associates) for about 15 years and can therefore bring the practical experience of running a business to AIPG. Like any organization, AIPG must manage its finances and plan for the future with an eye on income and expenditures, paying taxes, submitting to financial audits, etc. Therefore, running a consulting firm is quite similar to overseeing the operations of an organization like AIPG. I believe I am well qualified for the Treasurer’s role.

I have been a Certified Professional Geologist with AIPG since 1992 and have attended many AIPG functions over the years. I have been (and still am) a member of many other professional organizations, but I believe that AIPG provides the best support nationally for professional working geologists. It is equally valuable for members of the academic community that are involved in the important mission of teaching the next generation of geologists. I am passionate in my support of the academic community. Many of the young professionals that we hire at Clear Creek have no prior experience; therefore we rely heavily on academic institutions to prepare our entry level geologists for work as geologists and hydrogeologists. I am aware of the on-going debate about geologic education and where it is perceived to be heading. Regardless of which side of this debate you find yourself on, in the end it is students and their employers that matter. If the students can find no employment when they graduate, then the institutions that provided the education will suffer in the long term from lack of interest and lack of funding. This is the ultimate “check and balance” to the whims of college presidents, state legislators, or college trustees that have their own political and academic agendas. In my personal experience as an employer of geologists, I have been pleased with the young people that we have hired; therefore I support the geology programs that support us regardless of what their programs are currently titled. If this should change in the future, my support for those programs will also change.

I look forward to supporting AIPG as an organization in whatever way I can. I truly believe it is my time to give back to the profession that has given me so much over so many years.
CANDIDATE FOR AIPG NATIONAL TREASURER 2015-2016

Candidate for AIPG National Treasurer

Jeffrey M. Groncki, CPG-11118
Deerfield, Illinois

I am thankful for the nomination to the position of Treasurer of the AIPG and I welcome the opportunity to work with the AIPG Executive Committee. AIPG has been part of my professional career since earning my graduate degree in Geology at Western Michigan University. Early on in my career, I was encouraged to participate in AIPG by my colleagues/mentors. During the first few years of my professional career, I worked in Michigan. As many of you know, Michigan is one of the most active and successful sections of AIPG, which afforded me the luxury of benefiting from frequent dinner engagements with top-notch speakers. A few years later, I moved on to Illinois where I have set some deep roots. Not long after moving to Illinois, I was introduced to the Illinois/Indiana Section of AIPG and soon thereafter I was invited to participate in the Illinois/Indiana Section as a board member. My experiences as a board member of the Illinois/Indiana section have helped me grow personally and professionally. I am constantly amazed by the dynamic of the Illinois/Indiana section because of the shared enthusiasm for promoting the profession of geology and the unwavering support of our board members and their ability to step up and take on more responsibility and ownership of the Illinois/Indiana Section.

I’m almost embarrassed to say that it took me 10 years of membership in AIPG before attending my first national convention. Oddly enough, it was the meeting that my section hosted in suburban Chicago (2011). This marked the first time that the Illinois/Indiana Section hosted the national convention in almost 50 years and the first time many of us on the organizing committee had developed a national program. We are very proud of the program that we offered to our membership, which included amazing field trips, technical programs ranging from carbon sequestration to urban geology, and world class sight-seeing opportunities in the city. During the convention, I took the opportunity to observe the executive committee meetings and get a glimpse of inner workings of AIPG. In 2012, I took over the presidency of the Illinois/Indiana section and have participated in the business meetings at the national conventions in Rapid City, South Dakota and Broomfield, Colorado as the representative from the Illinois/Indiana Section.

I am very proud of what the Illinois/Indiana section has accomplished in the past two years. To name a few: we established our first student chapter; offered exceptional field trips (free to students); sponsored a short course with continuing education credits (sold out registration); diversified the content of our newsletters to include more focus on the membership that is not centralized to the Chicago metro area; aligned our email communication platform with AIPG national; and worked with Ron Wallace to help establish the AIPG Section Leadership Award. These achievements should not be misconstrued in any way as my own, but as a representation of the collective work of a great group of people in the section that I represent. I would like to translate some of the most successful elements of the Illinois/Indiana section operations to the national level and help build a framework that will allow us to collect/evaluate/share best practices from each of our sections that will allow us to efficiently become more relevant to our membership.

I have attended/participated in the past three business meetings at our national conventions, which has given me great perspective into the operations and organization of AIPG. During that time, I observed what some might say is a ‘changing of the guard’ or ‘passing of the torch’ to the next generation of practicing geologists. It is truly an exciting time to be part of the AIPG and I’m hopeful that I can count on your vote, so I can help guide the direction of the AIPG as we work toward developing and implementing strategies that allow us to continue provide exceptional value, learning, and networking opportunities for our membership.

Thanks again to the Nominating Committee for encouraging me to take on a more active role in AIPG. I am honored by the nomination. If you have any questions, please don’t hesitate to contact me at jeff.groncki@Walgreens.com.

AIPG will have a booth at the GSA Rocky Mountain/Cordilleran Section meeting this year. If you are attending please stop by and say hello or if you would like to volunteer to help staff the booth please contact the office at 303-412-6205 or aipg@aipg.org

The meeting is scheduled for May 18-21, 2014 - Bozeman, Montana.
CANDIDATE FOR AIPG NATIONAL PRESIDENT-ELECT 2015

Helen V. Hickman
CPG-07535
Lake Clarke Shores, Florida

Statement of purpose or goals you have for AIPG: I believe the future of our organization rests on our ability to focus on developing the next generation of professional geologists and providing the tools needed for them to succeed in their chosen field. These tools should be innovative and collaborative. AIPG must provide benefits to all its members and this can be accomplished through collaboration at all levels in the organization. I also support AIPG and the sections protecting their profession through legislative activities; providing member support on technical and business issues; supporting state licensure; and providing technical guidance and information to the public at large on important topics.

Universities Attended | Degrees Granted | Dates
---|---|---
University of Wales | B.S. Geology and Chemistry | 1978

Company | Title | Dates
---|---|---
Geraghty and Miller | Hydrogeologist-Senior Scientist | 1981-1989
Montgomery Watson Americas | Supervising-Principal Hydrogeologist | 1989-2000
Brown and Caldwell | Chief Geologist/SE Groundwater Practice Leader | 2000-2010
Rare Earth Sciences (dba HSA) | Groundwater Resources Leader | 2010-2011
Aquatich GeoSciences Inc. | President/Principal Hydrogeologist | 2011-Present

AIPG Activities | Dates
---|---
AIPG National Conference Organizing Committee, Technical Sessions, Orlando, FL | 2010
AIPG Florida Section, President Elect, | 2010-2011
AIPG National Advisory Board Member | 2010-2011
AIPG Ad-Hoc Committee on Section Support | 2011
AIPG Florida Section 3rd Emerging Issues in Water Resources Conference, Co-Chair | 2011
AIPG 2011 National Conference Florida Delegate | 2011
AIPG Florida Section President | 2011-2012
AIPG National Advisory Board Member | 2011-2012
AIPG 2012 National Conference Florida Delegate | 2012
AIPG Florida Section Past President | 2012-2013
AIPG 2013 National Conference Florida Delegate | 2013
AIPG Florida Section President Elect | 2014

John M. Stewart
CPG-111115
Greensboro, North Carolina

Statement of purpose or goals you have for AIPG: My goals as President-Elect are to: develop a strategic initiative to re-evaluate the structure of the Sections to improve membership numbers and retention; continue to work with struggling and disenfranchised Sections; to continue a strong student and young professional membership push, but not at the expense of our older members; and to see our membership become more involved in the Foundation.

Universities Attended | Degrees Granted | Dates
---|---|---
Texas A&M University | B.S. Wildlife & Fisheries Science | 1978
University of Texas - Austin | None, Undergraduate Geology | 1982
University of Missouri - Columbia | M.S. Geology | 1984

Company | Title | Dates
---|---|---
(Southwest) MO State University | Instructor | 1984 to 1987
NC Dept. of Environment, Health, and Natural Resources | Hydrogeologist II, Supervisor | 1987-1989
BPA Environmental & Engineering | Hydrogeologist | 1989-2001
Trigon Engineering/Kleinfelder | Senior Hydrogeologist | 2001-2011
ECS Carolinas, LLP | Branch Manager, Principal Geologist | 2011 to Present

AIPG Activities | Dates
---|---
AIPG Carolinas Section President | 2006 to Present
AIPG Carolinas Section Co-Chaired Water Resources Conference | 2011
AIPG National Advisory Board Representative | 2010 and 2011
AIPG Representative SE GSA, Wilmington, NC | 2011
AIPG Representative SE GSA, Asheville, NC | 2012
AIPG National Position Statement Committee | 2012
AIPG National Co-Chaired “Careers in Geology” Session - National GSA | 2012
AIPG National Student Outreach Committee | 2013
AIPG Representative SE GSA, Blacksburg, VA | 2014

2014 AIPG and AHS national Conference Hotel Information

Prescott Resort & Conference Center
1500 State Route 69, Prescott, AZ 86301
(855) 957-4637
$199 Night with AIPG/AHS G3986 Room Block

Resting on the “Top of the Rock” offering picturesque views of the warmth and scenery of Prescott, the Prescott Resort and Conference Center is the choice hotel for those seeking a luxurious getaway in Northern Arizona. Located just 90 miles northwest of Phoenix, the Prescott Resort is a great escape for a relaxed weekend, corporate retreat, or conference meeting. Experience the charm of Northern Arizona at the Prescott Resort.

Our Prescott Resort hotel offers newly renovated guest-rooms that share the culture of the Yavapai Prescott Indian Tribe. Each of our 160 guest rooms feature modern amenities that cater to our guests needs, i.e. High-Speed Wireless Internet and Flat-Screen Televisions. Each room was designed in the spirit of the Yavapai Tribe and offers artwork indicative to the majestic scenery of the Prescott area.

For more information go to www.aipg.org and select the conference website.

Please come join us in Prescott for our conference. For complete meeting information, visit the conference website on the AIPG home page at www.aipg.org.
J. Todd McFarland  
CPG-11348  
Nashville, Tennessee

Statement of purpose or goals you have for AIPG: Continue to promote professionalism within the geological community with a focus on students and young professional members. I will accomplish this goal by coordinating with national and state sections to support programs and initiatives to continue development of student chapters and grow young professional membership.

Universities Attended  
University of Kentucky  
M.S. Geology  
2003
University of Kentucky  
B.A. Chemistry  
1999

Company  
Shield Environ. Assoc., Inc.  
Staff Geologist  
2003 to 2006
AMEC Environment & Infrastructure, Inc.  
Geo-environmental Team Leader  
2006 to Present

AIPG Activities  
AIPG Tennessee Section President  
2013
AIPG Tennessee Section Past President  
2014
AIPG National Advisory Board Member  
2014

Steven J. Stokowski  
CPG-06607  
Leesburg, Virginia

Statement of purpose or goals you have for AIPG: To promote the role of professional geologists as decision makers in industry and government, providers of critical information to society, and as professionals to be consulted regarding mineral, water, and other natural resources. To improve the understanding of the value of professional geologists working in industry, both with other professions (especially engineers) and with the general public. To reverse trend to remove coursework in basic geologic skills (petrography, etc.) and knowledge (economic geology, etc.) as a requirement for a geology degree.

Universities Attended  
SD School of Mines & Technology  
M.S. Geology  
1980
George Washington University  
B.S. Geology  
1974

Company  
US Geological Survey  
Geologist  
1975
Martin Marietta Laboratories  
Research Assistant  
1975-1977
Uranium Research Program – SDS&M  
Research Assistant  
1979-1980
Genstar Stone Products Co.  
Materials Research Engineer  
1980-1981
Vulcan Materials Company  
Research Scientist, Manager  
1981-1985
SES Group  
Aggregate Technologist, Petrographic Laboratory Expert  
2008-2012
RJ Lee Group  
Senior Materials Scientist  
2012
Stone Products Consultants  
President & Consulting Geologist, Petrographer  
2012-Present

AIPG Activities  
AIPG Alabama Section Member  
1982-1985
AIPG 41st Annual Meeting, Saratoga Springs, NY, Field Trip Organizer  
2004

(Candidate did not submit nomination article)
R. Douglas Bartlett

CPG-08433
Scottsdale, Arizona

Statement of purpose or goals you have for AIPG: As treasurer, apply my many years of experience as a business owner to the continued financial health of AIPG. Foster the development of sound fiscal policy that can sustain future growth and success for the organization.

Universities Attended Degrees Granted Dates
Colorado State University M.S. Geology 1984
Colorado State University B.S. Geology 1977

Company Title Dates
Dames & Moore Assistant Geologist, Denver CO 1977-1981
Dames & Moore Project Geologist, Denver CO 1985-1989
Dames & Moore V.P., Phoenix AZ – AZ Geoscience Group 1989-1999
Anaconda Minerals Exploration Geologist, Denver CO 1999-present
Clear Creek Associates Principal Hydrogeologist 1999-present

AIPG Activities Dates
AIPG Arizona Section President-elect 2013
AIPG Arizona Section President 2014
AIPG National Meeting, Chairman

Jeffrey M. Groncki

CPG-11118
Deerfield, Illinois

Statement of purpose or goals you have for AIPG: My interest in participating in AIPG at the national level is to build upon the recent momentum built by the Executive Committee related to becoming more relevant to our membership. I have attended/participated in the past three business meetings at our national conventions, which have given me a great perspective into the operations and organization of AIPG. My goal is to help develop and implement strategies that enable AIPG to continue provide exceptional value, learning, and networking opportunities for our membership. I am thankful for the nomination to this position and welcome the opportunity to work with the AIPG executive committee.

Universities Attended Degrees Granted Dates
TSUNY Potsdam B.A. Geology 1997
Western Michigan University M.S. Geology emph. Hydrogeology/Geophysics 1999

Company Title Dates
Malcolm Pirnie, Inc. Hydrogeologist 1999-2011
ARCADIS/Malcolm Pirnie, Inc. Senior Hydrogeologist/Team Leader 2011-2013
Walgreen Co. Environmental Manager 2013-present

AIPG Activities Dates
AIPG National Meeting, Technical Program Chairman 2011
AIPG Illinois/Indiana Section Board Member 2004-present
AIPG Illinois/Indiana Section President 2012-present

2014 AIPG and AHS National Conference Abstract Subject Areas

- Application of GW Flow Models to Water Planning
- Colorado River
- Colorado River & Suspended Sediment
- Colorado River Experimental High Flows
- Colorado River Watershed & Uranium
- Colorado River Watershed Springs
- Drought & Climate Change
- Ecosystem Flow Needs
- Education/Outreach
- Energy
- Engineering Geology
- Environmental Geology
- Ethics/International Practices in the Profession
- Geochemistry & Geomorphology
- Geographic Information System Applications
- Geohazards
- Geology of Arizona
- Geophysics & Groundwater
- Geophysics & Subsidence
- Geostatistics
- Groundwater Management & Policy
- Groundwater Modeling
- Groundwater Quality
- Hydraulic Fracturing
- Hydrogeologic Framework Studies
- Hydrology
- Industrial Minerals
- Long-Term Groundwater/Surface Water Monitoring
- Mapping
- Mexico
- Mine Closure & Reclamation
- Mine Water
- Mineralogy
- Mining & Economic Geology
- Oil & Gas
- Overdraft, Safe Yield & Sustainable Yield
- Paleontology/Archeology
- Porphyry Copper
- Precious Metals
- Project Profiles
- Rare Earth Elements
- Reclamation in Arid Environments
- San Pedro Watershed
- Santa Cruz River
- Springs as Geochemical & Biodiversity Indicators
- Surface Water - Groundwater Interaction
- Surface Water Quality
- Tribal Water Concerns/Management Strategies
- USGS
- Verde River Watershed
- Water Management
- Water Quality Management
- Young Professionals/Early Career Scientists
Official AIPG 2014 Ballot
National Officer Election

PRESIDENT ELECT -
(President in 2016)

☐ Helen V. Hickham
☐ John M. Stewart

VICE PRESIDENT -
(Term of Office 2015)

☐ J. Todd McFarland
☐ Steven J. Stokowski

TREASURER -
(Term of Office 2015-2016)

☐ R. Douglas Bartlett
☐ Jeffrey M. Groncki

Election of officers shall be by a ballot. The ballot shall be sent to all Members by May 15. Election shall be by the majority of all qualified ballots cast. In order to be counted, ballots must be received at Institute Headquarters on a date named by the Executive Committee, which date shall be no later than June 30.

Only AIPG CPG’s and MEMBERS are authorized to Vote.

Ballots Must Be Received At Headquarters By JUNE 30, 2014. Your AIPG Name and Member Number Must Be Printed Below For The Ballot To Be Valid.

Name _______________________________

Member Number _______________________

Mail your ballot to:

AIPG
12000 Washington St, Suite 285
Thornton, CO 80241

Vote Online or Mail in this ballot
Thank You for 25 Years!

The following members have received their 25 year pin and certificate. Your dedication to AIPG throughout the years is truly appreciated. It has ensured the growth and success of the Institute. Please join AIPG headquarters in thanking these members for their continuous support.

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<td>Suresh Sharma</td>
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### Thank You for 25 Years!

**Mark Shellhorn**  CPG-07527
Midland  MI

**Jane Spellman**  CPG-07545
Fayetteville  AR

**Gary Stumpf**  CPG-07509
Fairfax  VA

**Stephen Sullivan**  CPG-07491
Louisville  KY

**Bruce Sypniewski**  CPG-07528
Chicago  IL

**Jerry Taylor**  CPG-07517
Prairieville  LA

**Thomas Thomas**  CPG-07529
Lemont  IL

**Robert Tobin**  CPG-07474
Lincoln  NE

**Timothy Vogt**  CPG-07463
Las Vegas  NV

**Julie Weatherington-Rice**  CPG-07433
Worthington  OH

**John Yellich**  CPG-07538
Kalamazoo  MI

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### AIPG Student Chapters

<table>
<thead>
<tr>
<th>University</th>
<th>Founded in</th>
<th>Chapter Sponsor</th>
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<tr>
<td><strong>Bowling Green University</strong></td>
<td>2004</td>
<td>Robert K. Vincent, MEM-0216</td>
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<tr>
<td><strong>Central Michigan University</strong></td>
<td>2003</td>
<td>Eric Wallis, CPG-09518</td>
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<td><strong>Colorado School of Mines</strong></td>
<td>1999</td>
<td>Graham Closs, CPG-07288</td>
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<td><strong>Columbus State University</strong></td>
<td>2011</td>
<td>Ron Wallace, CPG-08153</td>
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<td><strong>Eastern Illinois University</strong></td>
<td>2013</td>
<td>Craig McCammack, MEM-1295</td>
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<td><strong>Eastern Michigan University</strong></td>
<td>2006</td>
<td>Walter J. Bolt, CPG-10289</td>
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<td><strong>Florida State University</strong></td>
<td>2014</td>
<td>Anne Murray, CPG-11645</td>
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<td><strong>Georgia Southwestern State University</strong></td>
<td>2013</td>
<td>Ronald Wallace, CPG-08153</td>
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<td>2005</td>
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<td><strong>James Madison University</strong></td>
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<td>Cullen Sherwood, CPG-02811</td>
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<td><strong>Ohio State University</strong></td>
<td>2004</td>
<td>Robin Roth, CPG-09264</td>
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<td><strong>Metropolitan State University of Denver</strong></td>
<td>2013</td>
<td>David M. Abbott, Jr., CPG-04570</td>
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<td><strong>Temple University</strong></td>
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<td>Dennis Pennington, CPG-04401</td>
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<td><strong>University of California-Davis</strong></td>
<td>2010</td>
<td>James Jacobs, CPG-07760</td>
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<td><strong>University of Georgia</strong></td>
<td>2011</td>
<td>Ron Wallace, CPG-08153</td>
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<td><strong>University of Nevada-Reno</strong></td>
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<td>Jonathan G. Price, CPG-07814</td>
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<td><strong>University of South Dakota</strong></td>
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<td>Derric Iles, CPG-10986</td>
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<td><strong>University of West Georgia</strong></td>
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<td>Eric Lowe, MEM-0385</td>
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<td><strong>Wayne State University</strong></td>
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<td>John Barkach, CPG-09121</td>
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<td><strong>Wright State University</strong></td>
<td>1996</td>
<td>Thomas Berg, CPG-08208</td>
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Wallace Scholarship for Women Geoscientists Announced

Alexandria, VA - The American Geosciences Institute congratulates the latest recipients of the Wallace Scholarship for women in geoscience. The newest awardee is Penn State doctoral candidate Elizabeth Denis and 2013 awardee, University of Florida doctoral candidate Kelly Deuerling, SA-5288, has received a second year of funding in a re-compete application.

Denis’ research, funded in part by a National Science Foundation (NSF) Graduate Research Fellowship, currently integrates geochemistry and sedimentology to investigate fire and aridity relationships during the Paleocene-Eocene Thermal Maximum (PETM) a past hot, CO₂-rich climate.

Denis researches how organic matter distribution is influenced by sediment dynamics. Her undergraduate degree at Brown University provided the foundation for her dissertation by identifying that certain compounds of organic matter found in the sedimentological record can be used as fire markers. Her research is part of a greater project between NSF, and the Smithsonian Institution to demonstrate how the PETM serves as a unique analog to the current anthropogenic induced changes to the carbon cycle.

Her research will be used to develop educational modules for grade school students through Penn State’s outreach programs.

Deuerling, who was awarded the Wallace Scholarship initially in the 2013-2014 year, has been awarded the one-time renewal of this scholarship. She has spent the last year analyzing the samples she collected in western Greenland as part of a research team she helped coordinate, and she hopes to have her first manuscript on solute fluxes in proglacial watersheds submitted by late spring 2014; research that may provide insight on ice sheet fluctuation over time and watershed sourcing. The timeliness of her research, as well as its broad appeal and potential impacts on the greater geoscience community, helped to distinguish Deuerling as a promising young scientist within the geoscience profession.

Although Deuerling anticipates graduating in two years, she has already started seeking out traditional post-doctoral positions and she is keen to be passionate about whichever career path she pursues.

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Given annually in honor of Harriet Evelyn Wallace, a founding member of the Geoscience Information Society (GSIS), a national organization and AGI Member Society that facilitates the exchange of information in the geosciences, the new Harriet Evelyn Wallace Scholarship is awarded to a female student pursuing a thesis-based Master’s or Doctorate degree in the Earth sciences. The scholarship is awarded to the applicant who most exemplifies the strong likelihood of a successful transition from her graduate studies to the geoscience workforce. The successful candidate receives $5,000 for her first scholarship year, and will be eligible for a second year scholarship of $5,000 upon successful completion of her first year. Each year, a second $5,000 award will be given to a new female graduate student for a total of 2 awards per year starting in 2014. For more information on the scholarship please visit http://bit.ly/1g4K7gl.

The American Geosciences Institute is a nonprofit federation of geoscientific and professional associations that represents more than 250,000 geologists, geophysicists and other earth scientists. Founded in 1948, AGI provides information services to geoscientists, serves as a voice of shared interests in the profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in society’s use of resources, resiliency to natural hazards, and interaction with the environment.
EDITOR’S CORNER

A Time of Transition

Robert A. Stewart, CPG-08332

This will be my final column as the editor of AIPG, as I begin my transition as the new Executive Director of AIPG.

My new responsibilities extend to the fascinating variety of tasks needed to ensure that AIPG continues to thrive as an organization representing the interests of students, young professionals, and established professional geologists in the United States and internationally. I am exceptionally fortunate to begin my tenure with AIPG on a sound financial footing, with an expanding array of services to its members, particularly students. AIPG has grown to its present stature under the guidance of Bill Siok, AIPG’s 2014 recipient of the Ben H. Parker Memorial Medal. Congratulations, Bill, well-deserved! Bill will make a segue away from AIPG headquarters into a term as the secretary of the American Geosciences Institute (AGI), continuing AIPG’s long history of volunteers and service to that organization.

TPG is also making a transition this year from a semi-annual to a quarterly publication. With the introduction of AIPG’s eNews in 2013, we now have dramatically increased flexibility in our publications without an accompanying cost. Our intention is to move TPG to an entirely on-line format by 2015. Some of the benefits include:

- Unlimited color graphics in the various articles
- Fewer restrictions on the size of graphics
- Space for graphics not previously available for professional essays
- AIPG branding on each on-line article indicating its publication in TPG
- Monetary savings to AIPG, as the cost of print publications, reprints, and mailing are reduced

Personally I enjoy print editions of magazines and newspapers, but the trend to on-line publication is inexorable in many respects, and we believe that the benefits outweigh the drawbacks.

I have relocated to a new home in Erie, CO, a short distance north of AIPG headquarters. My wife and I each made a house-hunting trip, armed with literature on expansive soils from the Colorado Geological Survey and AIPG’s Homebuyer’s Guide to Geological Hazards. We passed on one home after the due diligence revealed a six-inch settlement problem in the kitchen, not disclosed by the sellers. According to the seller’s realtor, we were being “too picky.” At any rate, the due diligence for the Erie house revealed no significant problems with expansive soil, no radon problem, and we weren’t in a part of Erie notable for subsidence from historical coal mining. Erie is within the limits of the old Boulder-Weld Coal Field, and many of the local mines apparently took their names from anthracite mines in northeastern Pennsylvania, the home to many of my relatives. Except for radon, a direct measurement by an inspector, I was able to do most of the background research remotely, through the Colorado Geological Survey’s website, their popular publication on expansive soil, and the Natural Resource Conservation Service’s web soil survey. We were also fortunate to find a knowledgeable home inspector, who with the Erie building inspector provided us with a high degree of comfort about the lack of significant geologic hazards in our area.

Back in Connecticut, obligatory seller disclosures have expanded since we bought our house in 1994. Our water supply came from an on-site well, and the Connecticut Department of Public Health now mandates uranium and arsenic analysis of private well water, in addition to lead and potability. Over the past few years, arsenic and uranium have been detected with some regularity in well water from previously unexpected areas of the state, such as Weston (arsenic) and Stamford (uranium), which are distant from known source areas such as Paleozoic sulfidic schists (arsenic) and the Jurassic Portland Arkose (uranium). Further sampling and investigation on a state-wide basis will doubtless clarify the geologic basis for naturally-occurring uranium and arsenic. Happily, neither metal was detected in our well water.

Groundwater quality in Weston, Stamford, and other towns in Connecticut has been in the news recently, and an internet search will provide links. As I finished my column today (May 21, 2014), I used Google to confirm that the links were active. Upon opening Google for the search, the home page included a Google Doodle celebrating Mary Anning’s 215th birthday. Mary was a pioneering 19th-century fossil collector and paleontologist, who is recognized by the Royal Society of London as one of the 10 British women who have most influenced the history of science. Wikipedia provides an excellent overview of her life and accomplishments, with references for further reading. Mary’s interest in fossils began on childhood collecting trips with her father, who sold the fossils to support his family. My own, and I suspect many AIPG members’ interest in geology, developed on fossil-collecting trips with parents. My first experience involved picking through rip-rap on the Lake Ontario beach we visited near Toronto. My parents provided empty fruit baskets to hold my specimens, food and water, and benign neglect as I explored the beach.
TEST YOUR KNOWLEDGE

1. We are describing a depositional environment dominated by marshy conditions. Which of the following terms applies?
   a) Neritic
   b) Lacustrine
   c) Paludal

2. All three of these dinosaurs were carnivorous and fierce predators. Which one is not a Late Jurassic specimen?
   a) Tyrannosaurus
   b) Allosaurus
   c) Ceratosaurus

3. Which of the following minerals is part of the alkali feldspar series with blue shimmering crystals as key components of the common ornamental rock that we know as “Larvikite”?
   a) CaAl₂Si₂O₈
   b) NaAlSi₃O₈
   c) (Na,K)AlSi₃O₈

4. You are part of a team of engineers and geologists advising city officials on urban development planning. A dam is being considered to be built across a local stream channel. Assume a simple rectangular structure with a length of 100 feet. The dam is expected to impound water to a height of 40 feet. Recalling the unit weight of water \( (\gamma_w) \) as 62.5 lb/ft³, what would we expect the total force of the water behind the dam to be?
   a) \( F = 2,500,000 \) lb
   b) \( F = 4,000,000 \) lb
   c) \( F = 5,000,000 \) lb

Should I Become a CPG?

Have you been thinking about upgrading your membership to CPG? If the answer is yes, what are you waiting for? To find out if you have the qualifications go to Article 2.3.1 of the AIPG Bylaws. The AIPG Bylaws can be found on the AIPG website or the directory.

The CPG application can be found on the website under ‘Membership’. Just follow the instructions. The basic paperwork includes the application, application fee, transcripts, geological experience verification and sponsors.

If you have any questions, you may contact Vickie Hill, Manager of Membership Services at aipg@aipg.org or call headquarters at 303-412-6205. www.aipg.org
What next? An Executive Director Search Committee was formed in 2013 to look for a new Executive Director. The search has taken many months and I am pleased to let you know that Bob Stewart has been selected as the new Executive Director of AIPG. Does the name sound familiar? Yes, Bob is the Editor of TPG. Bob has been a CPG since 1991 and has served many roles for AIPG including an active member of the Northeast Section, National Editor of TPG, and member of the National Screening Committee. In 2011 Bob was awarded a Presidential Certificate of Merit for work as the Editor of TPG and in 2013 he was awarded the Martin van Couvering Memorial Award for service to AIPG. Bob will officially take over the reins at Headquarters on May 19, 2014. Let’s all welcome Bob. Even though this transition marks a significant change for AIPG, I envisage this change to be seamless.

Passion. This is a word I use to help describe how we should feel when we take on any activity, challenge, or job. Give the best effort possible to maximize the result. We should all strive for this. There are many ways all members of AIPG can show passion to the organization. For example, at the Section level a member can help keep the Section strong and active. You can reach out to our most valuable resource – students. How do I do this? Talk to folks in your Section to determine what colleges and universities are in your Section and which ones have geology or earth science programs. Here is where it may become difficult. Contact the department head at each program and invite yourself to the department to talk about professional careers in geology and/or the earth sciences. Buy pizza! Headquarters will send you a package of materials to help get the new student chapter going along with $100 of seed money. Although this may seem like a lot of work it is actually fun – just ask Ron Wallace. Ron has spearheaded the student chapter buzz in Georgia. At last count Ron had organized 4 student chapters in Georgia. Now this is passion! This does not happen at the wave of a magic wand. YOU have to have the passion and commitment to help make a new student chapter a reality.

I challenge you to start at least one student chapter for each AIPG Section. This means that our goal is approximately 25 new Student Chapters for 2014. This will require passion. I encourage you to contact me or Ron Wallace for any help you need to make this a reality. Thank you!

On a related topic, I was asked by the Earth Sciences Department at the University of New Hampshire to be part of a panel of professionals to talk to both students and faculty about opportunities after graduation. One student asked the question “Are there mentors in business?” An interesting question! One professional answered that he is not a good mentor, but that he had a good mentor when he first started out. When it was my turn to respond I said that I am a good mentor and that it is a privilege to ‘transfer’ the knowledge and experience I gained/accumulated over the years to new professionals. Another student asked if I was afraid that the new person would take my job after I trained them. I responded, no. Why not they asked? I said we cannot have fear that the new person will result in the loss of a job. You have the privilege to ‘transfer’ the knowledge and experience I gained/accumulated over the years to new professionals. Another student asked if I was afraid that the new person would take my job after I trained them. I responded, no. Why not they asked? I said we cannot have fear that the new person will result in the loss of a job. You have to be confident in who you are and your abilities. There may, and most likely will be a time when you move on. However, you do so knowing that you mentored the next generation and were not afraid to do so. That is passion.

President's Message continued on page 33.
Answers:

1. The answer is choice “c” or “paludal”. “Neritic” or the “neritic zone” refers to the coastal marine environment basically extending from the shoreline to the edge of the continental shelf (or depths to 600 feet). “Lacustrine” relates to the depositional environment related to lakes.

2. The answer is choice “a” or “Tyrannosaurus”, a Late Cretaceous inhabitant, the “tyrant lizard” that could attain forty feet in length!
Both Ceratosaurus and Allosaurus lived during the Late Jurassic. Ceratosaurus had a pair of bony ridges above the eyes, a horn on the snout, a hand with four fingers and attained lengths of about twenty feet. By comparison, Allosaurus had a hand with three fingers and could grow in excess of thirty-five feet in length.

3. The answer is choice “c” or “(Na,K)AlSi₃O₈” or “anorthoclase”.
“Anorthoclase” is part of the alkali feldspar series, falling between “albite” (NaAlSi₃O₈) and “orthoclase” (KAlSi₃O₈) as the corresponding end-points. The blue, shimmering crystals of “anorthoclase” make “Larvikite” a popular ornamental stone. “Larvikite” (Norway’s national rock) is generally dark in color (gray to black) and a type of “monzonite” with little quartz content. “Larvikite” has also been classified as an “alkalic syenite”. The mineral “anorthite” (CaAl₂Si₂O₈) is the calcium feldspar end-member of the plagioclase feldspar series.

4. The answer is choice “c” or “F = 5,000,000 lb”. The proof flows (see figures below):

![Diagram]

The net pressure (P) at a height “z” above the base (bottom) of the dam is:

\[ P = \gamma_w (H-z) \]  

(1)

Consider a section of infinitesimally small thickness (dz) and area (A = Ldz). Then, the force acting on the section of area (Ldz) is:

\[ dF = (P) dA = (P)(Ldz) \]  

(2)

Substituting (1) into (2) we obtain:

\[ dF = \gamma_w (H-z)Ldz \]  

(3)

The force (F) of the water behind the dam is calculated by integrating equation (3) from z = 0 to z = H. Then, (F) becomes (integrating from z = 0 to z = H):

\[ F = \int \gamma_w (H-z)Ldz \]  

(4)

\[ F = \gamma_w HLz - \gamma_w Lz^2 \]  

(5)

\[ F = \gamma_w H^2L - \frac{1}{2} \gamma_w H^2L \]  

(6)

\[ F = \gamma_w H^2L (1 - \frac{1}{2}) \]  

(7)

\[ F = \frac{1}{2} \gamma_w H^2L \]  

(8)

Equation (8) is what we need to solve the problem. In our case, H = 40 feet, L = 100 feet and \( \gamma_w = 62.5 \) lb/ft³. Thus, equation (6) becomes:

\[ F = \frac{1}{2}(62.5)(40)^2(100) = 5,000,000 \text{ lb} \]  

(9)

Equation (9) is the numerical answer that we seek. Five million pounds constitutes a significant force and the dam must be designed with this figure in mind.
As a geologist, I never find myself bored or uninterested with the applied side of our profession. As a professional, I never find myself uninterested in AIPG’s responsibilities to young professionals.

If you are an engaged member of AIPG or one of our sister societies, you are fully aware of the criticality of recruiting students into the societies. They represent, as we all recognize, the very future of our societies. AIPG is working to address the demographics of age so that its future will be assured. Members who founded AIPG are dwindling in numbers, many of us who became members of AIPG early in our careers are reaching retirement age, but we wish to be secure in the knowledge that our student recruitment efforts will be eminently successful and that the next 50 years will see AIPG gain strength, visibility, credibility, and members.

AIPG statistics regarding student recruitment and retention are very respectable and in-line with sister societies. Upon graduation, students are eager to transition to the Young Professional membership level and this is when AIPG encourages them to become ever more involved in section level and national level governance.

Most encouraging is that the efforts to engage students and to offer them incentives to become Young Professionals are now paying off in the election from among their numbers to the national Executive Committee. My successor as AIPG Executive Director, Robert A. Stewart, is a thoroughly dedicated AIPG CPG and will represent its members to the entire geoscience community and the public with conviction, competence, and quintessential professionalism. I have the utmost respect for Bob and will do what is in my power to make his tenure the best AIPG has ever experienced.

Best wishes to Bob and AIPG for a most successful future!

President’s Message continued from page 31

As I mentioned in my last message, AIPG has been slow with integrating young geoscience professionals into the decisions made for the organization at the National Level though we have made great strides this year as evidenced by the current members on the Executive Committee. To keep this momentum going we will have a Technical Session for Young Professionals (YPs) at the Annual Meeting in Prescott, Arizona. I will reach out to Sections in order to attract YPs to the Annual Meeting to give technical presentations on projects that are involved with at their work. Please pass the word along to YPs that you know. Remember, you also have the opportunity to learn something new from a YP.

Since I last spoke with you, AIPG had an Executive Committee meeting in Tucson, Arizona. I had the opportunity to speak at the Annual Meeting of the Arizona Section. I will visit the Florida Section for a meeting at Florida Atlantic University in Boca Raton. I will be giving a technical presentation on “Evaluating Surface Water and Groundwater Interactions in a Stressed Aquifer System using an Ecohydrological Approach.” I will also be attending the inaugural meeting of a new student chapter at the university. Great job! We still need 24 more. Let me know if you would like a visit to your Section.
Calibrating and Re-calibrating 100-year Floods and Similar Events

Peter Dohms, CPG-7141, sent me the following comment on the calibration of 100-year floods and similar events made in column 148’s “Societal considerations as part of geoscience ethics codes and practice guidelines” topic (Nov/Dec ‘13). “In response to the ‘war story’ of the re-destruction of US Highway 34 in Big Thompson Canyon from the ‘1000-year flood’ of 2013, I have a comment. Way back in the dark ages when I took my Senior level course, Introduction to Hydrology (taught by the Civil Engineering Department), there was a section on the generally-accepted method of calculating the ‘100-Year Storm Event.’ The technique taught involved plotting the database of individual storm events on ‘Log-Probability’ graph paper, laying the ‘best fit’ line, projecting it out to the 100-year mark on the ‘Y’ (Probability) axis and reading the corresponding rainfall on the ‘X’ (Log) axis. Typically, an amazingly large number of ‘inches of rain’ would be the result.

“There’s a simple point—our professor EMPHASIZED very strongly that, ‘once you experience a rain event that equals [or comes close to] the predicted ‘100-year’ event, it is REQUIRED that the analysis be repeated, inserting this measured storm into the database, and creating a new ‘best fit’ line to determine the ‘improved prediction’ of a 100-year storm.’ Here is where the ethical dilemma arises.

“When I lived in Southeast (state name redacted to protect the civil servant, who were only obeying orders...), our community experienced three (3) rain events in the quarter century of my residence that met the published criterion of the ‘100-year storm.’ When I asked some knowledgeable civil engineers ‘How can this be?’ I was given the answer that, were the State’s engineers to update their predicted ‘100-year rain event,’ it would demonstrate that all the highway bridges were undersized to accommodate the flows, and that ‘all Harry’ would break out (resulting in an unhappy Legislature, which held the purse strings...). It was somehow in the State’s ‘financial best interest’ to accept the risk of not realizing the magnitude of a realistic appraisal of potential flooding.

“Now, I have no way of knowing if the engineers who re-designed the highway through Big Thompson Canyon after the July 31, 1976 flood took into account the necessity to update their database and the prediction of a ‘new and improved’ 100-year storm. My advice at the current juncture, however, is that they had BETTER do the calculation before US-34 is rebuilt again.”

Dohms makes the excellent point that the probability curves for big events should be recalibrated as relevant new data becomes available. Dealing with the consequences of the new prediction is another and, admittedly political (because of public cost), issue. In the case Dohms cites, should the state be required to rebuild all the highway bridges at once? Or should the state wait until a flood actually took out a bridge prior to rebuilding it? It may be that a bridge-by-bridge evaluation is required. (For example, if a bridge does actually fail due to the new rainfall, the cost of rebuilding the bridge is already budgeted; otherwise the project would have to be put on hold until another event.)

As I pointed out in column 148, it may be most prudent not to build for the extreme event but recognize that occasional and hopefully infrequent re-building will be required. This question can best be answered by appropriate scientific and engineering analysis using the best available data and alternatives can then be presented to the legislature, or to whomever has to pay the bills.

The Erosion of the Geoscience Curriculum

In column 149 (Jan ’14), I commented on David King’s article in the Sep/Oct ‘13 TPG. Also in the January issue, James Tyburezy, et al. of the Arizona State University’s School of Earth and Space Exploration responded to King’s article and Editor Robert Stewart’s “Editor’s Corner” setting out their philosophy that “values an educational environment that encourages cross-pollination of ideas in science and engineering while preserving—not eliminating—the traditional strengths of formal curricula in these fields.” Arizona State’s “goal is to prepare students to build their careers in a world undergoing rapid change, one that requires agility, flexibility, and the ability to work and communicate with individuals from multiple disciplines. Both our BS and BA programs emphasize writing, critical thinking and interdisciplinary collaboration—all skills that employers tell us repeatedly are paramount for students to have. While our BS degree is designed for students who will pursue a career in science, our BA degree in Earth and Environmental Studies is designed to provide traditional liberal arts majors with a strong appreciation for and literacy in earth and environmental sciences.” Both my comments in column 149 and Robert Stewart’s “Transdisciplinary education—caveat emptor!” column in the

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Jan ‘14 TPG reflect on Arizona State’s approach including the potential pitfalls therein. A solid background in the hard sciences continues to be required for a successful geoscience career. Beware the “geobasketweaving.”

Education for Certification, Fundamental Courses, and the Changing Syllabus

The preceding topic leads nicely into this reflection on the basic courses/subject matter required for a successful geoscience career. I am the Screening Committee chairman for the Colorado Section and so review all the applications for AIPG Certification submitted by Colorado applicants. The CPG screening form, which is completed by those reviewing a CPG application, specifically asks if an applicant has taken the following core geoscience courses: physical geology, historical geology, stratigraphy, mineralogy/petrology, field geology, and structural geology. A place is provided for listing additional geoscience courses and screeners are asked to verify that the applicant has taken at least the minimum 36 semester or 54 quarter hours of geoscience courses. I see two types of problem with the current education verification problem.

The first problem is that a practicing geoscientist needs not only a solid geoscience curriculum but also appropriate math, physics, chemistry, biology, and perhaps other courses depending on the chosen area of geoscience specialty. In addition, a basic accounting course, business management courses, courses in the regulations affecting one’s area of practice, etc. are also needed by the time one reaches Certification-level education and experience. The screening process does not provide for credit for such courses. When I was an undergraduate, the requirements for completing an earth science major were 4 upper level earth science courses and 4 additional upper level science courses appropriate to the area of earth science one intended to pursue. In addition, one had to take 3 science courses other than earth science to complete the general distributive requirement. Basic math, physics, and chemistry courses commonly fulfilled the distributive requirement. One of my classmates was a pre-med who was an earth science major because he liked the subject. For him, a lot of biology courses, organic chemistry, etc. completed his major requirements and his medical school requirements. Most of us who became professional geoscientists took far more than the minimum 4 upper level earth science courses along with 2-3 math courses (statistics, in addition to the basic calculus, etc.), physical chemistry, etc. Several of us filled the social science distributive requirement with the geography department’s cartography and terrain imagery interpretation courses, which were important earth science skills as well. Perhaps it is time to re-examine the AIPG’s recommended course distribution requirement. Allowing for additional math, chemistry, physics, biology, etc. courses should also increase the number of semester or quarter hours required for Certification.

The other problem is the changing content of a particular course’s syllabus. Physical geology traditionally focused on the basic identification of rocks and minerals, recognition of the differences between igneous, metamorphic, and sedimentary rocks, basic structural concepts, etc. Current introductory geoscience courses contain a good deal of environmental science material that consequently reduces the amount of time devoted to the traditional aspects of physical geology. Even when the focus of a course hasn’t changed, some of the concepts taught and answers expected have changed over the years. The difference between the historical geology course my father took at the University of Nebraska in 1936 and the course I took as an undergraduate in 1971 provide an excellent example. While both courses focused on the geologic time scale’s division of geologic time and the evolution of plants and animals as revealed by their fossils, there were some important differences as revealed by the final exam review questions my father prepared and kept in his class notebook, which I now own. For example, the most important economic products of each geological period were part of the syllabus; one such question was, “Tell of the climate, life, and economic products of the Mississippian.” Another question asked about the economic importance of the Berea Sandstone. The 1936 answer was probably as a building stone rather than the more recent importance as a petroleum reservoir.

The questions addressed in this topic were prompted by a Certification application I recently reviewed. The applicant had just acquired the required 8 years of practice experience. His transcripts contained the required hours of geoscience education but did not include courses labeled mineralogy or petrology. Perhaps his “earth materials I and II” courses covered these fundamental areas. I never had an undergraduate course in stratigraphy; I learned basic stratigraphic concepts in an undergraduate structure and stratigraphy of North America course and was able to pass a graduate stratigraphy course.

Discussions of the basic education required for current geoscience practice are perennial topics of conversation and debate. The status of geoscience education, “The Erosion of the Geoscience Curriculum,” was the lead article in column 149 (Jan/Feb/Mar’14). “Field camp: it’s not optional for the professional” was discussed in column 131 (Jan/Feb ’11). I was the lead author of “What Education Qualifies One as a Geologist?” in the May/Jun ’05 TPG. These are issues that should be periodically reviewed and discussed by practicing professionals so that those in school can be adequately counseled about the courses they should take in order to gain a solid foundation for professional practice.

Societal Considerations as Part of Geoscience Ethics Codes and Practice Guides

I introduced this topic in column 148 (Nov/Dec ’13). Jessica Elzea Kogel, CPG-11224 and 2013 SME President, provided an interesting example in her “Gender issues in mining: Complications are high away from mainstream operations,” her President’s Page in the January 2014 issue of Mining Engineering. Kogel describes listening to an African woman describing the plight of many women involved in the artisanal and small-scale mining (ASM) industry around the world. Some estimate that about 30% of the approximately 15 million ASM miners worldwide are women and that in parts of Africa the estimates are that 60% of the ASM miners are women. ASM mining is frequently plagued by a variety of unsafe working conditions and practices. Nevertheless, the income received by ASM miners may be significantly higher than that from other available income sources. ASM mining operates without complying with land tenure, environmental, and a wide variety of regulations but is tolerated because of the difficulties in shutting such operations down. Resolution of these difficulties is
not easy but is something responsible mining companies are trying to deal with in working in areas where ASM mining is common.

“Is that data point really an outlier?”

William J. Stone’s (MEM-2164) article “Is that data point really an outlier?” in the Jan ’14 TPG is a short but excellent discussion of the topic (even if “datum” (singular) should be used instead of “data” (plural)). When I review QA/QC assay data from reputable companies, I expect to see the occasional outlier. The question is not whether outliers occur, but why do they occur? Was there a sampling or analytical error (including misplacement of sample on a tray for automated sample handling and transcription errors)? Investigation of outliers is needed. Often a reasonable answer can be found, but sometimes outliers are simply outliers.

Student Issue 2014

The January issue of the TPG has been devoted to topics of interest to students for several years. This year was no exception and contained articles from students, young professionals, and those near the end of their careers on a wide variety of topics. These articles will be included in the Student—Young Professional index and document location on the AIPG website, http://aipg.org/Students/studenttopics/Student%20topics%20index%20linked.xlsx. Kristina Pournabib, SA-3410, contributed an excellent follow-up to her “Capstone Experience” column on field camp with “Expectations in the field,” her account of things she learned about attending field camp (e.g., practice measuring strikes and dips with a Brunton before going to field camp if you can—GPS doesn’t work in canyons and steep-sided valleys). Felicia Kruger, SA-4731, provided the interesting perspective of the non-traditional student on returning to school after marriage and children to finish a bachelor’s degree and go on to graduate school in “Undergraduate research and graduate school.” At the other end of the age spectrum, Ray Bisque, CPG-1595, Professor Emeritus, and one of my first bosses in ’67-’69, wrote “Enjoy your research and craft your thesis well—it will be around for a while” describing his PhD work on the unstability of certain carbonates used in aggregate (alkali-carbonate reactivity, ACR) that has led to his current work (56 years later) on coal-derived fly ash and whether calcium, silica, alumina, and water lead to polymerization of the fly ash and whether these geopolymers might be useful in certain applications. These are but a few of the many articles that are worth reading in this year’s student issue. I urge your perusal of the whole issue.

Geologic Ethics & Professional Practices is now available on CD

This CD is a collection of articles, columns, letters to the editor, and other material addressing professional ethics and general issues of professional geologic practice that were printed in The Professional Geologist. It includes an electronic version of the now out-of-print Geologic Ethics and Professional Practices 1987-1997, AIPG Reprint Series #1. The intent of this CD is collection of this material in a single place so that the issues and questions raised by the material may be more conveniently studied. The intended ‘students’ of this CD include everyone interested in the topic, from the new student of geology to professors emeritus, working geologists, retired geologists, and those interested in the geologic profession.

AIPG members will be able to update their copy of this CD by regularly downloading the pe&pp index.xls file from the www.aipg.org under “Ethics” and by downloading the electronic version of The Professional Geologist from the members only area of the AIPG website. The cost of the CD is $25 for members, $35 for non-members, $15 for student members and $18 for non-member students, plus shipping and handling. To order go to www.aipg.org.
The search for the source of groundwater contamination requires a review of the hydrogeologic setting, especially the direction of ground-water flow. When a published ground-water report or water-table map exists, this is fairly straightforward. Flow is from higher to lower water-level elevations, generally perpendicular to contours. If such previous work is not available, one may construct a water-table map, using data from existing wells and/or new monitoring wells installed at the site.

When I started working at a state environmental agency, I was more senior than most of the staff. So, I was asked to casually review the projects of some of the others in the Ground-Water Section and gently offer mentoring, if I felt it was needed. The cases typically involved leaks or spills of petroleum or petrochemical fluids.

One of the guys whose work I reviewed was working on a case in which petroleum had been detected in a municipal well located just off one of the busiest north/south streets in the town where our office was located. When I asked where he was in his pursuit of the case, he enthusiastically showed me the Yellow Pages and said he had the source narrowed down to one of three businesses: two gas stations and a bulk distributor, all on that busy street. I was taken aback, as I had expected to be shown a water-table map with the location of the contaminated well. Trying to hide my amazement, I asked what the ground-water flow direction was in the area of the city well, assuming he had just skipped over that part in an effort to impress me with the bottom line. However, he didn’t know and seemed unsure why I would ask that. I explained that if flow were to the northwest (away from those businesses), he was on the right track, but if it were in the opposite direction (toward the businesses), he was not.

Becoming interested, he wondered where he could find out the local flow direction. I referred him to a major U.S. Geological Survey report that had been out long enough to be a sort of bible on the region. I was frankly surprised that he didn’t have a copy on his shelf. I suggested it would contain some useful information and that the water-table map might be a good place to start. When I retrieved my copy and we pored over the water-table map, it was obvious he was looking for businesses on the wrong street! Tip: Before you go to the phone book, do your homework. Determine the hydrogeologic setting of your site. Just because there is a potential source of contamination nearby doesn’t mean it is the source.

Dr. Stone has more than 30 years of experience in hydroscience and is the author of numerous professional papers as well as the book, Hydrogeology in Practice – a Guide to Characterizing Ground-Water Systems (Prentice Hall). Feel free to argue or agree with him by e-mail: wstone04@gmail.com.
Did You Remember Your Units?

Michael J. Urban, MEM-1910

In addition to always remembering to include units whenever numerical data are provided in the classroom or industry, as the title of this article implies, one might also try remembering details about where some of these units originated or how they are derived. We often take these little letters -- and sometimes numbers -- following our numerical information for granted (e.g., cm, s, N, m/s², etc.). When was the last time you used dimensional analysis to solve a problem or reviewed the current definition for the “meter” or “second”? For some of us, units are always at the forefront of our brains, because we use them so much; for others of us, such mundane details daily fade deeper into the recesses of our minds. Dimensional units are not only imperative to geology and other sciences, but they can be interesting too, so let’s take a stroll down memory lane!

What is Measurement and What Kinds of Things Do We Measure?

In commerce, many quantities are important to measure: how much, how far, and how long. We can imagine the chaos ancient people experienced bartering with neighbors and other merchants having no common units of equivalence; so it was inevitable that a common system of quantities and units be developed. Using body parts for measuring, such as the length from elbow to finger (cubit), size of one’s foot (foot), and 1000 paces of a Roman legion (mile), were all common early on and illustrate the depth of human ingenuity and problem-solving capacity. Establishing common units took place over many hundreds, probably thousands, of years, and involved many different societies and ideas.

While some of the stories associated with the origins of measurement may not necessarily be completely and historically accurate, a few are entertaining (e.g., defining a yard as the distance from a king’s nose to his thumb when his arm is held out), and others curious (e.g., the arbitrary, royal decree that the mile be exactly 8 furlongs of 220 yards each). Until a commonly agreed upon system of measurement was established, variability existed and consequently, difficulties persisted for people. Even if the community in one region created a system, other neighboring communities may have developed independent and altogether different systems. Organized government eventually led to the adoption of consistent weights and measurements, and today, there is no more universally accepted system of measurement than the metric system.

English (U.S.) Customary and Metric System

Most familiar to the majority of Americans are the English or U.S. customary units, such as inches, pounds, ounces, and miles. Unlike the preferred base-10 decimal system of metric measurement adopted by scientists, U.S. customary units, or the inch-pound system, include a variety of bases (e.g., 12 and 16); although most of the widely used unit conversions are committed to memory by kids in high school across the United States, they are nevertheless cumbersome and inconvenient (i.e., 12 inches = 1 foot, 1 yard = 3 feet, 1 mile = 5280 feet, 1 pound = 16 ounces, 1 gallon = 4 quarts, 1 quart = 2 pints, 1 pint = 16 fluid ounces, etc.). The origination stories of many of these units are fascinating, and sometimes, intricate (e.g., why the mile is defined today as 5280 feet). The mission of humanity to create a universally accepted, convenient and easy to use system of measurement eventually led to the adoption of a decimal structure and incorporation of prefixes applicable to each base unit.

There are seven base quantities, and respective units, in the metric system as defined by the International System of Units (SI): length (m = meter), mass (kg = kilogram), time (s = second), electric current (A = ampere), thermodynamic temperature (K = kelvin), amount of substance (mol = mole), and luminous intensity (cd = candela). Each of these quantities is specifically defined and many have advanced toward greater levels of precision since their inception.

A significant goal over time has been to link these base units, as much as possible, to nature itself. The definition of the meter, for example, has evolved through a number of descriptions over the years, tracing its origins first to a portion of the circumference of the Earth; then eventually to the wavelength of radiation from krypton-86 lamps; and finally to its current definition related to the distance light travels in a vacuum over a certain amount of time. In like fashion, the second – originally a fraction of a mean solar day – has been most recently defined as the time for a transition of an electron between two energy levels of cesium-133. Other base quanti-

1. One furlong at 220 yards multiplied by 8 equals 1760 yards or 5280 feet (1 yd = 3 ft).
2. There are 12 inches in a foot; 16 ounces in a pound.
3. The United States is only one of very few countries in the world that does not use the metric system as the national standard.
4. By definition there is no “degree symbol” used when reporting temperature in kelvin (K).
5. Length of the meter is distance light travels in 1/299,792,458 of a second, which now also effectively allows for conversion between distance and time (critical to special relativity).
ties, like mass, progressed from the mass of a cubic centimeter of water at its greatest density (i.e., the gram), to a fabricated prototype with specific characteristics (i.e., the kilogram).

There are some units outside the SI, which can be used acceptably with SI measurements (e.g., min = minute, ° = degree, eV = electronvolt), and others, that are not acceptable for use with SI (e.g., atm = standard atmosphere, µ = micron, and U.S. customary units).

Derived Units

Units that are derived are simply those obtained through mathematical operation. For example, the metric unit for “area” is the square meter, because when determining area two numbers with metric units for length (e.g., 4 meters in one dimension and 3 meters in another dimension) are multiplied together (i.e., 4 m x 3 m = 12 m²). Volume (m³), acceleration (m/s²), and density (kg/m³) are all examples of derived units. There are also derived units having specific, acceptable, and approved formal names, such as hertz (Hz, s⁻¹), newton (N, N·kg·s⁻²), and radian (rad, m/m).

Dimensional Analysis

The metric system makes conversion and manipulation of units easier, but depending on the specific problem being worked, unit interaction can be complex and mistakes can be made. A useful process for diminishing the potential for unit mishap, and for assisting in the determination of correct units when working mathematical problems, is called dimensional analysis. This process works by diluting specific units (e.g., m/s²) into basic qualitative representations (e.g., acceleration, or [A]). Essentially, any physical quantity (e.g., length, mass, time, temperature, etc.) can be defined in generic terms, or dimensions, instead of units. For example, in the case of velocity (m/s), the dimension of length (m) could be assigned the capital letter [L] and time the lower case [t], allowing us to easily see that a stream of depth (d) 5 m and width (w) 10 m, having a velocity (v) of 0.5 m/s, would discharge (Q) in units of cubic meters per second. We would know this before working the problem out, permitting us to expect a certain unit for the answer and re-checking our work if we arrived at something different.

\[ Q = vdw \]

\[ Q = \frac{1}{2s} \cdot \frac{5m}{1} \cdot \frac{10m}{1} = 25 m^3/s \]

Such a simple verification of the problem above is hardly needed or useful (and, in fact, may actually be more confusing); however, the process is quite beneficial for complex operations or convoluted units. If you are designing a geothermal heating system, you might need to determine an equation for heat transfer rate given the temperature difference along a rod, length of the rod, and thermal diffusivity of the rod. In such a scenario, dimensional analysis would be valuable. The process is equally useful when completing inter-system unit conversions (e.g., customary to metric).

An entirely separate article could be written on rules for unit use and style conventions, but that discussion will be deferred to another time.

Featured Resource

The featured resource for this issue is the NIST Reference on Constants, Units, and Uncertainty at http://physics.nist.gov/cuu/Reference/contents.html. The site provides a wealth of background information and details about the International System of Units and its origin. In addition to elaborating further on much of the content covered in this article, the site goes into depth about SI rules and style conventions and more.

References


Geoscience Online Learning Initiative (GOLI) - AGI/AIPG

You, as an AIPG Member, are invited and encouraged to submit a presentation to be given online for the Geoscience Online Learning Initiative (GOLI). AGI and AIPG have teamed up to build a portfolio of online learning opportunities to help support the professional development of prospective and early-career geoscientists as well as addressing topics of interest to the broader geoscience profession. GOLI courses support both synchronous and asynchronous online learning, and count toward continuing education units (CEU’s).

A $200 stipend and 10% share of registration fees are provided to the presenters (details on presenters guide).

If you are interested please read the GOLI - AGI/AIPG Presenters Guide and Guidelines and Suggestions for Webinar Presentations on the AIPG National website (www.aipg.org).

AIPG

303-412-6205

www.aipg.org
This is my first column in *The Professional Geologist* as an actual professional geologist (in the employed, not quite the licensed, sense). Since my last writing, I have made the move to Denver, Colorado to take a position with an environmental consulting firm. Two months into the gig, I am starting to settle in—I think I know the names of at least 90% of the people in my office and I finally have my own place (waaaay too close to a great ice cream shop) with, thanks to David Abbott, CPG-04570, a lovely geological map of Colorado on the wall.

The feeling that I lucked out has yet to leave me. Everyone at my new company seems really helpful and happy, which is a great sign. Hired as an entry-level geologist, my time thus far has been mostly spent tagging along with the other geologists on site visits to learn the ropes, reading standards, and doing some internet data research. I have also spent a fair amount of time watching eagles and mapping prairie dogs, awakening my recently dormant inner biologist. I am OSHA certified, I am no longer cursing Microsoft Outlook, and I have the beginnings of a field toolbox. Things are looking good.

Though I would expect a new job, especially my first one out of school, to be stressful, the non-work related aspects of this move have been much more stressful than anything having to do with work. Finding my way around town, finding an apartment, waiting an hour at the DMV in my hometown was if the person in front of you was friends with the County Clerk.) then watching the guy at the DMV punch holes into my nearly-expired, oh-so-beautiful Kentucky license, and feeling the coming-on of spring with no garden to dig my toes in have all been immensely harder than navigating my new job environment. I am settling in, though. My apartment still needs a few essential items, including a Kentucky geologic map to match the Colorado one, but those will come.

My current position is a testament to the value of networking and mentoring offered through organizations like AIPG. I was introduced to my employer by David Abbott while I was in town for the national meeting. He and Sue subsequently offered their spare bedroom to me when I moved out here until I was able to secure my own place. Having their help and support through this transition has been incredibly invaluable. There has been a lot of talk lately about how to engage student and young professional members and I think this is an area definitely worth discussing. While offering a spare bedroom is likely not an option for most, dinner and some orientation tips can go a long way in easing the student to young-professional transition. I am envisioning a process (formal or not) by which graduating/recently graduated students could be connected to established members in the area they plan on moving to. Such connections could establish the mentor-mentee relationships that are arguably the lifeblood of a professional organization.

Being in a new and very different geological setting, new issues are making their way onto my radar. Since I am in transition and just starting to feel settled in, I have had no time to explore any of these issues beyond random conversations, a half an ear to the radio, and intermittent scans of a few out of control inboxes. I did manage to get to the past two *TPG* issues last week, which were very interesting and informative, and I am starting to make headway in my stack of newsletters that have made the transition with me and continue to build. Stories on the new Common Core and Next Generation Science Standards have caught my attention, as has this year’s extreme winter weather. Of course, there is also the chemical spill in West Virginia and the whole Russia-Ukraine-Europe natural gas dynamic. Geology finds its way into many facets of today’s news, and I am looking forward to doing a little more digging.

**Stephanie Jarvis, SA-1495, stephaniekjarvis@gmail.com**

**Transitions**

**Come Join Us**

The Association for Women Geoscientists’ 2014 Canadian Rockies Geology Field Trip is the field trip of a lifetime! The field trip is August 28 to September 7, 2014, and is based out of Calgary, Alberta, Canada. The 9-day main trip itinerary includes a classic geological transect through the Canadian Foothills to Main Ranges of the Foreland Fold and Thrust Belt, the geology of the Columbia Icefields Parkway, the Rocky Mountain Trench, and Crowsnest Pass areas, and a hike to the Burgess Shale. An optional 2-day trip to Dinosaur Provincial Park and to the Royal Tyrrell Museum can be added on to the end of the main field trip.

The field trip base fee is US$1700/person for the full 11-day field trip and US$1400/person for the 9-day field trip that does not include the Dinosaur Provincial Park/Tyrrell Museum option. Registration information is available on the AWG website at - www.awg.org/trips/index.htm. For more information about the field trip contact Debbie Hanneman at whgeol@gmail.com.
The other day I was walking home from campus. The previous week had been a mix of snow and below freezing conditions, so the fresh snow had a precarious layer of ice underneath, making walking quite difficult. It had snowed more the previous night, and so I was proceeding home with caution. Following the footsteps already imprinted in the powder, or at least trying to keep the same stride as the person who made these tracks, most likely someone taller than me, as I was having trouble keeping pace with the footprints. A snow flurry started to lightly drop from up above and I broke my concentration of looking down at my feet to watch the falling snow. I held out my ungloved hand and let the snow accumulate in my palm. Admiring the multitude of nearly perfect crystalline shapes for a brief moment, until the heat of my hand dissolved everything into a single solution. Winter has always been my favorite season; snow has a way of transforming your surroundings and making even the most mundane objects beautiful.

My affinity towards all things related to winter is greater than just enjoying the cold weather and admiring a fresh snowfall. Each passing winter is an opportunity to experience a sort of “seasonal mineralogy” (seasonal for at least most of the continental United States). Water ice is considered to be a mineral species and falls into the hexagonal crystal system. Like all minerals, water ice forms at specific pressure and temperature conditions, but its existence is more transient than the majority of minerals that are stable at room temperature (other exceptions to the definition of a mineral include liquid mercury). A friend of mine recently gave me an illustrated book on snowflakes and I was pleasantly surprised to read that snowflakes have garnered the attention of early scientists alike, such as Johannes Kepler (as in Kepler’s Laws which describe motions of the planets around the sun). Kepler was intrigued with tracing the origins of a snowflake’s symmetry and noticed a great comparison to the symmetry found in minerals. During Kepler’s time little advancement was made in the determination of the structure of a snowflake. It wasn’t until the evolution of modern X-ray crystallographic techniques that finally allowed scientists and interested thinkers alike a peak into the symmetrical arrangement of molecules that makes up the foundation of these macroscopic crystals. With each instance of fresh snowfall, different snowflake morphologies can be observed depending on the temperature and humidity of the surrounding environment. The morphology of a snowflake can fall anywhere along the spectrum, ranging from plain needles, to simple 6-sided hexagons, to delicately branching 6-sided dendrites; each unique morphology reflecting the complexity (or lack there of) of a snowflake’s unique journey down to the earth’s surface. Being a young scientist during today’s time when molecular-scale crystallographic determinations can be made without much difficulty makes me thankful to be able to take advantage of this technology for my own research. I can’t imagine in the past how whole dissertations were made on just doing the crystallographic refinements of one or two minerals, whereas today, that information can be theoretically generated using various computer programs in just a few minutes.

Talking about snowflakes makes me think of the commonly heard phrase “no two snowflakes are alike.” Indeed, snowflakes can have similar appearances, and when synthetically created can share even more similarities in their form. Ultimately, there are always going to be slight differences between each snowflake, whether it is inconsistencies in crystal axis lengths, small chemical impurities, or crystal intergrowth offsets. This concept can be also applied to all of the other minerals, especially in teaching hand sample identification to students, who often experience confusion when equating mineral properties listed on database sites to properties seen in their own hand samples. Minerals, like most everything naturally-occurring on this earth, are direct products of their environments of formation, and samples used in the classroom are not going to be as well-developed (for the most part) as reference mineral samples, like how the appearance of snowflakes can be widely variable. I believe that mineralogy is one of the most (if not the most) integral courses of the geology discipline. The understanding of the formation of minerals and taking a closer look at their symmetry allows scientists to quantify what properties of the mineral make it unique and how can this information be used to further our insight into the applications of that mineral.

As I look back outside upon the completion of this article, there has been a drastic change in the weather. No longer can I see passers by gliding through the pristine snowfall, but instead I see snow except for some dirty snowdrifts left over from the street plows. The wonder of winter slowly fading away with the melting of each last flake of snow, but winter has been a variable season lately. By the end of the week I’m sure there will be a shift in the weather, and these above freezing conditions and rain will soon drop and the white winter will again resume.
Hurricane Sandy Inland Water Damage in the NY - NJ Metropolitan Area - A New Perspective on the Nature of Urban Flooding in the Northeast United States

Nicholas K. Coch, Ph.D., CPG-06419
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Queens College Of C.U.N.Y.

Introduction

Hurricane Sandy (2012) resulted in unprecedented water damage from submergence in floodwaters as well as the impacts from water-borne debris. The great damage (more than $50 Billion) was not only a function of the power of the storm and the great development in the region, but also the unique geologic and topographic factors that amplified surface flooding. The reasons for the greater surface flooding in Hurricane Sandy are the subject of this paper.

Most Sandy flooding reports in New York City attribute all of the damage to salt water surge. However, my field studies, and the photographic and videotape documentation of others, suggest that both fresh water flooding and debris impact were significant components of the damage. In reality, the flooding was not simple submergence, but involved increased fluid forces resulting from the movement of that water.

This article focuses on freshwater flooding and its interaction with the salt water surge at the coast. It examines flooding damage components and considers the mitigation actions needed to reduce future auto and structural losses.

Nature and Relief of the Land Surface in the Northeast United States

The geology and topography of the coastal areas in the Northeast United States are very different from the rest of the hurricane-prone coasts in the Southeast and Gulf of Mexico regions. In addition, much of the land surface has been paved in northeast urban centers. The Northeast is characterized by mountains and hills rather than the gently sloping coastal plains to the south.

Major factors in the development of flooding conditions are: 1) the nature of the surface (bedrock, sand, and pavement), 2) the rate of rainfall and, 3) the slope of the land surface. Three of New York City’s five boroughs (Manhattan, The Bronx and Staten Island) are underlain by relatively impermeable bedrock. The other two boroughs (Queens and Brooklyn) are underlain by glacial sands and a sandy coastal plain on the south shore of Long Island (Figure 1). However, the normal permeable nature of the sandy areas has been greatly reduced by paving.

Building of New York’s extensive street grid (north-south avenues and east-west streets) in the early part of the 19th century resulted in lowering high areas and filling in low ones (Walsh, 2006). The marked relief of the bedrock in New York City is important because the steeper the land surface, the faster is the surface water flow velocity. In northern Manhattan and the Bronx, the relief is so marked that it requires long staircases for people to move from the low areas to the high areas. A number of intermittently passable (to autos) “stepped streets” (Walsh, 2006) are required for people to walk from the low to high areas of the northern Bronx and Manhattan (Figure 3).

These marked elevation differences are less apparent in the heavily developed lower half of Manhattan. However, some
large-scale relief changes in lower Manhattan have survived development. As a child growing up in the Bronx (Bronx County), I remember the water torrents that would pour down those long stairs (Figure 3) in a heavy summer afternoon rainfall. The limited capacity of New York City’s combined sewers would cause the surface waters water to pool in the low areas.

Why is Hurricane Flooding Greater in the Northeast?

Sandy’s landfall 100 miles to the south of the city resulted in relatively low rainfall in New York City (Halverson and Rabenhorst, 2013). However, most hurricanes making landfall closer to the city are accompanied by higher rainfall. If the rainfall rate exceeds the rate of ground surface infiltration, the excess water will flow downhill across the surface and pool in the low areas. The prevalence of bedrock, rather than sediment, at the surface, greatly increases the flash flooding potential in the Northeast (Figure 4).

In an urban area, concrete and asphalt can cover from 20% to 90% of the land surface. The extent of paved surfaces versus open vegetated areas in the N.Y. - N.J. metropolitan region can only be appreciated in a satellite view (Figure 5).

Paved surfaces in urban areas are totally impermeable and surface discharge increases rapidly. Where sloping surfaces are paved, the velocity of the floodwaters can be appreciable. (Figure 6).

New York City has grown considerably by filling in the margins of its waterways (Nevius and Nevius, 2009). Walsh (2005) identified 45,500 acres of land filled since colonial times. Major landfilling in the southern boroughs of New York City occurred between 1924 and 1957 (Figure 7). These filled lands have subsided due to compaction, and were major sites of both fresh water (rain) and salt-water flooding during Hurricane Sandy.

Fresh Water Flooding

New York City is far different from what it was in colonial times. The recently completed Mannhatta Project (Sanderson, 2012) has given us a detailed picture of the massive hydrologic and topographic changes that have taken place in 300 years of development (Figure 8).

Southernmost waterways were filled as the small (in 1800) city grew northward. All the former streams in Manhattan were filled by the middle of the nineteenth century during development of the innovative street grid system (east-west
streets and north-south avenues). With the streams gone and more and more of the city paved over, there are now very few places for rain to infiltrate into the ground.

New York City is no stranger to crippling freshwater flooding by summer convective storms and nor’easters. The December 1992 nor’easter illustrated that even moderate storms can cause significant flooding, especially if they occur during a high tidal cycle (Cole et al. 2008). On August 27, 1999, three inches of rain in two hours submerged low points on arterial highways and flooded the subways creating major transport problems (New York Times, 1999). Another nor’easter in 1994 caused freshwater flooding that closed the FDR Drive along the East River. Low points were flooded by as much as four feet of water, which stranded about 50 cars and required SCUBA divers to rescue some of the drivers! (National Weather Service, 1994).

In 2011, Upper New York State and New England sustained catastrophic flooding during Hurricane Irene. The flooding resulted from orographic rainfall that occurred as Irene moved over the mountains of the Northeast (Coch, 2012a). There was considerable flooding in New York City as well (Coch 2012b). The glacial moraines of Long Island (Figure 1) were sufficiently high to initiate a detectable increase in rainfall (Coch, 2012a).

Coch (1994, 2012b) speculated on the effects of a very wet hurricane passing across the New York-New Jersey Metropolitan Area on a coast-normal track. Hurricane Sandy made the demonstration. After Hurricane Sandy, I reviewed numerous photos of street flooding in areas located at the inland edge of the salt-water incursion. Based on personal familiarity with those areas, I realized that the flood levels there were somewhat higher than predicted by Sandy’s surge levels alone (Figure 9).

How could higher-than-average flood levels be achieved during hurricanes and tropical storms? My hypothesis is illustrated in Figure 10. In hurricanes, where fresh water meets salt water, there would be a zone of anomalously high water at the junction (Figure 10).

I am inferring that the difference in predicted and actual flood levels resulted from fresh water additions to the water column because flood levels were higher than predicted by salt-water surge level predictions alone. However, this is only an inference. Conducting salinity and water depth sampling of floodwaters at various stages in a future urban hurricane landfall could add substance to the hypothesis. However, it may be difficult to get volunteers for such a study.

**Flood Velocities**

Examination of videotapes shows that Hurricane Sandy flooding, in many cases, was not just a simple gradual submersion in quiet waters. In that case, structures would be simply subjected to the mass of the rising water. However, vehicles clearly exhibited collisions with each other (Figure 11) in waters that were being driven down slope by gravity (freshwater) and hurricane winds that were driving a salt-water surge inland.

Wind-driven waves formed on floodwaters in lower Manhattan (Figure 12). Fixed structures such as doors, windows and walls will fail under the force of wind-driven waves, unless suitably reinforced.
Flood Damage Mitigation

A wide range of projects has been proposed to limit future flooding damage in New York City. Some are limited in area and cost, and deal with protecting only critical facilities such as power plants, roadways, and transit entrances.

Other concepts deal with protecting whole sections of the city. One large-scale proposal is to build a series of massive surge barriers within New York Harbor (Hill, 2012). My objections to this mitigation proposal are presented in Coch (2012c). In this paper I will concentrate on mitigation measures for fresh water flooding in the Northeast. The problem of coastal surge and wave action will be discussed elsewhere.

As discussed above, major storms and hurricanes in New York City have closed many arterial highways, such as the FDR Drive and the Belt Parkway, by flooding across low segments of the roadway. These low areas are known as “choke points.” Once a choke point develops, that route is useless for subsequent transport. Choke points most commonly develop as a result of saltwater flooding or combinations of saltwater and freshwater flooding, which was common during Hurricane Sandy. However, freshwater alone has created choke points in past New York City hurricanes (Figure 13). The photos in Figure 13 illustrate freshwater flooding in the Borough of Queens. These areas are underlain by glacial sands (Figure 1) with a high infiltration rate; however, the flooding areas are surrounded by paved surfaces that limit infiltration. This is the essence of urban freshwater flooding.

Choke points are serious impediments to both evacuation and post-storm relief efforts. These vulnerable areas can be protected either by raising the level of the roadways or building floodwalls. It is vital that the floodwalls are of adequate strength to resist flood pressures and high enough that their tops exceed any past flood levels.

Massive street flooding may be infrequent, but in a major coastal urban center such as the New York City metropolitan area, the consequences can be catastrophic. It is vital to protect critical structures such as hospitals and power plants. During Hurricane Sandy, street flooding destroyed the lower levels of two major hospitals along the East River. Millions of dollars of diagnostic medical equipment was destroyed in hospital basements and the patients had to be transferred to other facilities at higher elevations. Manhattan was plunged into darkness during Sandy when the floodwall was overtopped in Con Edison’s 14th Street generating plant. Power was cut to avoid equipment damage. The flooding of this one power facility cut the power to most of lower Manhattan (Figure 14). Tens of thousands of people were trapped for days in high-rise buildings without electricity.

Over 250,000 vehicles were destroyed by flooding in Hurricane Sandy (D. Hermanek, personal communication 2013). Removing the damaged and flooded vehicles to concentration centers was a major logistical task (Figure 15).

New York City is an area with high topographic relief. A simple solution to flooding damage to vehicles is to move them to higher areas, just as we do for inhabitants of frequently inundated areas. There will be abundant parking spaces in inland commercial areas when the hurricane makes landfall.

CONCLUSION

Review of photographic and videotape data, plus field observations, have provided a new perspective on the nature of hurricane flooding in a densely developed urban coastal center. The role of fresh water flooding has been underestimated in paved, northern urban centers underlain by bedrock. The confluence of gravity-driven fresh water and a wind-driven saltwater surge can create anomalously high water levels where the two meet. Water damage is not simply the result of static
pressure from slowly rising waters, but the additional forces resulting from movement of those waters. Structural surfaces (doors, bulkheads, floodwalls) must be reinforced to resist the total force of the static water column and its motion.

Understanding the mechanics of coastal flooding and applying appropriate mitigation can significantly reduce hurricane induced flooding in urban areas. Hurricane Sandy has shown that massive urban flooding may be infrequent but it will have great consequences in the bedrock urban centers of the Northeast. Sea level is rising at a rate of about a foot per century in the greater NYC Metropolitan Area (Rosensweig and Solecki, 2001) and the flooding problem will only increase with time. We must start the necessary planning to reduce flooding damage in urban areas.

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Nicholas K. Coch, CPG-06419, received his Ph.D. in 1965 from Yale University with a specialization in sedimentology and coastal geology. In 1967, he joined the faculty at Queens College and the CUNY Doctoral Faculty in Earth and Environmental Sciences. He is now a Professor of Geology in the School of Earth and Environmental Sciences at Queens College of C.U.N.Y.. He has co-authored two college geology textbooks (Physical Geology) and is the author of Geohazards (Prentice Hall). In 2008 he received the Presidents Award for Teaching Excellence at Queens College, and the John Moss Award For Excellence in College Teaching from the National Association of Geology Teachers. He is a Fellow of the Geological Society of America and a Member of The American Meteorological Society, Society of Sedimentary Geologists, National Association of Geology Teachers, American Association of Petroleum Geologists and is a Certified Professional Geologist.

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How to Safely Share the Road With Cyclists
By Lee Michael Katz

Pedal power is growing all over the country. Bike lanes are popping up everywhere and bike-riding has more than doubled in some cities. But the mismatch between a massive vehicle and a lightweight bicycle frame can have tragic consequences. Here are some ways to reduce the danger when sharing the road with cyclists:

- **Defensive driving extends to bikes.** You drive a safe length behind other motorists, so don’t ride the bumper of a bike. Leave adequate space for you to react—this is especially critical when passing a bicyclist.
- **Yield—and watch out for bicyclists who don’t.** Failure to yield by both motorists and bicyclists accounts for nearly 25% of collisions. Bicyclists can easily miss stop signs, so take extra care in bike-riding areas.
- **Pay extra attention to hidden bicyclists.** With their small profile, bikes won’t show up nearly as easily as a vehicle in your mirrors. For example, when turning right, check the curb lane and check over your right shoulder so you don’t cut off any bicyclists.
- **Open doors carefully.** Your vehicle doors may open into a bike lane or travel path, so be careful when opening your doors. The last thing you want to do is knock over a passing cyclist.
- **Return the favor when biking.** When you’re pushing the bike pedals instead of the gas, don’t zigzag between cars and signal with your hand when turning. You have the same responsibility to obey traffic laws on your bike as you do in your car.

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I recently retired after having worked 41 years as a geologist with the US Geological Survey. We moved to Arizona, where we live right across the street from our only child, our son-in-law, and our two grandkids. I had figured this would be a pretty good place to apply my trade and start my own consulting business.

The State of Arizona requires geologists to be licensed and registered with the state. An applicant is required to take two national tests administered twice a year by the National Association of State Boards of Geologists (ASBOG). The first test, the Fundamentals of Geology, is meant to determine your general knowledge of the subject, and commonly is administered to recent geology graduates just starting in the field. If you pass that test you are eligible to take the Practice of Geology exam, which evaluates your capability to properly and ethically conduct projects. Somewhere in this process you also need to work on geological projects under three different registered geologists.

I used to think I was a geologist. Surely with 41 years of geological experience with the USGS, the State would recognize me as a geologist. Although the USGS does not require ASBOG testing or registration it does have pretty strict regulations for being classified and promoted as a geologist. And not to brag, but I had a pretty darn successful career.

I called the Technical Registration Board and asked if I could be “grandfathered in.” No such luck.

Not one to give up easily, I scrutinized the regulations and discovered that the board CAN exempt an applicant from the testing and/or experience requirements. The regulations do not tell you how to petition the board, so I made up my own approach. I submitted: 1) The AZ application form; 2) an affidavit stating why I have not worked for three licensed geologists; 3) three evaluations of me and my work from USGS supervisors; 4) a resume; 5) my bibliography; 6) copies of three publications that demonstrate the breadth of my experience; 7) a copy of my AIPG certification; 8) transcripts from my alma mater; 9) the registration fee; and 10) a cover letter explaining that the regulations did not say how to petition the board, so this is what I am sending them.

I received a response stating they had received my application and to check back IN WRITING in a month to make sure they had all the necessary material needed to make a decision. I checked back in writing in a month. No response. I checked back in another month. No response. I checked back in yet another month. No response. Frustrated, I went one step up the food chain, and checked with the supervisor. I received a prompt response saying they would submit my package to the Board that month. A month later (June) I received a letter saying my experience with the USGS was acceptable, that I did not have to take the FG test, but I had to take the PG test that was being administered in early October. Not quite what I had hoped for, but a lot better than a sharp Jacob’s staff in the eye.

I figured I would be quite embarrassed if I did not pass the test, so I went into OCD study mode. I bought three different study guides and downloaded the ASBOG guide. I studied for at least two hours nearly every morning and three hours almost every evening seven days a week for three months. I read the study guides cover to cover. One study package consisted of flash cards that I loaded into my Smartphone. I could look at the questions whenever I had spare time, and could delete them once I was sure I understood them and knew the answers.

All the study guides contained errors and blunders. Fortunately my work at the USGS exposed me to a wide variety of geologic disciplines. Nevertheless, I was compelled to go to other sources to research topics when I thought the study guides were in error.

Part of my study process involved taking six practice tests. I think that helped a bunch. Mind you, the only tests I have taken in the past 40 years were for blood or urine. I had completely forgotten HOW to take a test. I had to learn to read EVERY answer, not just take the first one that seemed right. I had to learn to try to determine if an answer was WRONG so I could eliminate it. I also learned to be careful. When I took some of the first few tests I knew the right answer but was careless and circled the WRONG one on the answer sheet. Pretty stupid thing to do.

My wife Pam just watched in disbelief as I spent all this time studying. But she still supported me through the lengthy process. She even suggested I make a dry run to the testing facility, which was a good idea. The building was unmarked and hard to locate. It was equally hard to find the entrance to the building. I would have been a nervous wreck if I did that just before the exam.

Six people took the exam here in Phoenix. I was at least twice as old as any of them. The first few questions were way outside my wheelhouse. Arrrrgh. But I didn’t freak out and soon came upon many questions on familiar subjects.

The exam lasted four hours. Just like practice, I read every answer and eliminated the wrong ones. I made sure the one I chose was the best fit. And, taking the advice of my friend Nyal, I did not over-think the questions.

I had a half an hour left at the end, so I checked to make sure I had circled the intended answer on the answer sheet and had not been sloppy. When I left the building I was confident I had passed the exam, but who knows....

Two months later I received a letter from ASBOG. I passed; handily.

I credit my aggressive studying. I question if I would have passed the exam without all that work. Not that I became any smarter; I became more prepared.
Now I can officially practice geology in Arizona. And many other states that require geologists to be licensed will accept the ASBOG results for the AZ test and will issue a license just for a fee. No more tests like that -- EVER.

BAZINGA! Now I am a geologist.

Bill Langer, CPG-01152, is a consulting geologist and principal of Bill Langer Research Geologist LLC. He was a research geologist with the United States Geological Survey (USGS) from 1971 until his retirement in 2011.

AIPG Member Honored for Leadership in Water Policy in Alabama

On February 6, 2014, AIPG Member Bennett L. Bearden, CPG-07700, was honored for his leadership in water policy in the State of Alabama. Governor Robert Bentley presented a Certificate of Recognition to Bearden for advancing water policy in Alabama as Chairman of the Alabama Water Agencies Working Group (AWAWG), the Governor’s task force for developing a statewide water management plan. Bearden chaired the AWAWG from April 18, 2012 to December 1, 2013. Bearden continues to serve as a Special Counsel on Water Law and Policy to the Governor’s Office and a policy advisor to the AWAWG. Bearden is Director of the Water Policy and Law Institute at the University of Alabama. He holds a doctorate (JSD degree, 2011) in water law and policy from McGeorge School of Law, University of the Pacific. He received his Juris Doctor degree (Summa Cum Laude) from Birmingham School of Law in 1992 and his Master of Laws degree in Commercial and Corporate Law (with honors) from the University of London in 2006. He received his Bachelor of Science in Geology degree (1981) and Master of Science degree (geology, 1984) from the University of Alabama. Bearden served as Special Counsel to the Office of the State Geologist of Alabama at the Geological Survey of Alabama (GSA) from 2008-2013 and chief counsel for GSA’s Water Team. He is the co-author and co-editor of a leading casebook on water law and policy, *Cases and Material on Water Law*, 9th edition, published by West Publishing Co.

LBG Names Four Associate Vice Presidents

Shelton, CT – February 4, 2014 -- Leggette, Brashears & Graham, Inc. (LBG), a professional groundwater and environmental engineering services firm, has named Sean Groszkowski, CPG-11657, Darrick Jones, Brian Kimpel, CPG-08818, and Steve Rayburn Associate Vice Presidents.

Based in the firm’s White Plains, New York office, Mr. Groszkowski manages environmental projects with multi-million dollar construction and remedial costs that cross a wide spectrum of environmental disciplines, including regulatory compliance, hazardous waste investigations and cleanups, hydrogeological investigations, environmental assessments, contaminant fate and transport modeling, and litigation support. He specializes in management of inactive hazardous waste and site remediation under the New York State Brownfield Cleanups Program (BCP). Mr. Groszkowski holds a B.A. degree in geosciences, from Franklin & Marshall College. He is a Certified Professional Geologist with the American Institute of Professional Geologists. Additionally, his technical affiliations include the Association of Ground Water Scientists and Engineers (National Ground Water Association), and the American Academy of Environmental Engineers (AAEE).

Mr. Jones is a geologist in LBG’s Farmington, Connecticut office with 19 years of consulting experience in geology, hydrogeology, environmental site assessment and remediation. He is a Licensed Environmental Professional (LEP) in the State of Connecticut and has performed environmental assessments across the East Coast states. His core business practice includes transaction consulting, site development related work, Connecticut Transfer Act site assessments, and litigation support. In addition, he has extensive experience with underground storage tank removal and replacement, Connecticut Transfer Act filings, land use permitting, contaminated soil disposal permitting, and LEP verifications. Mr. Jones holds a B.S. degree in geology from the University of Connecticut.

Mr. Kimpel manages LBG’s offices in Madison, Wisconsin and Freeport, Illinois. He has more than 25 years of environmental consulting experience, with expertise in soil and groundwater assessment and remediation, landfill permitting and compliance, petroleum and pipeline services, and environmental due diligence. A Certified Professional Geologist and Licensed Geologist in Illinois, Wisconsin and Tennessee, Mr. Kimpel earned an M.B.A. from Northern Illinois University and a B.S. degree in geology from Illinois State University. He is a member of the American Institute of Professional Geologists.

Mr. Rayburn heads the environmental services operations in LBG’s Houston office, providing comprehensive environmental consulting services for oil and gas sector clients in Texas and throughout the Southwest. He has over 20 years of environmental consulting and management experience, including work on large due diligence projects for major oil and gas, pipeline, and industrial acquisitions as well as numerous multi-phased site investigations and remediation projects throughout the country. Mr. Rayburn holds a bachelor of science degree in natural resources and wildlife from Texas A&M University.

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AWARDS ANNOUNCED

2014 J.P. Gries Geologist of the Year Award Announced

March 19, 2014 – The South Dakota section of the American Institute of Professional Geologists (AIPG) has named South Dakota School of Mines & Technology professor Dr. Colin J. Paterson as 2014 J.P. Gries Geologist of the Year. The award is named in honor of Dr. John Paul Gries, a longtime geology professor at the School of Mines.

Dr. Paterson, a native of New Zealand, earned Ph.D. and B.Sc. (Honors) degrees in geology at University of Otago in 1978 and 1972, respectively. He inherited his love of the outdoors, sports, and geology in the majestic terrain of the South Island of New Zealand. While attending university there, Paterson interned with mineral exploration companies, completed his Ph.D., and then took a position as lecturer in economic geology at the University of Cape Town in South Africa (where he fine-tuned his squash skills), and used these educational and research experiences to launch an academic career in North America.

Dr. Paterson currently serves as professor of Economic Geology at the School of Mines, where he has remained a faculty member of the Department of Geology & Geological Engineering for the past 32 years. In this position, he has educated thousands of undergraduate and graduate students in geology, many of whom have gone on to achieve success in the mineral industry in North America and elsewhere around the world. Dr. Paterson has led geology field camps and trips for college students in the Black Hills, Turkey, Spain, Hawaii, New Zealand, and the southwest United States. He has published over 30 professional papers in the field of geology.

Dr. Paterson has made many other exceptional contributions to the field of geology and the environment, a few of which are listed below.

- Following a 1993 NASA Space Grant-funded summer faculty internship at USGS EROS Data Center, Paterson helped develop the first undergraduate and graduate classes in Geographic Information Systems (GIS) at the School of Mines.
- Chairman, Dept. of Geology and Geological Engineering at School of Mines from 1995-1997.
- Director, Black Hills Natural Science Field Station (geology field camp) from 1999-2005.
- Co-founder and President of the Norbeck Society, Inc., an advocacy group for stewardship, restoration, and enjoyment of public lands in the Black Hills.
- Founder and advisor of “Norbeck Uni” and “Society of Economic Geologists”, student organizations at the School of Mines.


Dr. Robert D. Hatcher Awarded Marcus Milling Legendary Geoscientist Medal

Alexandria, Va - Robert D. Hatcher Jr., Distinguished Scientist and Professor at the University of Tennessee-Knoxville and former President of the American Geosciences Institute (AGI), was unanimously approved by the AGI Executive Committee to receive the 2014 Marcus Milling Legendary Geoscientist Medal.

This award honors a lifetime contributor of high quality scientific achievements and service to the Earth sciences, and the Selection Committee’s nomination report highlighted his achieving legendary status for his lifetime of commitment to field mapping-based research, combining the latest geophysical, geochemical, isotopic and modeling techniques.

“It is both humbling and a great honor for me to receive the 2014 AGI Marcus Milling Medal,” Hatcher said, “I had the privilege of knowing Marcus Milling since before he became Executive Director of AGI, and have long admired his leadership abilities and creativity. Being named the 2014 recipient of this medal came as quite a surprise to me and I am very grateful to join the list of other recipients to receive this honor.”

Hatcher is also well known for his extensive research on the geologic structure and history of the Appalachians, which has included mentoring and inspiring students during his many field trips and authoring over 200 scientific publications, including 9 books. Dr. Hatcher will receive this medal at the awards ceremony on April 6, 2014, in Houston as part of the American Association of Petroleum Geologists annual meeting. He will also receive recognition at the AGI Past Presidents Dinner being held on April 5.

Dr. Hatcher has served on several Geological Society of America (GSA) and National Academy of Science committees. He has been President of GSA(1993) and has held additional leadership positions at GSA, AAPG and AGI and convened three GSA Penrose Conferences. A Penrose Conference to be held this spring will honor his career. He was also honored with the AGI Ian Campbell and GSA Penrose medals in 2006. He earned his B.A. and M.S. degrees in geology and chemistry in 1961 and 1962 respectively from Vanderbilt University and his Ph.D. in 1965 in structural geology from the University of Tennessee-Knoxville.

The committee ended its nomination with “Dr. Hatcher’s love of geological research and appreciation of how it can be used to benefit society has been passed on to the students he’s mentored in his career and to those who took his classes.”
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A Rapid, Inexpensive and Portable Field and Laboratory Method to Accurately Determine the Specific Gravity of Rocks and Minerals

Dr. Uwe Richard Kackstaetter, MEM-2437, Metropolitan State University of Denver, Dep. of Earth & Atmospheric Sciences

Abstract
Advances in load cell weighing scale technology now enable rapid specific gravity (SG) measurements of varied specimens using portable systems. This investigation demonstrates that the use of small consumer scales, coupled with a hydrostatic method of direct buoyancy displacement measurement for volume, yields a resolution high enough to make these inexpensive balances applicable for serious geologic field and laboratory work. Precision in SG determination of over 95% and accuracies within the 99th percentile established during this study rival sensitive precision analytical laboratory balances, provided that the scales have a minimum resolution of 0.01g. The ease of use, accuracy and portability of this system allows for rapid, quantitative, systematic density determination of geologic materials.

Key-Words: specific gravity, density, minerals, rocks, field method, hydrostatic measurement, load cell balance, electromagnetic balance, precision, accuracy

Introduction
Hydrostatic measurement of specific gravity (SG) in rocks and minerals is not new. One of the earliest precision instruments for measuring the density of materials was the Jolly Balance, invented by German physicist Philipp von Jolly in 1864 (Jolly 1864). Berman (1939) contributed a torsion microbalance capable of measuring minute mineral samples with an accuracy of 0.01mg or 1.0 x 10⁻⁵g. Modern laboratory techniques commonly rely on pycnometer methods for specific gravity determination of soils and small particles. Hydrostatic methods are customary in the jewelry and gem industry, sometimes with elaborate and expensive set-ups using precision analytical balances (Read 2012, p.58-62). All of these methods are, unfortunately, confined to laboratory settings. Thus, specific gravity as an added tool for mineral identification in the field has always been relegated to approximation by simply hefting a sample and identifying the density as either high, intermediate or low (Klein and Philpotts 2012, p.53).

Major advances in weighing technology have not only lowered prices of balances drastically, but as with most electronics, the size of these instruments has been also significantly reduced. Precision weighing electronics can be inexpensively mass produced and have found their way into low cost consumer scales, a development that appears to have escaped the notice of geological scientists. The small size, built-in calibration modes, and portability point toward a good candidacy for fieldwork. The following study investigates the applicability of small, inexpensive, field portable, electronic consumer balances for accurate quantitative determination of rock and mineral specific gravities in the field. In conjunction, a simplified approach was also developed to use said scales without any additional specialized materials, such as tripod stands or calibrated pycnometers, making the whole system very versatile and robust for a multitude of applications.

Method
In general, two types of weighing mechanisms are employed in electronic scales. Precision laboratory analytical balances use an electromagnetic balance system in which the counterweight on a fulcrum-beam is a measurable electromagnetic force. Less expensive electronic scales use a load cell which consists of an electrical resistance system mounted to an elastic aluminum body (Electromagnetic Type and Load Cell Type : SHIMADZU (Shimadzu Corporation) n.d.). For electromagnetic balances, internal electronics translate the amount of the electromagnetic counterbalance force into a digital, calibrated read-out. While these types of scales boast a very high precision and resolution, the internal fulcrum and associated electronics make them large and more sensitive to transport and changing environmental conditions.

Load cells on the other hand can be very small, allowing for balances the size of credit cards. As weight is placed on the scale, the load cell deforms, thus changing the internal electrical resistance. This in turn can be translated into an associated weight readout (Load Cell and Weigh Module Handbook - A Comprehensive Guide to Load Cell Theory, Construction and Installation 2010). Because the mechanism and electronics are very simple, these types of scales are fairly inexpensive. The inherent drawback has been a lower resolution and limited accuracy. However, in recent years small load-cell type portable scales have been marketed with a capacity and resolution of 300g x 0.01g to 60g x 0.01g. Using these portable balances while simplifying the density measurement approach should yield quantifiable, rapid, useful specific gravity data for rocks and minerals.

Specific gravity is a weight-to-volume ratio expressed in the metric system as g/cm³ or kg/m³, calculated according to SG=V/W.

The measurement of the weight of a specimen usually does not pose a problem. Obtaining exact volumes, however, can be challenging. One of the simplest procedures to accurately
The volume of a specimen is based on the Single Pan Hydrostatic method (Read 2012, p.60-61) employing the Archimedes principle.

As illustrated in Figure 1, an object submerged in water will displace the same volume of water as the volume of the object, hence \( V_{\text{object}} = V_{\text{H}_2\text{O displaced}} \). The weight of the displaced water is equal to the buoyant force acting on the submerged object or \( W_{\text{H}_2\text{O displaced}} = F_B \). Using the concept of equal and opposite forces, \( W_{\text{H}_2\text{O displaced}} \) displaced is added to the system of beaker, water, and suspended object. Thus, if a scale is employed, \( F_B \) and therefore \( W_{\text{H}_2\text{O displaced}} \) displaced can be measured directly. The density of water given as 1.0 g/cm\(^3\) makes it possible to easily convert the weight of displaced water into the volume of the object according to \( W_{\text{H}_2\text{O displaced}} = V_{\text{H}_2\text{O displaced}} \). Hence the direct reading of the displaced volume of the object, \( V_{\text{H}_2\text{O}} \), equals the volume of water as the displaced object as volume (V).

**Materials needed**

The following materials are involved for the determination of specific gravity in the field:

1. PorTable load cell electronic scale with gram readout, tare function and a capacity to resolution of at least 100g x 0.01g
2. Calibration weight for the balance
3. A lightweight 125mL plastic specimen cup with lid
4. About 30 cm of fine string or yarn. Nylon monofilament preferred. For increased accuracy when measuring small specimen, use Nylon-12 type monofilament fiber (very difficult to obtain)
5. About 100mL of water
6. (Optional) Calculator or Nomograph (see Appendix) to quickly compute specific gravity from measurements

**Procedure**

**Step 1:** Balance is turned on and calibrated according to instructions. Since the electronic load cell will be influenced by temperature and vibrations, calibration is imperative when starting a measurement series, especially in field applications. It takes only a few seconds and most balances will have a user friendly autocalibrate function.

**Step 2:** Use a homogenous specimen and weigh in grams on balance. Record measurement as \( W_{\text{air}} \).

**Step 3:** Tie slip knot into string or thread and attach specimen to string.

**Step 4:** Fill plastic container with water and place on scale. Use tare function to reset balance to zero.

**Step 5:** As shown in Figure 2, submerse specimen in container while holding the string. Make sure the sample is completely submerged and does not touch bottom or side of container. **Caution:** Air bubbles may cling to the specimen and can falsify readings considerably if not removed, particularly when measuring smaller samples. To dislodge air bubbles, submerge specimen repeatedly until bubbles are alleviated. Record this reading of the submerged material as volume (V).

**Step 6:** Calculate specific gravity by \( W_{\text{air}}/V \) or use nomograph (see Appendix) to obtain results. **Note:** Incredibly, the entire measurement process including set-up and calibration should take no longer than 2 minutes.

**Experimental Set-Up**

In order to test the validity of this rapid field specific gravity method, a sampling of four different inexpensive consumer load cell balances from “US Balance - Wholesale Digital scales manufacturing and distributing (www.usbalance.com)” was used as indicated in Table 1. An Ohaus Adventurer Pro AV264 precision analytical balance acted as reference standard for this test series. Identical measurement procedures were utilized for all five scales with the exception of averting calibration for the Ohaus AV264, since electromagnetic balances do not require frequent standardization.

Test specimens for specific gravity determination consisted of five varied quartz samples (2.65 g/cm\(^3\)), four impure barite pieces with a measured SG of 4.17 g/cm\(^3\) and four topaz specimens from the same source with a specific gravity of 3.53 g/cm\(^3\). The selected sample size for testing was based on most likely scenarios expected in the field, ranging from about 22g and 8.3cm\(^3\) to roughly 1.5 g and 0.4 cm\(^3\) specimens. The four consumer load cell scales were calibrated and measurements were performed according to the procedure listed above. Specific gravity was then calculated according to measured \( W_{\text{air}} \) divided by obtained \( V \).

**Results and Discussion**

In order to validate the application of this method, both precision and accuracy were calculated from the test series results for each individual scale. The averages of this assessment are listed in Table 1.
Precision is defined as “repeatability” of measurements or “spread of results” (Accuracy, Error, Precision, and Uncertainty n.d.). It can be calculated as

\[
\text{PRECISION} = \frac{\text{High} - \text{Low}}{\text{Average}}
\]

where the difference of the highest to lowest value of a measurement series is divided by the average of the data in the same measurement series. Values were established for the three independent minerals tested as well as the overall mean of the precision percentages for each individual balance.

As illustrated in Figure 3, the precision of inexpensive consumer scales with a load cell system of 0.01g resolution are on par with the control provided by the Ohaus analytical balance in establishing specific gravities, ranging in overall performance from 94% to 97%. There appears to be a slight but negligible improvement in precision for load cell scales of lower capacities. However, the consumer scale with a resolution of 1/10th of a gram showed a significant loss in precision. While the precision assessment for quartz in the 0.1g readability balance is 93%, both topaz and impure barite are below the 90% mark. The smaller sizes of the test series for the last two minerals are not sufficiently resolved with the lower resolution of the US-Siggi consumer balance.

Accuracy is more difficult to analyze. It is defined as the closeness of a measured value to an accepted standard (Accuracy, Error, Precision, and Uncertainty n.d.). The inverse of accuracy is construed as accuracy error. Calculation of accuracy can be performed for each individual measurement if the accepted standard value is known. A standard value can be established through averaging multiple measurements across a variety of different instruments using the same testing material. The standardized density value for quartz is 2.65 g/cm³. For the impure barite (4.17 g/cm³) as well as the topaz mineral specimens (3.53 g/cm³) a standard specific gravity value was established by averaging the measurements from the US-AWE, US-Glacier, US-Prospector, and the Ohaus AV264 balance. The measurements from the US-Siggi scale were not included because of the poor performance for specific gravity assessments due to low resolution.

Accuracy is calculated by dividing the measured value by the accepted or standard value as

\[
\% \text{ ACCURACY} = \frac{\text{Measured}}{\text{Accepted}} \times 100
\]

The percent Accuracy Error is established by 100 - %Accuracy. Figure 4 summarizes the % Accuracy errors for individual measurements across the various scales tested.

With the exception of the lower resolution US-Siggi 500g x 0.1g balance, all higher resolution load cell balances perform similarly to the Ohaus 260g x 0.0001g analytical scale when assessing specific gravities of varied materials. Again, performance improves slightly with lower capacity load cell balances. All in all, accuracy errors for the 1/100th gram scales are very reasonable and stay below 2.5% for individual measurements with total average errors below 1%. The accuracy of these consumer scales is comparable to the laboratory analytical

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<tbody>
<tr>
<td>Capacity/</td>
<td>300g /0.01g</td>
<td>250g /0.01g</td>
<td>150g /0.01g</td>
<td>500g /0.1g</td>
<td>260g /0.0001g</td>
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<tr>
<td>Resolution</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Acceptable</td>
<td>±0.02g</td>
<td>±0.02g</td>
<td>±0.02g</td>
<td>±0.2g</td>
<td>±0.003g</td>
</tr>
<tr>
<td>Tolerance Rating</td>
<td></td>
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</tr>
<tr>
<td>Dimension</td>
<td>5”x 3”x 0.625”</td>
<td>4.3”x 3.3”x 0.8”</td>
<td>2.875”x 4”x 1”</td>
<td>2”x 3.5”x 0.5”</td>
<td>12”x 11.8”x 8.7”</td>
</tr>
<tr>
<td>Determined SG</td>
<td>97.1%</td>
<td>98.3%</td>
<td>98.6%</td>
<td>90.0%</td>
<td>98.3%</td>
</tr>
<tr>
<td>Precision</td>
<td>99.8%</td>
<td>99.9%</td>
<td>99.8%</td>
<td>96.4%</td>
<td>99.8%</td>
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<tr>
<td>Determined SG</td>
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<td>Accuracy</td>
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Table 1 - Balances and their specifications used for rapid field SG testing, including experimentally determined results for average precision and accuracy of balances in measuring specific gravity.
balance measurement in density assessments. The elevated deviation of the 3rd barite specimen from the standard, present within all scales but especially obvious in the Ohaus analytical balance reading, is most likely due to a higher impurity specimen within the rather heterogenous set of the barite test run.

Conclusions

The test shows conclusively that low cost consumer balances based on load cell electronics perform very adequately for specific gravity measurements as long as the resolution or readability is within 1/100th of a gram. Fortunately, a varied newer selection of load cell based consumer balances fills this requirement. It is noteworthy that both precision and accuracy are on par with analytical balances when establishing material densities through a single pan hydrostatic specimen submersion method. However, this accuracy is contingent on frequent calibration of such load cell scales as well as the removal of air bubbles in submersed specimens. Battery operation, small sizes and reasonably robust electronics make these scales portable and a perfect companion for geologic field work. One of the smallest such consumer scales just recently released is the “American Weigh MB-100 Matchbox” balance with dimensions of a mere 1.4” x 2.9” x 0.5” and a capacity to resolution of 100g x 0.01g.

Most likely measurement errors are introduced when establishing the volume of samples, especially within small specimens. Possible discrepancies introduced through the yarn or thread employed to suspend the specimen are negligible and can be ignored. Those measuring very small samples on a routine basis may want to invest in a Nylon-12 monofilament thread, which has a density that approximates that of water at 1.02 g/cm^3, thus removing potential errors introduced by the added buoyancy of the string.

References


Appendix

Specific Gravity Nomograph for rapid determination of rock/mineral density using the Hydrostatic One Pan Method and a consumer load balanced weighing scale with a resolution of 0.01g. Nomograph generated using Python programming language scripting in conjunction with PyNomo Version 1.1 Release 0.2.2 software (Doerfler 2009). Example: Plot W_air of a specimen on the left vertical scale of the nomograph, here 25.00g. Mark V of specimen obtained through buoyancy measurements on the right vertical scale of the nomograph, example 9.40g. Connect both plots with a straight line. The intersection of this line with the diagonal scale gives the specific gravity, here 2.65 g/cm^3.
The article was peer reviewed by Associate Editors Edward M. Baltzer, CPG-08861 and John L. Berry, CPG-04032.

Dr. Uwe Richard Kackstaetter, MEM-2437, a German native, received his M.S. in Geology from BYU, Provo and his Ph.D. in applied geology and mineralogy from the University of Würzburg, Germany. His professional expertise on two continents ranges from environmental testing of drinking water wells, groundwater flow modeling, site contaminant evaluations, as well as geologic and hydrologic field investigations. As an educator he has taught not only in college and secondary classrooms, he has also conducted numerous national and international geological field courses. Dr. Kackstaetter’s current interests are in developing various practical approaches as advanced tools for the geosciences, such as automated percolation testers, new wavelength dependent night prospecting tools, improved processes of rock and mineral thin sectioning, and clay mineral analytical processing and computations. He currently works as Assistant Professor of Geology at Metropolitan State University of Denver where he teaches courses in Mineralogy and Optical Mineralogy, Hydrogeology, Applied Volcanology and Field Methods.

IN MEMORY

Walter Schmidt, CPG-06029, 63, of Tallahassee, Florida, passed away peacefully on March 29, 2014 in the arms of his loving family after a long and courageous battle with multiple myeloma and kidney failure. He was born in Philadelphia and moved to Melbourne, Florida to attend Florida Institute of Technology where he met his devoted wife of forty-one years, Cheryl. He earned his Bachelor’s Degree at the University of South Florida and both a Master’s and Ph.D. in Geology at Florida State University. He retired from the Geological Survey as the Director and State Geologist of Florida after 34 years of dedicated service. Walt was an incredible husband and father, a warm and caring person with an unassuming manner and a dry sense of humor. He enjoyed spending time with family camping and being at the beach. Walt was an avid sports fan, supporting the Florida State Seminoles.
U.S. Female Geoscience Degrees Continues to Increase

The number of degrees being awarded to women has generally continued to increase through time. The percentage of degrees awarded to women has not declined like enrollment, and the total number of degrees are rising at all levels. Similar to enrollment at the Master’s level, most of the change in 2012-2013 over the prior year is accommodated by the drop in degrees awarded to men.

Of particular note is the recent steady increase in doctorates awarded to women. In fact, the degree level with the highest percentages of degrees awarded to women is the doctorate. Interestingly, this trend has not apparently been reflected in the gender distribution in faculty, but it is potentially too early to see this given the fact that over 65% of new doctoral recipients proceed on to a post-doc position.

In 2012-2013 women received 41.4% of bachelor’s, 41.7% of master’s, and 43.5% of doctoral degrees in the geosciences. All data are from the AGI Directory of Geoscience Departments.

- Christopher M. Keane

www.agiweb.org/workforce/