

TPG is a publication of the American Institute of Professional Geologists

# THE PROFESSIONAL GEOLOGIST

VOLUME 55 NUMBER 2

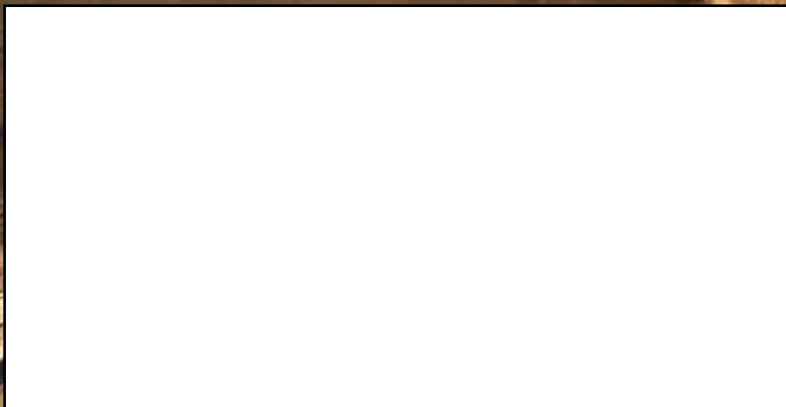
APR.MAY.JUN 2018

**Colorado Springs 2018!**

**Meet the 2019 National  
Officer Candidates**

*Peer Reviewed Article:*

**Bioengineering &  
Slope Stability**



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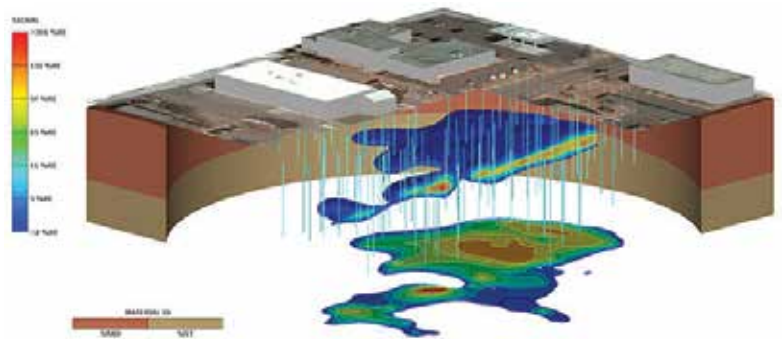
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# The Professional Geologist

Volume 55 Number 2

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On the Cover: Tidal ripples superimposed on dunes at Reid State Park in Georgetown, ME. Photographed during a Bowdoin College sedimentary geology class trip. Submitted by Zack Burton, Ph.D. Candidate, Stanford University.

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dbartlett@clearcreekassociates.com

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Mineral Strategies, LLC  
O: (303) 278-4521, Colorado Section  
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## NATIONAL HEADQUARTERS

1333 W. 120th Avenue, Suite 211  
Westminster, CO 80234  
7:30 AM - 4:30 PM MDT; M-F  
(303) 412-6205 • Fax (303) 253-9220  
aipg@aipg.org • www.aipg.org

**EXECUTIVE DIRECTOR** - Aaron W. Johnson, MEM - awj@aipg.org  
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**AIPG Publication Policy, October 4, 2010.** AIPG encourages submission of articles and editorials for publication in *TPG* on topics related to the science and profession of geology. Submittals shall be of interest to the members of AIPG, other professional geologists, and others interested in the earth sciences. Articles and editorials may be noted as follows at the discretion of the Editor, "The opinions, positions and conclusions presented herein are those of the author and do not necessarily reflect the opinions, positions or conclusions of the American Institute of Professional Geologists." All materials submitted for publication, including author opinions contained therein, shall include accurate and appropriate references. The Editor has the authority to solicit, edit, accept, or reject articles and editorials and other written material for publication. The Executive Committee has the authority if it so chooses to act on any particular case to support or overrule actions of the Editor regarding the solicitation, editing, acceptance, or rejection of any particular article, editorial, or other written material for publication.

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.

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 activities and programs that support continuing professional development and promote high standards of ethical conduct.



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AIPG 55<sup>th</sup> Annual Conference

# AIPG 2018

## Purple Mountain Majesties



Colorado Springs, Colorado • September 8-11

### AIPG 55th Annual Conference

Plan on attending AIPG's 2018 Annual Conference in Colorado Springs. Our field trips will explore central Colorado including the Cripple Creek & Victor gold mine, the Portland cement plant and adjacent Niobrara Formation quarry, the upper Arkansas geothermal systems, the latest in SW South Park geology, and the Wall Mountain Tuff, among others. The technical sessions will cover the full spectrum of geosciences; start thinking about and submit your abstract. We're planning short courses on being an expert witness, the use of Rock-Work's software, and preparing an AIPG/AGI GOLI course. We're having a Student career workshop on Saturday, September 8th, following an Association of Women Geoscientists (AWG) workshop. Young professionals start working on a presentation on a project you're working on that will induce your employer to send you to the meeting; remember such presentations are also good marketing for your firm. And we're arranging a trip on the Pikes Peak Cog Railway to the 14,115-foot summit of America's mountain along with visits to the Garden of the Gods, the Olympic Training Center, Florissant Fossil Beds National Monument, and other guest trips.

David Abbott – 2018 Conference Chairman  
CPG-04570

*Cripple Creek & Victor Mine*



*Garden of the Gods*



*Portland Quarry & Cement Plant*

Topographic Map Source: USGS Manitou Springs, Co. Quadrangle, 1961, rev. 1994

AIPG 55<sup>th</sup> Annual Conference

# AIPG 2018

## Purple Mountain Majesties



Colorado Springs, Colorado • September 8-11

### 2018 Conference Schedule - Colorado Springs, Colorado

Saturday Sept. 8	7:30 am–5:00 pm	Conference Registration
	8:00 am–12:00 noon	AIPG Executive Committee Meeting (open to all registrants)
	8:00 am–5:00 pm	Field Trip – Cripple Creek and Victor Open-Pit Gold Mine Tour
	8:00 am–12:00 noon	AWG Workshop—Bystander Intervention Training to Reduce Hostile Work Climates (free)
	9:00 am–4:00 pm	Workshop – Rockware Software
	12:00 noon–1:00 pm	AIPG Luncheon (free/full registrants; \$15/students; \$35/non-registrants )
	1:00 pm–5:00 pm	AIPG Student Career Workshop (free)
	1:00 pm–4:00 pm	AIPG Advisory Board Meeting (open to all registrants)
	4:00 pm–4:30 pm	AIPG 2018-2019 Joint Executive Committee Meeting & Business Meeting (open to all registrants)
	4:30 pm–5:30 pm	AIPG Foundation Meeting (open to all registrants)
5:00 pm–6:30 pm	Student Networking Event with Professionals (open to all registrants)	
Sunday Sept. 9	7:00 am–6:00 pm	Field Trip – South Park Colorado-An Exploration of the Complex Geologic Framework
	7:30 am–5:00 pm	Conference Registration
	8:00 am–4:00 pm	Field Trip – Wall Mountain Tuff-The Puzzling Presence of the Colorado Rockies
	8:00 am–5:00 pm	Field Trip – Portland Quarry & Cement Plant; Florence Oil Field
	8:30 am–1:00 pm	Guest Trip – Pikes Peak Cog Railway Trip
	10:00 am–4:00 pm	Exhibitor and Poster Set-up
	1:30 pm–5:00 pm	Guest Trip – Garden of the Gods Geology Trip
	5:30 pm–8:00 pm	Silent Auction (to be held during the Welcome Reception-sneak peak 5:30)
6:30 pm–8:00 pm	Welcome Reception – Exhibit Area Open (complimentary for all registrants)	
Monday Sept. 10	7:30 am–8:15 am	Section Delegate Meeting (open to all registrants)
	7:30 am–5:00 pm	Conference Registration
	8:00 am–5:00 pm	Field Trip – Arkansas Valley Geothermal
	8:30 am–10:00 am	Plenary Session
	9:30 am–3:00 pm	Guest Trip – Western Museum of Mining & Industry and the US Air Force Academy Tours
	10:00 am–5:00 pm	Exhibits Open
	10:30 am–5:00 pm	Technical Sessions
	12:00 noon–1:30 pm	Luncheon with Keynote Speaker (complimentary for all registrants)
	3:30 pm–5:00 pm	Workshop – Putting Together a GOLI Webinar
6:30 pm–8:30 pm	AIPG Awards Banquet (all attendees welcome with additional fee)	
Tuesday Sept. 11	7:30 am–3:00 pm	Conference Registration
	8:00 am–5:00 pm	Field Trip – Colorado Springs Hazards/Landslides in the Cheyenne Mountain Area
	8:30 am–12:00 noon	Short Course – Expert Witness
	8:30 am–5:00 pm	Technical Sessions
	9:00 am–12:00 noon	Guest Trip – Olympic Training Center Tour
	10:00 am–3:30 pm	Exhibits Open
	12:00 noon–1:30 pm	Luncheon with Keynote Speaker (complimentary for all registrants)
1:00 pm–5:00 pm	Guest Trip – Florissant Fossil Beds National Monument Trip	

Colorado Springs Marriott, 5580 Tech Center Drive, Colorado Springs, CO 80919  
(800) 932-2151 or (719) 260-1800 – Rate \$129+ tax per night

Geologic Map Source: Colorado Geological Survey, Manitou Springs, Co. Quadrangle, 2005



# Registration

NAME \_\_\_\_\_ COMPANY \_\_\_\_\_

NAME FOR BADGE \_\_\_\_\_

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ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

SPOUSE/GUEST NAME FOR BADGE \_\_\_\_\_

EMERGENCY CONTACT NAME \_\_\_\_\_ EMERGENCY CONTACT PHONE \_\_\_\_\_

<b>REGISTRATION FEES</b> <small>(Full registration includes the Excom Meetings, Welcome Reception, Technical Sessions, Poster Sessions, Exhibits, and Lunch and Breaks on Saturday, Monday, and Tuesday)</small>	<b>EARLY BIRD</b> <small>(Through 8/17/18)</small>	<b>REGISTRATION</b> <small>(After 8/17/2018)</small>	<b>TOTAL</b>
AIPG Member Full Registration	\$425	\$525	\$
Non-Member Full Registration	\$475	\$575	\$
Young Professional Full Registration (must be AIPG YP Member)	\$325	\$425	\$
Daily Registration <input type="checkbox"/> Sat <input type="checkbox"/> Sun <input type="checkbox"/> Mon <input type="checkbox"/> Tues	\$250	\$350	\$
Spouse/Guest Full Registration / or Welcome Reception Only	\$225 / \$45	\$325 / \$45	\$
Student Full Registration / with Sat. Luncheon, 9/8/18 Student Career Workshop	\$145 / \$160	\$145 / \$160	\$
Student Daily Registration <input type="checkbox"/> Sun <input type="checkbox"/> Mon <input type="checkbox"/> Tues	\$95	\$95	\$
AIPG Luncheon Sat., 9/8/18, Free/Full Registration; \$15/Students; \$35/Non-Reg	\$0 / \$15 / \$35	\$0 / \$15 / \$35	\$
<b>TOTAL AMOUNT DUE</b>			\$

<b>FIELD TRIPS</b> <small>(must be registered for the conference)</small>	<b>AMOUNT</b>	<b>TOTAL</b>
<b>Cripple Creek and Victor Mine Tour</b> <small>(Sat., 9/8/18, 8:00 am - 5:00 pm)</small>	\$99	\$
<b>South Park Colorado-Geologic Framework</b> <small>(Sun., 9/9/18, 7:00 am - 6:00 pm)</small>	\$99	\$
<b>Wall Mountain Tuff-Colorado Rockies</b> <small>(Sun., 9/9/18, 8:00 am - 4:00 pm)</small>	\$99	\$
<b>Portland Quarry/Cement Plant; Florence Oil</b> <small>(Sun., 9/9/18, 8:00 am - 5:00 pm)</small>	\$99	\$
<b>Pikes Peak Cog Railway Trip</b> <small>(Sun., 9/9/18, 8:30 am - 1:00 pm)</small>	\$75	\$
<b>Garden of the Gods Geology</b> <small>(Sun., 9/9/18, 1:30 pm - 5:00 pm)</small>	\$45	\$
<b>Arkansas Valley Geothermal</b> <small>(Mon., 9/10/18, 8:00 am - 5:00 pm)</small>	\$99	\$
<b>Western Museum of Mining &amp; Industry and the US Air Force Academy Tours</b> <small>(Mon., 9/10/18, 9:30 am - 3:00 pm)</small>	\$99	\$
<b>Colorado Springs Hazards/Landslides</b> <small>(Tues., 9/11/18, 8:00 am - 5:00 pm)</small>	\$99	\$
<b>Olympic Training Center Tour</b> <small>(Tues., 9/11/18, 9:00 am - 12:00 noon)</small>	\$45	\$
<b>Florissant Fossil Beds National Monument</b> <small>(Tues., 9/11/18, 1:00 pm - 5:00 pm)</small>	\$45	\$
<b>TOTAL AMOUNT DUE</b>		\$

<b>SOCIAL EVENTS • WORKSHOPS • DONATION</b>	<b>AMOUNT</b>	<b>TOTAL</b>
<b>Welcome Reception</b> <small>(Sunday) <input type="checkbox"/> (please check if attending, included with registration)</small>		
<b>AWG Workshop</b> <small>(Sat) <input type="checkbox"/></small> <b>Rockware Workshop</b> <small>(Sat) <input type="checkbox"/></small>		
<b>AIPG Awards Banquet</b> <small>(Monday)</small> Please select your dinner choice: <input type="checkbox"/> Beef Filet Medallions/Whipped Potatoes <input type="checkbox"/> Grilled Salmon/Rice <input type="checkbox"/> Veggie Wellington with Marinara Sauce	\$70	\$
<b>Make a Donation to the Foundation of the AIPG for the Student Career Workshop</b>	\$	\$
<b>TOTAL AMOUNT DUE</b>		\$
<b>TOTAL AMOUNT DUE (from all sections)</b>		\$

**PLEASE CHECK METHOD OF PAYMENT**

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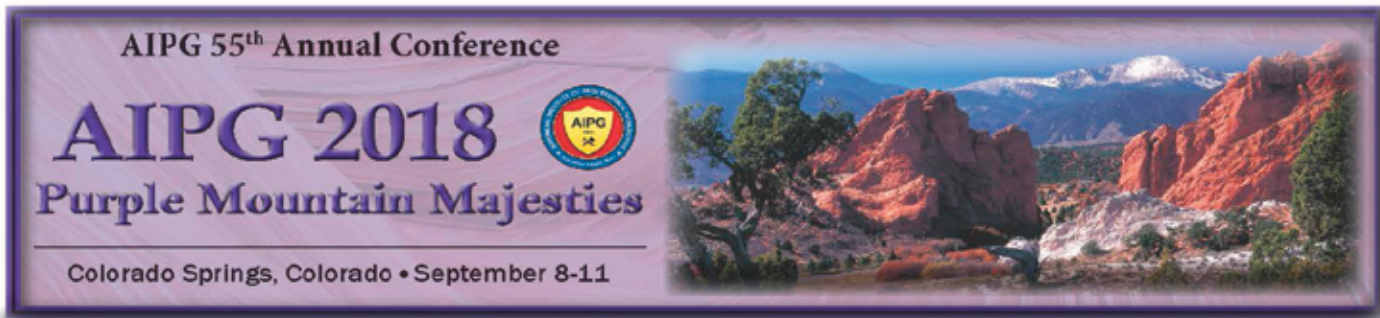
**Hotel Information:** Colorado Springs Marriott, 5580 Tech Center Drive, Colorado Springs, CO 80919, (719) 260-1800, (800) 932-2151. When making reservations, be sure to use the group code 'American Institute of Professional Geologists Annual Conference' to receive the reduced conference rate of \$129+ tax per night, which will be honored until 8/20/18.

**Cancellation Policy:** You must send written notification of registration cancellation by mail, email, or fax to the AIPG office. Registration cancellations received by August 24, 2018, will receive a refund of their payments minus a \$50 processing fee. No refunds can be issued for cancellations after August 24, 2018, or for no-shows after the meeting. Substitutions welcome. Based on the decision of AIPG, field trips are subject to cancellation due to lack of participation. Notification and a full refund for field trips will be given in case of required cancellations.

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**Map Source:** Colorado Geological Survey, Colorado Springs Landslide Susceptibility Map, El Paso County, Co. Quadrangle, 2003



## FIELD TRIPS

### SATURDAY

#### Cripple Creek and Victor Open-Pit Gold Mine Tour

Saturday, September 8, 2018

8:00 am – 5:00 pm

Registration for this trip includes box lunch, water, snacks, transportation, and entrance fee

The Cripple Creek mining district is a world-class mining district located 20 miles west of Colorado Springs, Colorado. As described by Newmont, "Newmont's Cripple Creek & Victor Mine (CC&V) is located in Teller County, Colorado, southwest of Pikes Peak. CC&V was formed as an operating company for mining operations in 1976, with mining in its Cresson Project starting in 1995. CC&V's modern, high-tech operations allow for responsible surface mining of various ore types. The majority of the ore is processed in a zero-discharge, valley-type, leach pad to recover gold and silver. In 2015 CC&V commissioned a rod, ball, and flotation mill which processes CC&V's higher grade, non-oxidized ore."

Annual production of gold is 396,000 ounces. Mineralization is hosted in a Tertiary-aged alkaline volcanic/diatreme complex. Country rocks surrounding the volcanic diatreme are composed of Precambrian granites and metamorphic units. Gold mineralization within the Cripple Creek district occurs in two principal styles: as broad zones of disseminated, low-grade, gold-pyrite and telluride mineralization and as fracture zones containing high-grade, gold-silver tellurides. Regional and district geology will be discussed during the field trip.

This trip will have moderate physical walking activity. Standard field protection equipment: safety shoes/boots, protective eyewear, hard hat, gloves, safety vest. The mine will have extras if needed, but feel free to bring your own.

### SUNDAY

#### Portland Quarry & Cement Plant; Florence Oil Field

Sunday, September 9, 2018

8:00 am – 5:00 pm

Registration for this trip includes box lunch, water, snacks, transportation, and entrance fee

Leader: Tom Newman, CPG

Ever wonder the difference is between cement, concrete, and mortar? Can a person be submerged in the Niobrara Formation? Or, what happens to my car tires when I am done with them? You can find all three answers, (and more!) on a field trip to Portland, CO (ever wonder how that town got its name?) to tour LafargeHolcim's Portland Cement Quarry. Starting with the raw materials, we'll tour the quarry (inside the Niobrara Formation) then to the processing plant. Samples can be taken.

The Niobrara is the primary oil producing formation in eastern Colorado, Nebraska and Kansas. For Petroleum Geologist, this is an extraordinary opportunity to see the Niobrara in situ!

This trip is led by Thomas ("Tom") Newman, of LafargeHolcim, Chief Geologist in North America for Holcim, now LafargeHolcim, for more

than 20 years. His knowledge about raw materials, processing plants and cement is unsurpassed.

About the Holcim Portland Cement Plant ([www.holcim.com/us](http://www.holcim.com/us))

The Portland Cement Plant started in 1897 and in 1996 upgraded to a dry process. Now the oldest continuously operating cement plant in Colorado. With 125 employees, the Portland cement plant supplies markets in Colorado, New Mexico, Kansas, Wyoming, Idaho, Texas, Utah and Nebraska. The Portland cement plant produces Type I/II Moderate and Low Alkali cements, Type III, Type GU, Type IPF and Masonry Type N. They have an annual capacity of 1.8 million metric tons.

Trip Requirements: Moderate physical activity of walking in the quarry. Standard field protection equipment: safety shoes/boots, protective eye wear, hard hat, gloves, safety vest. The Plant will have extras if needed. If desired - bring hammer and sample sacks.

#### Wall Mountain Tuff – The Puzzling Presence of the Colorado Rockies

Sunday, September 9, 2018

8:00 am – 4:00 pm

Registration for this trip includes box lunch, water, snacks, transportation, and entrance fees

Leader: Lon Abbott, University of Colorado, Boulder

The Colorado Rockies first rose during the Laramide Orogeny, which is a most puzzling orogeny because it occurred far from an active plate boundary. But that's just the beginning of the head-scratching that ensues when one contemplates why the modern Rockies exist. The Laramide Orogeny didn't produce enough crustal shortening to support a mountain range as high as the one we see today. That theoretical argument is supported by the observation that the crust under the Rockies is no thicker than it is under the adjacent Great Plains. The so-called "rootless Rockies" must be supported by a different mechanism than the typical crustal root that buoys ranges like the Himalaya or Andes.

Furthermore, abundant evidence shows that soon after they rose, the Laramide Rockies were beveled by erosion and buried by a mixture of volcanic ash and their own debris. The mountains took their modern form within the last 5 million years thanks to a cycle of vigorous erosion that exhumed those buried Laramide crystalline block uplifts. But when it was that the mountains achieved their current height above sea level and what triggered the pulse of erosion during the last 5 million years, whether renewed tectonic uplift or global climate change, remain unsolved mysteries. On this field trip, we'll examine the geological evidence that demonstrates that the Laramide Orogeny didn't produce today's mountains and contemplate some of the clues that might someday help answer the questions of when and why the modern mountains rose.

We'll travel from Colorado Springs to Florissant Fossil Beds National Monument via Garden of the Gods and the scenic Rampart Range Road, contemplate the clues the monument's spectacular fossil trees hold for the history of uplift, visit the state's largest Laramide thrust fault in South Park, and traverse an Eocene paleocanyon filled with volcanic debris shed off the post-Laramide landscape before returning to Colorado Springs at approximately 4 pm.

*See You in Colorado Springs!*



AIPG 55<sup>th</sup> Annual Conference

# AIPG 2018

## Purple Mountain Majesties



Colorado Springs, Colorado • September 8-11



### South Park Colorado – An Exploration of the Complex Geologic Framework

**Sunday, September 9, 2018**

**7:00 am – 6:00 pm**

**Registration for this trip includes box lunch, water, snacks, and transportation**

**Leader: Peter Barkmann**

South Park undoubtedly is one of Colorado's crown jewels in many respects. It cradles the headwaters for the South Platte River. Not only does this river system form the primary water supply for much of Colorado's bustling Front Range metropolis and agricultural economy, but it also creates habitat for world class fisheries and supports vast wildlife populations. The sublime landscape seen at the surface conceals a complex geologic setting that records a long history of sedimentation and tectonic deformation. The geology, with its variety of strata and structures, creates a groundwater regime which feeds world class unique and productive fens – prehistoric bogs that have existed since the Pleistocene and are unique for the rare species of flora and fauna. Situated at just under 10,000 feet, the fens of South Park are astonishing vestiges of the last Ice Age. The fens provide the most ecologically diverse, floristically rich bogs known to exist in the Southern Rocky Mountains. This field trip will explore how Paleozoic, Mesozoic and Cenozoic strata record, and even create, varied tectonic fabrics defining unique habitat for fen existence. We will cross the Elkhorn-Williams Range fault system into the structural block caught between Laramide uplifts preserving synorogenic sediments from the Penn-Perm ancestral Rocky Mountain tectonic episode in juxtaposition with synorogenic sediments from the subsequent Laramide tectonic episode. On our traverse we will visit some spectacular fens formed by this complex geologic framework.

### GUEST TRIP

#### Pikes Peak Cog Railway Trip

**Date: Sunday, September 9, 2018**

**Time: 8:30 am to 1:00 pm**

**Registration for this trip includes snacks, water, transportation, and railway ticket**

**Leaders: Tom Van Arsdale, CPG and Susan Abbott, AS**



Zebulon Pike did not quite make it to the summit in November of 1806—he got as far as Mt. Rosa in waist deep snow—but you can! That's because the Pikes Peak Cog Railway, built in 1891, will take you on an absolutely beautiful ride to the 14,115' summit.

The Cog Railway is obviously an engineering masterpiece, but it also provides people of all ages the opportunity to witness the splendor of the Rockies and the, "amber waves of grain." That's right, "America the Beautiful," was written as a poem by Katherine Lee Bates in 1893 while sitting atop Pikes Peak. The music was later added by Samuel A. Ward, and the combined piece was first published in 1910.

After a short bus ride from Colorado Springs to Manitou Springs, the Railway will leave at approximately 9:20 am and return to Manitou Springs at approximately 12:30 pm. While atop Pikes Peak you can visit the Pikes Peak Summit House, which has some great eats (donuts are their specialty), and a gift shop. Please be aware, the summit is often 30 – 40 degrees colder than the mountain's base so bring appropriate warm clothing (coat, hat, scarf, gloves, etc.). Also keep in mind, dehydration is the leading component of altitude sickness so bring a water jug, and eat some fruit in the morning (there are no bathroom facilities on the railway).

This is an absolutely fantastic ride, so have fun! Caution: those with breathing problems or know altitude sickness should not go on this trip.

### GUEST TRIP

#### Garden of the Gods

**Sunday, September 9, 2018**

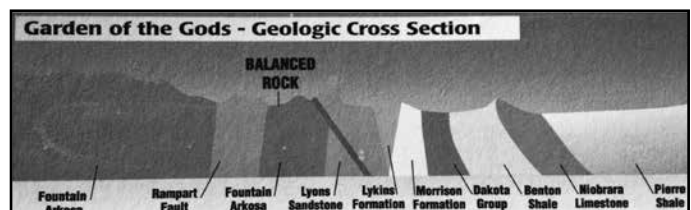
**1:30 pm – 5:00 pm**

**Registration for this trip includes snacks, water, and transportation. Lunch will be on your own at the Garden of the Gods Café.**

**Leader: Maggie Silvertooth, Dept. of Interior**

The Garden of the Gods' red rock formations were created during a geological upheaval along a natural fault line 80-55 million years ago during the Laramide orogeny, in which a number of plates began to slide underneath the North American plate. The angle of subduction was shallow, resulting in a broad belt of mountains running down western North America.

Archaeological evidence shows that prehistoric people visited Garden of the Gods about 1330 BC. At about 250 BC, Native American people camped in the park; they are believed to have been attracted to wildlife and plant life in the area and used overhangs created by the rocks for shelter. Many native peoples have reported a connection to Garden of the Gods, including Apache, Cheyenne, Comanche, Kiowa, Lakota, Pawnee, Shoshone, and Ute people.



**DON'T MISS OUT ON THE TRIPS!**

AIPG 55<sup>th</sup> Annual Conference

# AIPG 2018

## Purple Mountain Majesties



Colorado Springs, Colorado • September 8-11



## MONDAY

### Arkansas Valley Geothermal

Monday, September 10, 2018

8:00 am – 5:00 pm

Registration for this trip includes box lunch, water, snacks, and transportation

Leaders: Frederick B. Henderson III PhD, Mt. Princeton Geothermal LLC, Paul Morgan PhD, Colorado Geological Survey

Structural Geology and Geothermal Energy Potential of the Northern Rio Grande Rift Zone, Upper Arkansas Valley, Chaffee County, Colorado.

This Field trip will traverse the Upper Arkansas Valley, Chaffee County, Colorado which is underlain by a northern segment of the Rio Grande Rift Zone and contains several developed hot springs which appear to be connected to deep peripheral geothermal reservoirs in rift zone valley fill sediments that could contain sustainable 300°F geothermal water sufficient to supply plants of 10MW or more of electrical energy to the adjacent grid. These targets are well defined by reworked and recent geochemical data, thermal gradient measurements, structural projections, magnetotellurics measurement and AirMag surveys. This deep peripheral exploration model is believed to apply to some other areas in Colorado.

## GUEST TRIP

### Western Museum of Mining and Industry, and the Air Force Academy Tours

Date: Monday, September 10, 2018

Time: 9:30 am to 3:00 pm

Registration for this trip includes box lunch, water, snacks, transportation, and entrance fees

Leaders: Tom Van Arsdale, CPG, and Susan Abbott, AS

The Museum of Mining and Industry is a must-see for anyone interested in the fascinating history of Colorado mining, and mining in general. There are numerous interactive exhibits and spectacular specimens of this rich heritage, including the rescue chute used for the 2010 Chilean miner rescue. And, after a two hour visit, you will then zoom! ... to the United States Air Force Academy. The bus ride to the Academy is a mere 4.5 miles so you will have plenty of time to eat before exploring the grounds of one of the most elite institutions within our nation. And don't miss the chapel!

## TUESDAY

### GUEST TRIP

### Olympic Training Center Tour

Date: Tuesday, September 11, 2018

Time: 9:00 am to Noon

Registration for this trip includes snacks, water,

transportation, and entrance fee

Leader: Susan Abbott, AS

The U.S. Olympic Complex in Colorado Springs is the flagship training center for the U.S. Olympic Committee and the Olympic Training Center programs. USA Swimming and USA Shooting have their national headquarters at the center. Athletes train at the center for several summer and winter sports including wrestling, swimming, gymnastics, and figure skating.

The visit to the Olympic Training Center includes time to walk the grounds, check out the visitor's center, and a visit to the gift shop. Our tour guide joins us at 10 am for a private tour that begins with a video presentation followed by a guided walking tour of the facility, during which we might see athletes training.

The tour ends at 11:30 so we can return to the hotel for lunch.

## GUEST TRIP

### Florissant Fossil Beds National Monument

Tuesday, September 11, 2018

1:00 pm – 5:00 pm

Registration for this trip includes snacks, water, transportation, and entrance fee.

Leaders: Susan Abbott, AS

Florissant Fossil Beds National Monument is an hour's drive from Colorado Springs and contains one of the richest Eocene fossil deposits in the world. The site contains fossils of insects, leaves, seeds, fish, and a few mammals and birds. Most of these fossils are still buried underground, but the visitor center contains beautifully excavated and prepared specimens. One of the first things you will notice are the massive petrified tree stumps of redwood trees next to the visitor center. You will see more of these and along the short park trails.

We can begin our time at the monument at the visitor center by watching a 14-minute film, *Shadows of the Past*. Then we are free to explore the visitor center and the short self-guided park trails near the visitor center; one trail is ½ mile long and the other is a mile. We will spend about 2 hours at the monument.

The drive to Florissant takes us through Manitou Springs, past the cutoff to the Road to Pikes Peak, and up Fountain Creek canyon. It is a pretty drive that should include nice views of Pike's Peak.

This is a truly unique and fascinating place to explore fossils. Florissant is at an elevation of 8,388 feet. Please consider whether the altitude will affect you. The weather in Florissant is likely to be cooler than Colorado Springs and may be very different, so be prepared for rain, wind, and potentially, snow. Walking shoes are recommended.

### Colorado Springs Hazards/Landslides in the Cheyenne Mountain Area

Tuesday, September 11, 2018

8:00 am – 5:00 pm

Registration for this trip includes box lunch, water, snacks, and transportation

Description available online at [www.aipg.org](http://www.aipg.org).

AIPG 55<sup>th</sup> Annual Conference

# AIPG 2018

## Purple Mountain Majesties



Colorado Springs, Colorado • September 8-11



## Congratulations 2018 National Award Recipients



**Ben H. Parker  
Memorial Medal**  
*Barbara H. Murray,  
CPG-6203  
Scottsdale, Arizona*



**John T. Galey, Sr., Memorial  
Public Service Award**  
*Thomas A. Herbert,  
CPG-2551  
Tallahassee, Florida*

**and  
Section Leadership  
Award Recipients**

*Dennis McGrath  
Northeast Section*

*Troy Bernier  
Florida Section*

*Robert Blauvelt  
Northeast Section*

*Michael Hultgren  
Minnesota Section*

*Shanna Schmitt  
Minnesota Section*

*Tom Van Arsdale  
Colorado Section*

*Ramona Cornea  
Illinois/Indiana Section*

*Brent Smith  
Ohio Section*



**Martin Van Couvering  
Memorial Award**  
*Dennis Pennington  
CPG-4401  
Ambler, Pennsylvania*



**Award of Honorary  
Membership**  
*Ron J. Wallace,  
CPG-8153  
Roswell, Georgia*



# Invitation from The Professional Geologist

*TPG is in need of technical articles (which will be peer reviewed), articles about aspects of geological professional practice, section and other news of interest, anecdotes of fun or fear in the field, and commentary to stimulate discussion.*

*You are cordially invited to take advantage of the opportunity to use your news journal to publically express your point of view or explain work products related to the science, practice, and regulation of the profession of geology.*

*Don't grouse if TPG lacks articles on a topic that interest you: send us an article.  
Don't complain if you disagree with an article: send us a rebuttal.*

*TPG is your news journal. Almost all the material appearing in TPG is elicited through members: AIPG cannot publish that which is not available.*

*Please consider submitting a thought-provoking or informative article relating to your chosen profession or to the political issues that affect our profession.*

*R.S.V.P.*

**American Institute of Professional Geologists**

**NATIONAL HEADQUARTERS**

**1333 West 120<sup>th</sup> Avenue, Suite 211,  
Westminster, CO 80234-2710**

**(303) 412-6205 · FAX (303) 253-9220 · e-mail: [aipg@aipg.org](mailto:aipg@aipg.org) · [www.aipg.org](http://www.aipg.org)**

("Plus ça change, plus c'est la même chose" – advertisement adapted from one run in the November 2001 issue)



# Inside this Issue

John L. Berry, CPG-04032

In this issue and the last we have had some focus on critical and strategic minerals – as my students in the Smokies would have said, “Thangs we gotta hev but we don’t got!” In the January/February/March 2018 issue we ran “Rare Metal Bearing Granites....” by Mabrouk Sami, page 8, and “Cobalt on the Rise” by member Jim Burnell, page 18; in this issue we have the INTRAW press release on their webinar “Tracking the World Supply of Raw Materials” on page 32 as well as Aaron Johnson’s Executive Director’s column on “The Future of Critical Minerals” (page 30) and his report on a Department of Interior Budget briefing (page 33), which is partly concerned with what the Federal Government is planning, or not planning, to do to secure critical mineral supplies for the United States. Critical minerals are those that are essential for high-technology, green and defense applications, but vulnerable to politically or economically driven fluctuations in supply (see Aaron’s article on page 30). At present, this designation applies particularly to the rare-earth elements (REE), tantalum (Ta), niobium (Nb), lithium (Li), molybdenum (Mo) and indium (In) (<http://www.criticalmetalsmeeting.com/>, accessed 2/27/2018).

In the late 1960s, the advent of plate tectonics focused the attention of geologists searching for copper-gold-moly porphyries on the “Ring of Fire” because it was suddenly clear why they tended to occur in the hanging wall of subduction zones. At the same time it also became very clear why epithermal deposits clustered in extensional terrain, as well as over subduction zones. The result was a wave of huge exploration successes that created an oversupply of copper from the mid-1970s onward and an abundance of gold in the market from the mid-1980s onward.

Since then, the list of critical and strategic elements has grown longer and longer (Table 1) due not just to the boom in production of electronic goods, but also due to the invention and increasing use of nickel- and cobalt-based super alloys in high temperature, high load, superconducting and corrosive environments. These alloys contain many rare metals as well as the ones we are used to, including chromium, iron, cobalt, molybdenum, tungsten, tantalum, aluminium, titanium, zirconium, niobium, rhenium, yttrium, vanadium, carbon, boron and hafnium (Table 1).

For several of the metals, for example lithium and the Rare Earths, in Table 1, there are large known sources, but for many, such as Cobalt, Niobium, large resources are either non-existent or concentrated in one or very few countries. It is amazing how often the dominant source is China: examples are rare earths (80% of world production), molybdenum (40%), tungsten (84%), vanadium (55%). The Democratic Republic of the Congo, one of the world’s most unstable countries, produces 52% of the world’s cobalt, and a major part of its Niobium. In all of these cases new sources in more stable and friendly areas are urgently required. Aaron emphasizes our duty to inform the public and our officials, but I want to stress the need, and the opportunity, for smart geologists to develop new models for the occurrence of some elements, and to recognize new areas containing elements of the geology that hosts oth-

ers: for example the Bambui Basin of Brazil is of the same age and contains a stratigraphic succession similar to that of the central African Katangan Basin that contains most of the world’s known Cobalt reserves, yet when I was last there its geology was not well enough known to enable one to plan an efficient exploration program there for copper-cobalt deposits.

Our peer reviewed article this issue is from a graduate student in Sri Lanka, Divomi Balasuriya, who has determined the best local species for stabilizing road cuts. These are often low shrubs: I have often wondered why grass is so ubiquitously used for that purpose here in the United States.

Table 1: Estimated global production of various metals in 2009  
[technology metals in red: rare metals in bold: rare earths (Lanthanides) labeled REE]  
Sources: US Geological Survey, British Geological Survey  
(adapted from <http://www.techmetalsresearch.com/what-are-technology-metals/>)

Metal	Production [tonnes]
Tungsten (2012)	76,400
Vanadium (2016)	76,000
Niobium	62,900
Cerium REE	62,500 est.
Cobalt	62,000
Uranium	35,332
Lanthanum REE	32,860
Chromium (2015)	30,400
Silver	21,332
Neodymium REE	19,096
Cadmium	18,000
Lithium	18,000
Yttrium	8,900
Bismuth	7,300
Praseodymium REE	6,150
Gold	2,350
Dysprosium REE	2,000
Selenium	1,500
Samarium REE	1,364
Zirconium	1,230
Gadolinium REE	744
Indium	600
Terbium REE	450
Europium REE	272
Palladium	195
Platinum	178
Germanium	140
Gallium	78
Rhenium	52
Rhodium	30
Hafnium	25



## Candidate for AIPG National President-Elect

**J. Todd McFarland, CPG-11348**

*Nashville, Tennessee*

I am truly fortunate to be nominated for president-elect of AIPG and would like to thank the nominating committee for this opportunity. My career as a geologist was not a traditional path. As I prepared for my last two semesters as an undergraduate in chemistry, I was unsure of what career path to take. After spending many years in the caves of south-central Kentucky, I had a desire to mix my working days inside with some adventure. When I chose an environmental geology class as an elective course, my uncertainty disappeared. My future was defined after the first day of that class. I spent the next year immersed in a typical undergraduate geology curriculum, although at a somewhat accelerated pace. I was then admitted to the geology program and completed my graduate degree.

After graduation, I spent a few years behind a drill rig, logged soil throughout the southeast, sampled too many wells to count, and quickly learned what it meant to be a field geologist. However, I still had a lot to learn about what it meant to be a professional geologist. 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 remained involved with the organization on the Section level and became the Tennessee Section President in 2013. My first trip to the annual AIPG meeting was the 2013 meeting in Colorado where I was subsequently elected to the Advisory Committee for 2014. I was honored to serve as Vice President in 2015 following my year on the Advisory Committee. I was the Tennessee Section President in 2017 as well as the general chairman for the 2017 National Meeting. I am also the Chapter Sponsor for two student chapters in Tennessee.

The office of President-Elect includes presiding over the advisory board, and my time on the advisory board, my year as Vice President, and my role as the Tennessee section delegate at the national meeting provides me with the experience needed to serve this role and connect with the incoming advisory board. An additional role of the President-Elect includes assisting with preparation of the budget for the fiscal year. In my current role as a consulting geologist, I am tasked with management project financials with varying budgets for a variety of clients as well as review of project financial statements each month, so this work history will provide me with the experience needed to assist with budget planning.

The President of AIPG acts as the official spokesperson for the Institute, which I consider a great opportunity to represent the geological community. AIPG must continue to promote professionalism and focus on students and young professional members to solidify our membership.

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*One of the things I have enjoyed during my time with AIPG is the interaction with geologists in academia, regulatory, mining, consulting, and other fields. I will continue to promote advancement of the geological profession. I will focus on the development of students and young professional members through on-line learning initiatives and networking events on a national and sectional level to foster interaction with our professional members. The wealth of knowledge that can be conveyed to our students and young professional members will be invaluable to their careers and can only benefit the future of AIPG.*

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A geological community that strives to constantly advance must include students and young professional members that understand the value of the profession. AIPG has the resources to advance our profession and geologists have the opportunity to make a difference in this world every day. As noted by Victor Frankl, it does not matter what we expect from life, but rather what life expected of us. We take the responsibility to find the right answer to its problems and to fulfill the tasks which it constantly sets for each individual. As the President of AIPG I will continue this focus and help to grow this great organization. I am honored to have the opportunity to write this statement for my candidacy as President-Elect and appreciate your support.



## Candidate for AIPG National President-Elect

**John M. Stewart, PG, CPG-11115**  
Greensboro, North Carolina

I want to thank the Nominating Committee for considering me as a candidate for the position of AIPG National President-Elect. This is quite an honor and one I take quite seriously. Eight years ago, I attended the National Convention and stumbled into National office and I have not looked back. I was elected during my first convention to the Executive Board as an Advisory Board Representative and then again the next year. Last year, due to the quirks of our By Laws, I was asked by the Executive Committee if I would fill in as Vice-President. I gladly accepted. I was elected again this year as an Advisory Board Representative and I look forward to working with the Executive Committee again this year. So I have past and present experience working on and with the Advisory Board. One of the responsibilities of the President-Elect is to serve on the Advisory Board as its presiding officer. Therefore I have the experience and knowledge to work with the future Board. Over the last two years, I have worked with the Executive Committee and headquarters, so I have both past and present working knowledge of initiatives AIPG is working on. As I look back on the years severing AIPG, I am not surprised why I accepted the nomination for President-Elect. I personally believe that we, those that can and have the ability, should give back when they can. I always have, and hopefully always will believe this way. Giving back to an organization such as AIPG and its members is something I enjoyed doing and hope to continue doing in the future.

While serving on the Advisory Board and as Vice-President, I learned a tremendous amount about AIPG and its various programs. I learned a lot about the interaction between National and the Sections. I can provide the Advisory Board and Executive Committee first hand concerns from “struggling chapters”, a continued and ongoing concern of mine. AIPG is continuing to work with these Sections and is hoping to start a new initiative to personally visit these Sections. I will work with the Advisory Board to keep this initiative moving forward.

We are doing a great job getting students to join AIPG. I have attended Southeast GSA conventions over the last five years and have presented in technical sessions specifically for the students. I have participated in mentor lunches with the students and talked to many students while attending the AIPG booth. I will be attending the Southeast GSA again this year in Knoxville and look forward to “signing up” and talking with more students. Unfortunately, as the students leave school, we are losing them in the transition from school to work. The current Executive Committee is working toward

building a connection between our Young Professional members and how to help students make the transition to Young Professional status. I will work with our Young Member Board representative to help develop programs to make this connection. This is an important step in growing membership and keeping our Young Professional engaged.

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*I also learned how interconnected AIPG is with other geologic organizations such as AGI, ASBOG, and GSA. As President-Elect, I will encourage continued participation in and with these organizations and will attend meetings and represent AIPG when necessary. AIPG is also looking into expanding our International opportunities, thus increasing membership and possibly holding joint conferences. These relationships provide great opportunities for our members and I will continue working with the Executive Committee and Head Quarters to promote these initiatives.*

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By now, many of you are aware of the new National Accredited Professional Geologist category under discussion. This new category has great promise but will take a tremendous amount of work over the next several years to fully develop and implement. I am on a subcommittee to begin working on the details of this new category and am fully committed to developing this membership category in the future. One criteria of the category will be continuing education. This requirement, along with several state licensing boards also requiring continuing education to maintain licensure, is a great opportunity for AIPG to further develop its on line education initiative. This program, in its infancy, has great potential as a means to educate not only our members but all geologists. I will continue to work with Head Quarters to support development of this program.

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](mailto:jstewart1@ecslimited.com).



## Candidate for AIPG National Vice President

**Shanna A. Schmitt, PG, CPG-11781**  
*St. Paul, Minnesota*

I'm honored to be one of the nominees for the 2019 AIPG Vice President. I've been volunteering with the Minnesota Section since 2011 and with National since 2016. I enjoy volunteering, and I know successful organizations have a strong, dedicated, and diverse volunteer base. I like learning what we do and how we do it at a Section and National level, collaborating with other members and sections, professional organizations, and geoscience departments, and figuring out what we can do to improve and grow.

I decided to be either a geologist or astronomer during my eighth grade earth science class. It was a favorite course for many of my classmates. I also read Jurassic Park and wanted to be a paleontologist – you get the idea. When I got to college, it's a good thing I knew geology existed because no one else seemed to know what it was except that Introduction to Geology was way more fun than Introduction to Physics. What's not to love about a major that features field trips?!

---

*I've been involved with AIPG since 2003 when I started attending Minnesota Section meetings with one of my mentors (thank you Paul!) when I wasn't out sampling. The Minnesota Section holds monthly luncheons September through May, and the luncheons include an hour technical talk. The monthly luncheons, spring socials, and field trips are fantastic networking and professional development opportunities. I love learning about aspects of geology I do and don't practice. I became an AIPG Member in 2006, became a licensed Professional Geologist in Minnesota in 2011, and upgraded to an AIPG Certified Professional Geologist in 2015.*

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Much of my professional development has centered around AIPG. I served in various officer and committee positions with the Minnesota Section including Secretary/Treasurer, Webmaster, President, National Delegate, and Director. I've also served on the National Advisory Board, and I'm currently the liaison on GSA's Professional Development Committee.

I've enjoyed learning from other professionals at section meetings and technical sessions at the national conference, learning more about Minnesota and other local geology on (many) field trips, learning how AIPG works with other organizations, and advocating for the profession. I'm passionate about talking to geoscience majors regarding professional careers and the basics they need to know to get started.

I believe AIPG is a very relevant and useful organization and I can help the institute by bringing dedication to my role as Vice President. Some of the main duties of the Vice President are outreach to the Sections, to help struggling Sections grow and develop, communicate Section concerns and ideas to the Executive Committee, and to complete tasks as assigned by the President.

I'm excited to be a part of the new membership category that was unveiled last year. I'm excited to see where our partnership with AGI's Geoscience Online Learning Initiative (GOLI) takes us. High quality, web-based talks are needed for our members that live or work away from our main meeting locations. I'd like AIPG to continue updating our promotional materials and position statements.

I believe I'd be an effective Vice President. If you have questions for me as you're filling out your ballot, please reach out. You can email me at [shanna.schmitt@state.mn.us](mailto:shanna.schmitt@state.mn.us) or call/text me at 651.894.3513. Thank you for your consideration!

*Cast your vote by June 30, 2018 to elect  
 AIPG National Executive Committee Of-  
 ficers.  
 Voting ballot is available in this issue on  
 page 23 and online at  
[www.aipg.org](http://www.aipg.org).*





## Candidate for AIPG National Vice President

**Nancy J. Wolverson, CPG-11048**  
*Reno, Nevada*

Thank you to the nominating committee for recommending me for the position of Vice President on the 2019 Executive Committee. It would be an honor to serve the organization through the mission statement; “.....to be an effective advocate for the profession of geology and to serve its members through activities and programs that support continuing professional development and promote high standards of ethical conduct.”

Through my position on the Executive Committee Advisory Board, it has become clear to me that the membership in AIPG throughout the U.S. varies greatly. In Nevada, our CPG members have almost exclusively joined to be a Qualified Person (QP) with the Canadian stock exchanges. Several other Western States have similar membership. Many states are very active with their local political scene due to the changes in laws about geologist registration. Other states have membership with emphasis in specific geology specialties; hydrology, environmental, geotechnical, among others. With such a broad spectrum of expertise, it can be difficult to organize a membership drive, but that is exactly what we should do over the next few years.

My undergraduate education at Eastern Washington University was well rounded. Our field camp course was taught in Southern Nevada, where I decided that the geology, wide-open spaces and climate were for me. After graduation, I got a job in Reno, where I then went on to complete my Master's degree at the Mackay School of Mines, University of Nevada-Reno.

My career has given me the opportunity to work in a variety of geologic terranes throughout the US and at many locales in the world. My first real job was to investigate the uranium potential in Nevada for the Department of Energy. Uranium demand declined in 1981 and I moved on to my first job in gold exploration. I spent most of the 1980's doing grass roots exploration throughout Nevada during a time of major advances in the understanding of Carlin-style gold deposits and volcanic-hosted hot spring gold deposits.

In 1989 I took a position evaluating gold properties for acquisition. After we acquired the Haile Mine in South Carolina, I moved there to manage the exploration and prefeasibility study. Before we could make the decision to advance the project, Amax was sold, and the project was put on hold. I spent a year working with a consulting company evaluating gold

projects for an international client, where I had the opportunity to work in the Tien Shan Mountains of Eastern Kyrgyzstan. The geologic setting was very similar to Nevada's Basin and Range and it was a fascinating cultural experience.

My consulting experience for the next several years included project evaluation in Mexico, exploration and property evaluation in Ecuador and exploration/development work in Chile. During these years I also completed my MBA in Finance. In 2004 I returned to Nevada and continued consulting until accepting a position exploring for uranium in Nevada, New Mexico, and throughout the Western US. So, 25 years after starting my career in uranium exploration, I had come full circle. The uranium market did not hold up for long and I returned to gold exploration in 2008.

Since returning to consulting, I have had a wide variety of experience. After completing several qualifying Technical Reports for company IPO's on the Canadian Exchanges, I began working with my current primary client, Paramount Gold Nevada Corp. Currently I manage the exploration, compliance and reclamation at the Sleeper Mine in north central Nevada, along with all permitting activities at our Grassy Mountain underground gold project in Oregon.

During my career, I have also had the opportunity to work with geologists in many specialties; hydrology, engineering, geotechnical, permitting, among others.

The Vice President of AIPG is tasked with liaising with the Executive Committee and the State Section Presidents with the purpose of advising the Executive Committee of any and all State Section problems, questions and concerns. The Vice President can also be tasked with special projects, and the Advisory Board is often called on to assist the Vice President in all activities. Currently, the contact with State Sections is focused on helping sections that are inactive increase their activities and membership. This goal should continue into 2019 and beyond.

As mentioned above, the geologic specialties and interests vary widely across the country. I think another way to engage more members in the State Sections is to gather and evaluate data on each State's membership makeup. With the data in hand, the section will be better able to plan activities and meetings to better serve their membership.



## Candidate for AIPG National Treasurer

**Christine F. Lilek, CPG-10195**

*Juneau, Wisconsin*

We invest (money and time) in things that provide meaning and value to our lives. If members of an organization do not feel that the organization provides meaning and value to their lives, they do not continue to invest in the organization, and they do not recommend that others invest in the organization.

The American Institute of Professional Geologists (AIPG) organization has done a tremendous job of certifying, educating and marketing the geoscience professionals and resources to the industry, but we have not fully marketed the meaning and value of AIPG to all of our geoscience members. I believe this key task is essential to the growth of our organization.

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*As Treasurer, I would assist the Executive Board in developing a list of necessary and valued services AIPG provides the geoscience professional and students. We can then use that list to help develop and carry out a focused membership drive. I would also evaluate what fundraising events have been most successful for AIPG National and our Sections and provide a summary of how to recreate these successful events in the future.*

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I have experience in collecting and organizing these types of “Why does this certification, license, service matter to you” lists. I currently assist the Wisconsin Health Department each

year in providing renewal of funding reasons for our environmental risk assessor training and certification program. Our Lake District must demonstrate how we spend the tax payer’s money with meaningful and valuable tasks at the annual meeting, or run the risk of being eliminated as a Lake Improvement District. At the Wisconsin Department of Natural Resources, I assisted with funding renewal reason lists for our Green Tier certification program and our Brownfields clean-up program. Fund raising for our Wisconsin Women in Government college scholarships has required us to establish an on-going list of how the women who receive the scholarships are benefiting the communities and businesses that provided donations. If we are not successful in gathering a list of meaningful and valuable accomplishments for all of these programs, the money and volunteer time dries up and the program dies.

Another activity of successful organizations is sharing detailed success stories with their membership units; in our case our Sections. It’s not enough to just showcase successful event agendas and participant photos in our news stories, but share the “how to organize, advertise and sponsor” a successful event with each other. In an upcoming TPG article, I share these details from the 2017 National-Wisconsin Sand Mine Life Cycle Seminars and Field Trip in hopes that these details will make it easier for other Sections to hold their own events. As National Treasurer I would encourage additional detailed stories from our Sections across the country.

Together we can grow our monetary and time investments in AIPG after we fully understand how AIPG provides meaning and value to us all.

## **CORRECTION NOTICE**

### **Our apologies.**

In the Jan.Feb.Mar 2018 issue of the *TPG*, we mistakenly printed on page 50, that Nathainail Bashir, SA 8101 was awarded first place in the undergraduate category for the National Student Poster competition.

### **Correction**

Nathainail is a Ph.D. candidate at the Missouri University of Science and Technology. **He was awarded second place in the Graduate category in the poster competition. Congratulations Nathainail!**



## Candidate for AIPG National Treasurer

**Matthew J. Rhoades, CPG-07837**

*Golden, Colorado*

I have been a member of AIPG for more than 25 years and I have seen a lot of change in that time. AIPG has been pretty successful in retaining members and I think a large part of that is because the CPG designation carries so much weight. With that said, however, now is not the time to lessen our efforts at sowing goodwill in the geologic community and attracting new members into our ranks. Maintaining a steadily increasing membership roll count is critical to our success. There are many competing organizations out there looking to attract the same new potential members that we are looking for. The competition has gotten very keen. I live in Denver and I have a front row seat for viewing this dynamic. Denver is host to numerous state and Federal agencies employing geologists, it is an engineering and environmental consulting hotspot, as there are innumerable consulting firms based in Denver. There are also many oil and gas firms here, as well as mining and mineral development companies. There are a number of very active geological associations and organizations.

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*In order for the AIPG to compete with other organizations on an ongoing basis, we must continue to tailor, refine and hone our offerings of core services to existing and new potential members. Annual dues alone will not get the job done. Value-added services and events will attract new people and therein lies our future.*

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I have heard it said on many occasions that new millennial scientists just aren't "joiners" looking to participate in large

organizations. Some of that may be true. However, I do know that many younger geologists welcome the opportunity to interact with their peers and with capable mentors if it means they can grow intellectually or professionally. These include field trips, geology club functions, lecture series, museum trips and group social functions. Reaching these groups and supporting them through AIPG's student sponsorship and student chapters is key to our continued, collective growth. As a mindset, all of AIPG's members should be willing to work with people much younger and less experienced in an effort to continually infuse the sense of wonder of geology and the benefits of hanging around with other like-minded professionals. It is how we can best 'pay back' the debt that we owe to those who mentored us along our own meandering professional paths.

As a member of the Executive Board, if elected, I will join in the brainstorming and policy-making efforts designed to move AIPG forward. As the Treasurer, I see my role in maintaining continuity with the great work performed by the previous Treasurer, Dr. Jim Burnell. In all fairness and for the sake of transparency, I think I should state that Jim Burnell is a personal friend and neighbor.

With that said, apart from the fiscal aspects of the Treasurer's role, I would like to participate in discussions regarding student recruitment, scholarships, professional development opportunities, ongoing mentoring opportunities, and networking and advocacy. All of these will have an economic impact and I would look to support those opportunities that will have a positive impact on net new revenue to the Institute.

### *AIPG Offers Mentor Program*

**Are you an AIPG Student or an AIPG Young Professional searching for a mentor?**

**or**

**Are you an AIPG member looking for a Student or Young Professional to mentor?**

**Be sure to update your information and check the membership directory at [aipg.org](http://aipg.org)**



## Candidate for AIPG National Young Professional

**Brandy M. Barnes, YP-0195**  
*Clermont, Florida*

It has been an honor to be nominated and then accepted into the role of Young Professional for the 2018 National Executive Committee. I am now humbled to be considered as a candidate for a second term and I'm thankful for the support of the Nominating Committee and Executive Committee.

In early 2014, I received an email from the geosciences department chair at Middle Tennessee State University. The email was forwarded to students interested in starting the first AIPG Student Chapter in the state. Needless to say, I took the opportunity and ran with it. By summer, the paperwork was turned in and I was approved! I was installed as the MTSU Student Chapter President. Being in a new organization and being involved in a new student chapter was very exciting. This excitement led to an even greater desire to be more involved with the Geosciences industry. So, when AIPG sent out an email asking for volunteers at their AIPG booth during the 2015 Geological Society of America meeting in Vancouver, Canada, I jumped at the opportunity and immediately agreed to participate. When I reflect on my time as a student growing into a professional, I consider this simple request for participation as a springboard to my career. I was able to connect with AIPG staff, members, students, etc., all with a passion for our profession, geological sciences, student mentorships, networking, and our future as a society.

AIPG continues to be a major part of my past, present, and future as a geologist. I was offered an amazing position as Graduate Geologist with Integrity Drilling and Geophysical Services, LLC through my involvement and networking within AIPG. I have attended the last three AIPG Annual meetings in Alaska, New Mexico, and Tennessee, where I have been present in Executive Committee Meetings, Delegate Meetings, and presented Strategies for Easing the Transition from College Student to Young Professional Geoscientist during the 2017 Student Day in Tennessee. Over the past two years, I have had the honor to serve as the Young Professional member for the Florida section where I am involved with Student Chapters, event planning, social media, and actions revolved around deregulation of geology business and individual licensures as well as serving as the 2018 National Executive Committee Young Professional.

It has been my honor and the highlight of my year to participate on the Executive Committee as the Young Professional. Prior to the Nashville meeting, I received a phone call from

Adam Heft on my nomination and interest in participating as the Young Professional member on the executive board. I can honestly say it was one of the most exciting conversations to date. I have had countless conversations with many members over the past few years regarding the importance of young professional involvement in the organization and it was truly a rewarding moment to hear the addition of a young professional position on the Executive Committee.

I am beginning this journey with developing "tools for our toolbox" in order for professional members, young professionals, and students to understand what AIPG can offer the new members and what it means to be a part of this organization. As a young person starting a career, it can be hard to visualize the long term plan as a geologist or our involvement in a professional organization; but, it is imperative that we grow and utilize young professionals because without them our resources and knowledge base on important topics (i.e. geology licensure) will get lost in translation and risk losing our opportunity at progression.

It is my goal to grow our young professional members by being involved in their student chapters and pointing them in the direction of utilizing their resources within AIPG and expanding their understanding of what our organization provides to its members. I believe that as we continue to invest in our young professionals and student members, we will serve AIPG on their state section boards and at the national level. As I continue into this year and if I should receive the honor of a second term, I will plan to have more enthusiastic young professionals serving on their state boards. And just as I experienced, this will lead to their excitement and desire to become involved with the AIPG, a path that I have been most blessed to have traveled.

I am committed to the growth and progression of our organization and excited about the collaboration between our members, staff, and officers. I am excited about our direction as a society and would be honored to receive your support for representing the 2019 National Executive Committee as the Young Professional member. Additionally, please let me know if you have any questions, thoughts, or input for continuing the development of the Young Professional member role by contacting me at [brandyb@idgsfl.com](mailto:brandyb@idgsfl.com).

Thank you for your consideration!



## Candidate for AIPG National Young Professional

**Erica L. Stevenson, YP-0238**  
*Farmington Hills, Michigan*

I am honored to have been nominated for the AIPG Young Professional Member for 2019. During my time as an active member of the Michigan Section I have grown to appreciate and admire the people of this organization that keep it running. I consider my membership with the AIPG as being one of great importance as its support has been crucial to my success. I humbly accept this nomination and look forward to the road ahead.

I began my time with the AIPG as one of the first student members of the Wayne State University Student Chapter. It was apparent to me that the AIPG was a great way for people like me to meet professionals in the field as well as to find support and advice. My time with the student chapter was not idly spent. I attended every quarterly and annual meeting. During the 2015 year, the Wayne State University chapter hosted the annual Christmas meeting for the Michigan Section. I and the chapter president at the time, Melissa Taylor, spear-headed the project and the meeting proved to not only be informative but also lucrative. A keynote speaker was present and a silent auction was held that helped to fund future Michigan Section meetings. I eventually became president of the student chapter during my last semester at Wayne State and encouraged new students to sign up and attend AIPG meeting. I still to this day stay in close contact with the Wayne State Student Chapter and help them to keep informed of upcoming meetings and scholarship opportunities.

If I am elected to be the AIPG Young Professional Member for 2019, I plan on focusing on 3 major topics: advocating the newly created Young Professional Member, representing the needs of young professionals entering the work force, and educating myself on the inner workings of the executive committee of the AIPG. The Young Professional membership designation is a great new opportunity for recent graduates to be able to gain support from the AIPG during arguably the most important time of their careers. Unfortunately, I do not think that this new position has been communicated effectively to the current student chapters. As the elected AIPG Young Professional Member, I will make it one of my duties to reach out to active student chapters at meetings to explain in detail the Young Professional membership designation. If resources allow, I would also like to reach out via email or social media to student chapters to further advocate the position.

Should I be elected, another task that I would take seriously is to better represent the needs of young professionals in the workforce.

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*AIPG Professionals bring wisdom and advice to the table that may not be getting to young professionals simply because the right questions aren't being asked. I would like to bridge this gap of communication by talking to young professionals about the problems they are facing as they begin their careers. I can then take these issues to back to the professionals within AIPG to root out some answers. A way to do this so that all young professionals within the AIPG could benefit from the advice given by others would be to simply publish an article in *The Professional Geologist*. Making the AIPG more accessible and useful to young members will ensure that the organization continues on for another fifty-five years.*

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The third goal of mine should you elect me would be to learn how the executive committee functions and how a respected national organization is managed. I believe this to be a very important task in that it allows for future generations to learn from their past leaders to ensure the longevity of the AIPG. Again, I see an opportunity for young professionals to learn from the wealth of knowledge that is held within the minds of the professional members. The AIPG is a great organization and we need to ensure that the people running it are capable people.

In summation, I have deep respect and love for the AIPG and the people it consists of. I think that the recent interest in the young professionals of our career field attributes to that. As the elected AIPG Young Professional member of 2019, I vow to better represent young professionals within the organization, advocate the Young Professional membership to students, and learn how to become a capable committee board member. Thank you for taking the time to read my mission statement and I hope that you share the same enthusiasm for these issues as I do.



## Candidate for AIPG National Editor

**John L. Berry CPG-04032**

*Austin, Texas*

I feel honored to be nominated to stand for a second term as AIPG National Editor. I value AIPG as an instrument for increasing professionalism in the practice of geology, for developing a body of thought and experience governing ethical practice, for developing a sense of cohesion and professional pride among practicing geological scientists, and as a national voice for geology as a profession. All of these functions become more important as the diversity of geological practice increases and as state registration of geologists spreads, fragmenting the profession intellectually and organizationally. Increasing specialization makes it more difficult to communicate with each other technically, and lack of institutional cohesion makes it difficult for us collectively to pull our weight in society. Therefore, as editor of TPG, if re-elected, I will focus on content that promotes professionalism, deepens discussion of ethical issues, and clearly communicates significant information in as wide a variety of technical areas as possible.

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*One important way to educate and engage people in professional affairs is to encourage open, informed, and polite discussion of issues that are somewhat controversial. TPG is one of the few places that this discussion can take place in a professional forum, and in the past year I have published letters to the editor and opinion pieces that express controversial, dissenting, or intriguing opinions, to encourage vigorous discussion of these issues. I intend to continue this practice.*

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I am also determined to increase the number and quality of peer-reviewed technical articles that we publish in TPG. To this end, I appeal to you, our membership, to write up your important contributions to the profession and submit them to us for publication. I intend that soon articles published in TPG will be indexed in the AAPG Data Pages, and therefore come to much wider attention.

Our profession affects public health, safety, and welfare in almost every way: ensuring clean water, facilitating environmental protection and clean-up, and addressing both geologic hazards and the hazards associated with producing essential fuels and minerals. We are also responsible for finding and quantifying the sources of these essential fuels and minerals. I will attempt to assist in increasing AIPG outreach to the public by clearly portraying the breadth and depth of our importance to society. I will also continue the focus on outreach to the students and young professionals who represent our future.

My background is in mineral exploration, mostly overseas, and in frontier exploration for oil and gas, entirely overseas. I have also done geophysics in the Arctic Ocean and some more academic work on weathering rates. I have had a long, varied, and satisfying career in geology and am happy use that experience to inform my work as editor, and thereby help to make the profession even more satisfying to those young people now beginning their careers.

I respectfully ask for you to vote for me for a second term as editor, and promise to do my very best to ensure that AIPG's publications do the best job possible of keeping you, our members, informed of what is going on in the Institute and the profession, and of keeping the world beyond us aware of the value of our profession to the nation and of the central rôle of AIPG within it.

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## New Applicants and Members

Can now be found on the AIPG website at

<http://aipg.org/membership/newappsmems.html>

**CANDIDATE FOR AIPG NATIONAL 2019 PRESIDENT-ELECT**



**J. Todd McFarland**

CPG-11348  
Nashville, Tennessee

**Statement of Purpose or Goals you have for AIPG:** Continue to promote advancement of the geological profession. Focus on the development of students and young professional members through on-line learning initiatives and networking events on a national and sectional level to foster interaction with our professional members. This will provide opportunities for potential career advancement and increase students and young professional members involvement with AIPG on a Student Chapter, Section, and National level.

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

Company	Title	Dates
Amec Foster Wheeler	Senior.Geologist	2006-Present
Shield Environmental Assoc., Inc.	Staff Geologist	2003-2006

AIPG Activities	Dates
AIPG National Meeting Committee Chairman	2017
AIPG Tennessee Section President	2017
AIPG Vice President	2015
Executive Committee Member - Advisory Board	2014
AIPG Tennessee Section Past President	2014
AIPG Tennessee Section President	2013

**CANDIDATE FOR AIPG NATIONAL 2019 PRESIDENT-ELECT**



**John M. Stewart**

CPG-11115  
Greensboro, North Carolina

**Statement of Purpose or Goals you have for AIPG:** My goal as President-Elect is to attend every meeting where my presence is required to prepare myself for the duties of President. I will work with other members of the Executive Committee and our membership to continue development of the National Accredited Professional Geologist category, work with our Young Professional Board member and members to help develop a sustainable plan to transition our student members to Young Professional status, and work with headquarters and our sister organizations to further develop our online education and learning modules.

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

Company	Title	Dates
ECS Carolinas, LLP	Principal Geologist	2011-Present
Trigon Engineering/Kleinfelder	Senior.Hydrogeologist	2001-2011
BPA Environmental & Engineering	Hydrogeologist	1989-2001
North Carolina Dept. of Environment, Health & Natural Resources	Hydrogeologist II, Supervisor	1987-1989
(Southwest) Missouri State Univ.	Instructor	1984-1987

AIPG Activities	Dates
AIPG National Advisory Board Representative	2010, 2011, & 2018
AIPG National Vice-President (Appointed)	2017
AIPG Carolinas Section President	2006-Present
AIPG National Student Outreach Committee	2013
AIPG National Position Statement Committee	2012
AIPG National Co-Chaired "Careers in Geology" Session - National GSA	2012
AIPG Carolinas Section Co-Chaired Water Resources Conference	2011

**CANDIDATE FOR AIPG NATIONAL 2019 VICE PRESIDENT**



**Nancy J. Wolverson**

CPG-11048  
Reno, Nevada

**Statement of Purpose or Goals you have for AIPG:** To encourage membership from all specialties of the geologic profession. As a national professional organization, we should use our breadth of experience and technical expertise to encourage students and young professionals in a career in the geologic sciences. The state sections and student sections should work together to promote career development at all levels of experience..

Universities Attended	Degrees Granted	Dates
Eastern Washington University	B.S. Geology	1978
Univ. of Nevada-Reno, Mackay School of Mines	M.S. Geology	1988
University of Missouri - St. Louis	M.B.A. Finance	2001

Company	Title	Dates
Self-Employed	Consulting Geologist	2008-Present
ICN Resources	Vice President, Exploration	2010
Self-Employed	Consulting Geologist	2007-2009
Western Energy Development Corp.	Vice President, Exploration	2006-2007
Self-Employed	Consulting Geologist	1996-2006
Marston & Marston	Senior Geologist	1995
Amax Gold Inc..	Senior Project Geologist/Acquisition	1989-1994
Minnova Inc.	Geologist	1986-1989
Amax Exploration Inc.	Geologist	1984
Dome Exploration (US) Ltd	Geologist	1981-1983
Bendix Field Engineering Corp.	Geologist	1979-1981
Western Nuclear Inc.	Geologist	1978

AIPG Activities	Dates
AIPG Nevada Section Membership Chair	2012-Present
AIPG National Advisory Board Representative	2017-Present

**CANDIDATE FOR AIPG NATIONAL 2019 VICE PRESIDENT**



**Shanna A. Schmitt**

CPG-11781  
St. Paul, Minnesota

**Statement of Purpose or Goals you have for AIPG:** I intend to continue to promote the geoscience profession. I will do so, in part, through outreach to students and geoscience departments. I will emphasize communication with each Section, listening to their input and assisting in their growth and development.

Universities Attended	Degrees Granted	Dates
Boston University	None (coursework)	1998
University of Hawaii at Hilo	None (field camp)	2001
University of Glasgow	None (coursework)	2001
University of Minnesota - Twin Cities	B.S. Geology	2003

Company	Title	Dates
Minnesota Pollution Control Agency	Hydrogeologist I/II/III	2006-Present
Terracon Consultants, Inc.	Field Tech/Staff Geologist	2003-2006
Minnesota Geological Survey	Student Worker	1999-2003

AIPG Activities	Dates
AIPG National Inter-society liaison on GSA's Prof. Development Committee (3yr. term)	2017-Present
AIPG Minnesota Delegate at National Conference in Nashville	2017
AIPG Minnesota Section Executive Committee Director (Outreach)	2017
AIPG National Advisory Board Representative	2016
AIPG Minnesota Section President	2016
AIPG Minnesota Delegate at National Conference in Alaska	2015
AIPG Minnesota Section Webmaster	2015
AIPG Minnesota Section Secretary/Treasurer	2011-2014

**CANDIDATE FOR AIPG NATIONAL 2019-2020 TREASURER**



**Christine F. Lilek**

CPG-10195  
Juneau, Wisconsin

**Statement of Purpose or Goals you have for AIPG:** Continue to promote advancement of the geological profession. Focus on the development of students and young professional members through on-line learning initiatives and networking events on a national and sectional level to foster interaction with our professional members. This will provide opportunities for potential career advancement and increase students and young professional members involvement with AIPG on a Student Chapter, Section, and National level.

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

Company	Title	Dates
Amec Foster Wheeler	Senior Geologist	2006-Present
Shield Environmental Assoc., Inc.	Staff Geologist	2003-2006

AIPG Activities	Dates
AIPG National Meeting Committee Chairman	2017
AIPG Tennessee Section President	2017
AIPG Vice President	2015
Executive Committee Member - Advisory Board	2014
AIPG Tennessee Section Past President	2014
AIPG Tennessee Section President	2013

**CANDIDATE FOR AIPG NATIONAL 2019-2020 TREASURER**



**Matthew J. Rhoades**

CPG-07837  
Golden, Colorado

**Statement of Purpose or Goals you have for AIPG:** To ensure that AIPG continues as a leading professional organization for working geologists. To continue to develop AIPG's value proposition in the core service areas, in promoting AIPG's visions and values to upcoming geologists and growing and refining AIPG for the next generation.

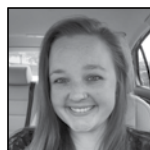
Universities Attended	Degrees Granted	Dates
University of Missouri - Kansas City	B.S. Geology	1981
Washington State University	M.S. Structural Geology	1984
University of Phoenix - Denver	M.B.A.	1992

Company	Title	Dates
J.T. Boyd Co.	Associate Senior Geologist	2016-Present
New Mexico Bureau of Geo. & Minerals	State Geologist & Director	2015-2016
WorleyParsons	Principal Geologist	2008-2015
Golder Associates	Associate Geologist	2004-2008
Maxim Technologies	Senior Geologist	2000-2004
Harding Lawson Associates.	Associate Geologist	1984-2000

AIPG Activities	Dates
AIPG National Conference Plenary Speaker	2016
AIPG National 50th Annual Conference Chairman	2013
AIPG Colorado Section President	2010

**Be sure to cast your vote by June 30, 2018!**

**CANDIDATE FOR AIPG NATIONAL 2019 YOUNG PROFESSIONAL**



**Brandy M. Barnes**

YP-0195  
Clermont, Florida

**Statement of Purpose or Goals you have for AIPG:** To enlighten students and young professionals on the importance of membership in professional organizations, such as AIPG, and provide leadership and mentorship during their journey and advocating for their success at the state and national level. To be a resource to the Executive Committee and our members on topics surrounding membership as well as advocating for student and young professionals in the matters of professionalism, mentorship, ethics, and licensure. To bridge the gap between what AIPG has learned in its many years as an organization and how we can grow into a better organization into the future..

Universities Attended	Degrees Granted	Dates
Middle Tennessee State University	B.S. Geology	2015

Company	Title	Dates
Integrity Drilling and Geophysical Service	Graduate Geologist	2015-Present

AIPG Activities	Dates
AIPG National Young Professional Representative	2018
AIPG Annual Meeting Student Day Presenter	2017
AIPG Florida Section Young Professional Member	2016-Present
AIPG MTSU Student Chapter Founder/President	2015-2016

**CANDIDATE FOR AIPG NATIONAL 2019 YOUNG PROFESSIONAL**



**Erica L. Stevenson**

YP-0238  
Farmington Hills, Michigan

**Statement of Purpose or Goals you have for AIPG:** I plan on being the voice for young professionals within the AIPG organization. I wish to translate the needs of recent graduates to more experienced professionals so that they can recruit happy, intelligent individuals that will go on to be Certified Professional Geologists. I also wish to learn how to properly run an organization of this size so that younger generations can take on the task as others step down.

Universities Attended	Degrees Granted	Dates
Wayne State University	B.S. Geology	2015

Company	Title	Dates
Golder Associates	Staff Geologist	2016-Present
Arch Environmental Group	Consultant I	2015-2016

AIPG Activities	Dates
AIPG Michigan Section Workshop Planning Committee	2017-Present
AIPG 5 Year Longevity Award	2017
AIPG Wayne State Student Chapter Founding Member/President	2015



**CANDIDATE FOR AIPG 2019-2020 NATIONAL EDITOR**



**John L. Berry**

**CPG-04032**  
Austin, Texas

**Statement of Purpose or Goals you have for AIPG:** To increase the role of TPG in strengthening AIPG, and geoscience as a profession, by taking active measures to attract more articles for peer review, as well as by publishing pieces that will attract serious discussion. To further increase outreach to the public and to prospective members especially students and young professionals. To continue focusing on ethics.

Universities Attended	Degrees Granted	Dates
University of Pennsylvania	B.A. Geology (with Honors)	1983
Columbia University	M.A. Geology & Geophysics	1986
Royal School of Mines (London)	.	1973

Company	Title	Dates
John Berry Associates,	Owner	1999-Present
Shell Oil Company	Staff Geologist (Research)	1982-1999
Earth Satellite Corporation	Senior Geologist	1977-1982
Self-Employed	Geologist	1975-1977
Southwestern Tech. Inst.	Part Time Faculty (Earth Sci.)	1973-1975
Zambian Anglo-American Corp.	Staff Geologist	1966-1971

AIPG Activities	Dates
AIPG National Editor	2017-Present
AIPG National Associate Editor	2016-2016

**2018 National Officer Voting Instructions**

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 CPGs, Members and Young Professionals are authorized to Vote.**

**Ballots Must Be Received At headquarters By JUNE 30, 2018. Your AIPG name and Member number Must Be Printed Below For The Ballot To Be Valid.**

*Your Vote Matters!*

**Mail Ballots to:**

**AIPG**  
**1333 W. 120th Avenue, Suite 211**  
**Westminster, Colorado 80234-2710**

**Official AIPG 2018 Ballot National Officer Election**

**President-Elect**  
President in 2020

**Vice-President**  
Term of office 2019

**Treasurer**  
Term of office 2019-2020

J. Todd McFarland, CPG-11348

Shanna A. Schmitt, CPG-11781

Christine F. Lilek, CPG-10195

John M. Stewart, CPG-11115

Nancy J. Wolverson, CPG-11048

Matthew J. Rhoades, CPG-07837

**Young Professional**  
Term of office 2019

**Editor**  
Term of office 2019-2020

**Name**  
\_\_\_\_\_

Brandy M. Barnes, YP-0195

John L. Berry, CPG-04032

**Member Number**

Erica L. Stevenson, YP-0238

\_\_\_\_\_

**Vote online or mail in this ballot**

# Letters to the Editor

## “How does one distinguish between Physical Geology and Historical Geology?” A comment on David Abbott’s “Geology Curriculum Then and Now “ (OctNovDec 2017 issue)

Kudos to David M. Abbott, Jr., for his contribution “Geology Curriculum Then and Now” in the Oct.Nov.Dec 2017 issue of *The Professional Geologist*. Some exam! In trying to answer the questions in the exam, it became evident that most of them dealt with matters pertaining to Historical Geology and that I had to hit my Historical Geology texts to answer many of them. Either consciously or unconsciously, Mr. Abbott’s father provided his students with half of the answer to the question on “*How does one distinguish between Physical Geology and Historical Geology?*”

Physical Geology focuses on the internal and external processes responsible for shaping the Earth’s interior and exterior throughout geologic time (about 4.6 billion years). The internal processes are closely connected with the flow of heat from Earth’s hot interior to its cooler exterior. Some of this heat is “primordial,” derived from the heat generated through the collision and accretion of planetesimal matter when the Earth was formed, and some of it from the decay of radioactive isotopes like U-238, with a half-life of 4.5 billion years. The external processes are driven by the heat emanating from the Sun and mediated by the forces of rain, hail, snow, ice, wind, and gravity, the processes of alternating heating & cooling (e.g., in desert terrains) and alternating freezing & thawing (e.g., in areas subjected to permafrost), and the activities of both flora and fauna.

In 1936, at the time of the exam, the internal processes that give rise to the Theories of Sea-Floor Spreading and Continental Drift were not well understood, although the Theory of Continental Drift had already been introduced by Alfred Wegener in 1912. He based his theory on the configuration of the American, European, and African - especially the South American and African - coastlines (Fig. 1), which suggests a one-time close fit\*. Lacking a driving mechanism to



**Figure 1** - The Mid-Atlantic Ridge extends from near the Antarctic northwards all the way to, and across, the Arctic Ocean. Iceland is the exposed part of a “hot spot” where the amount of lava extruded far exceeds that extruded at other places along the ridge. On this shaded relief map the ridge is the complex region of narrow ridges and valleys in the center of the ocean. (Basemap originally by National Geographic)

account for the separation of Europe and Africa from the Americas, the theory was contested by many, if not most, geologists till around 1962 when Harry Hess coined the term Sea-Floor Spreading. This mechanism explains the breakup and separation of continental landmasses, like the breakup and separation of Pangaea into Laurasia and Gondwanaland at the end of the Jurassic Period, throughout geologic time. It is based on the observation of hot mantle “rock”, i.e., magma, moving upwards through the process of convection and being extruded along divergent, i.e., spreading, plate boundaries like the



**Figure 2** - Bridge in Thingvellir National Park, extending from Europe (Left) to America (Right). The valley is formed by the latest movements of the two continents apart. It is about 50 feet wide and represents about 775 years of separation.

Mid-Atlantic Ridge - which lies exposed on the island of Iceland, about 25 miles northeast of its capital Reykjavik, at Thingvellir National Park (Fig. 2) - the East Pacific Rise, and the mid-oceanic ridges of the Pacific and Indian Oceans.\*\* It is this process of Sea-Floor Spreading and Continental Drift that gives rise to some of Earth’s mountain ranges, like the Himalayas, which were created by the collision of the (sub-)continental Indian landmass with that of the continental landmass of Asia, and like the Andes, which were created through the subduction of the more dense, mafic, simatic oceanic crust beneath the less dense, felsic, sialic continental crust of South America. This process of subduction is accompanied by an increase in volcanic activity resulting in the so-called Pacific “Ring of Fire.” On occasion, sudden rapid surges in the subduction process lead to earthquakes and tsunamis.

Both internal and external processes working together are responsible for today’s distribution of Earth’s continents and oceans, the distribution of its sedimentary rock formations through the processes of weathering, erosion, and deposition with subsidence, the distribution of its metamorphic rock units (e.g.,

\* Interestingly, the idea of Continental Drift was first alluded to in 1596 by Abraham Ortelius, born in Antwerp, Hapsburg Netherlands, i.e., today’s Belgium, based on his observation of the geometric similarity between the coasts of the Americas and those of Europe and Africa, in one of his many publications dealing with cartography.

\*\* The mid-oceanic ridges in the Pacific and Indian Oceans which separate the American, Asian, African, and Australian continents from that of Antarctica, and the East Pacific Rise which separates the South American continent from Asia.

Georgia's Lithonia Gneiss) through the burial and subjection of sedimentary rocks to high pressures, stresses and temperatures at great depths, the distribution of its igneous intrusive rock units (e.g., Georgia's Stone Mountain, a quartz monzonite monolith) through the intrusion of magma, and the distribution of igneous extrusive rocks through the extrusion of lava (e.g., the Columbia Plateau basalts of Washington, Idaho, and Oregon, and the Deccan Plateau basalts of India\*\*\*), the distribution of its various geologic terrains and structures, the distribution of its mineral and - most importantly - fresh water\*\*\*\* resources, and the distribution of its glaciers, both Alpine (e.g., the Swiss Alps) and Continental (e.g., Antarctica, Greenland, and Iceland's Vatnajökull).

While Physical Geology focuses on the internal and external processes that shaped and shape the interior and exterior, i.e., the surface, of the Earth, Historical Geology focuses on

determining the geologic age of the results – e.g. the time of deposition, intrusion and extrusion, and the times of mountain building (orogenesis, accompanied by folding and faulting) and glaciation (Ice Ages) – brought and being brought about by these processes. To do this, geologists rely on the following laws or principles: The Law of Original Horizontality, the Law of Lateral Continuity (allowing correlation), the Law of Superposition, the Principle of Cross-Cutting Relationships, the Laws of Faunal Succession (from simple, non-nucleated single-celled invertebrate to complex, nucleated, multi-cellular, vertebrate organisms), and the Law of Floral Succession (from seedless, pollen to seeded procreating plants), and call on the disciplines of Stratigraphy, Sedimentology, Paleontology, and Geochronology, amongst others.

Respectfully Resubmitted,

**Erik H. Schot, Ph.D., MEM-2189**

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### Acknowledgements:

*I thank John Berry for contributing to this paper in time, effort and with the two figures.*

\*\*\*The extrusion of the Deccan Plateau basalts at the end of the Cretaceous Period has been cited as one of the possible causes contributing to the demise, i.e., extinction, of the dinosaurs.

\*\*\*\*Fresh water makes up less than 3% of Earth's water budget (more than 97% of Earth's water is tied up in sea-water), and of that more than two-thirds is tied up in glacial and sea-ice (e.g., in the Arctic Ocean).

## Comment on “Just the ‘fracts’: Educating the public about fracking” (vol.55, no.1, p.46)

I laud efforts by AIPG members to become involved, and to try and educate the public about issues. Hoyt and Durbin gave a nice primer on the ‘new’ technology. However, it is important to realize that it isn't just about geology. And, it might be useful to be a bit more informed about fracture stimulation and horizontal drilling.

First of all, fracking and horizontal drilling are not new. In 1859, Colonel Drake drilled his first successful oil well. During the following year a number of wells were drilled around his location. Not all of them were as good as his. So, in 1860, five of them were fracture stimulated with dynamite. This led to some improvement in production. Between 1860 and 1865 there were 30 dynamite, fracture stimulations to enhance production in oil wells. In 1865, nitroglycerin was first used instead of dynamite. In 1866, the nitro torpedo patent was received. Nitroglycerin torpedoes were used in oil wells from then until the early 1940s; pretty much as a standard procedure. Driving a nitro wagon, and later a nitro truck was viewed as one of the riskier jobs in the oil patch. In 1941,

a nitro truck blew up on a public highway in Pennsylvania. The industry realized they had to find a safer, better way to fracture-stimulate wells.

The first hydraulic fracture stimulation of a well occurred in March of 1947. Hydraulic fracturing had several advantages: 1) it was non-explosive, 2) it could transport proppant into the formation to keep fractures open, and 3) it was more targeted to the formation.

In 1967 and 1973, western Colorado experienced two radical attempts at fracturing to stimulate gas production in tight sandstone. They took the form of underground nuclear explosions: project Rulison and project Rio Blanco. These were not a resounding success.

As for horizontal drilling, we were drilling horizontal wells, and successfully fracture-stimulating them, in the Austin Chalk in the mid-1980s. The technological breakthroughs of the 21st century were really about the ability to achieve multi-zone fracs without coming out of the hole each time, and better steering and drilling technology to make for faster, more accurate horizontals. That greatly enhanced economics.

So, what is the fuss really about? I believe that it's not hydraulic fracturing in and of itself. In my experience it is one, many, or all of the following: truck traffic in neighborhoods; noise from drilling operations; storage tanks near schools; light pollution from drill rigs; smells from storage tanks; diesel smells from drilling operations spills at the surface; induced earthquakes; potential aquifer contamination; split estate grievances; wastewater disposal; “get rid of fossil fuels” attitude, origin of the water source for fracturing and to compound all of this, the level of activity is much greater and it is around much longer.

When I was teaching at Professor Hoyt's institution in the early 1970s, hydraulic fracturing was already going full blast in the Denver Basin. However, there were very few objections because the well spacing was 640 acres, i.e. one well every square mile. Most folks didn't know the wells were being drilled except when a flare was lit for testing. And, farmers were getting some good money out of it.

*Continued page 54*

# Connecting Geoscientists and Policy Makers at All Levels: AGI's Geoscience Policy and Critical Issues Programs

Cassandra Rose\*, Michelle Barreto, Maeve Boland, Leila Gonzales, Ben Mandler, Anna Normand

\*Corresponding author: [crose@americangeosciences.org](mailto:crose@americangeosciences.org), AGI Policy and Critical Issues program manager

Geoscience information is an essential part of modern life, allowing us to find and produce the minerals, materials, and energy sources that make up and power our world; to harness and protect sources of clean drinking water; to identify safe places to build and live; and to better adapt to changes, both small and large, in the environment. The American Geosciences Institute's (AGI) vision (<https://www.americangeosciences.org/about>) is for a world that understands and trusts the role of the geosciences in fostering creative solutions for the Earth and humanity. To achieve that vision, AGI represents and serves the geoscience community of over a quarter million geoscientists by providing collaborative leadership and information to connect Earth, science, and people.

## What We Do

AGI's Geoscience Policy and Critical Issues programs support well-informed public policy and decision making by providing information and facilitating dialogue between the geoscience community and decision makers. The Geoscience Policy program, started in 1992, focuses primarily on federal geoscience policy activities in Washington, D.C., promoting and facilitating an all-way dialogue between the geoscience community, Congress, and the Administration. The Critical Issues program, which began in 2013, communicates reliable, freely available geoscience information to decision makers at all levels, with a focus on the state and local level. Both programs provide a variety of information services to help geoscientists and decision makers to track federal geoscience policy developments, access geoscience information on a variety of topics, and communicate about applied geoscience. We will highlight a few examples of recent information products that may be useful to AIPG members below, including opportunities for students to learn about geoscience policy and communications in action.

## Collaborations with AIPG: Professional Development Opportunities

AGI and AIPG have a long history of collaborating on projects and initiatives that engage geoscientists in geoscience communication and policy issues. AIPG first joined AGI as a member society in 1964, and has collaborated with AGI on a variety of efforts, including generously sponsoring Geoscience Policy internships for geoscience students and working on the Geoscience Online Learning Initiative (GOLI) (<https://www.americangeosciences.org/workforce/goli>), a platform of

webinars and asynchronous online courses that provide geoscientists with life-long learning and continuing education opportunities.

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**More recently, AIPG and the Critical Issues program have collaborated to expand the GOLI platform to include content from the Critical Issues webinar series. The Critical Issues program holds free webinars several times per year on a variety of decision-relevant topics, including natural hazards, mineral and energy resources, and water issues. Webinars feature three or more experts and decision makers who highlight major issues surrounding the specific topic as well as case studies of how those issues are being addressed at state and local levels. Starting in 2017, the Critical Issues program has collaborated with AIPG to provide Continuing Education Units (CEUs) for attendees of these webinars for a nominal fee. In addition, the content of these webinars has been used to create asynchronous online courses that are available for free in the GOLI course catalog.**

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## Geoscience in Your State

In late 2017, the Geoscience Policy program introduced the Geoscience in Your State factsheets [Figure 1], which feature information on natural resources and hazards, the geoscience workforce, and federal investment in the geosciences for each state in the U.S. These one-page factsheets are designed to show federal and state legislators and policy makers the importance of the geosciences to their state. The factsheets are available for public use and located on AGI's Geoscience Policy and Critical Issues website (<https://www.americangeosciences.org/policy/factsheet/states>). Geoscience Policy staff also monitor relevant developments in federal geoscience policy, which are summarized as news briefs and distributed in the Geoscience Policy Monthly and Annual Reviews.

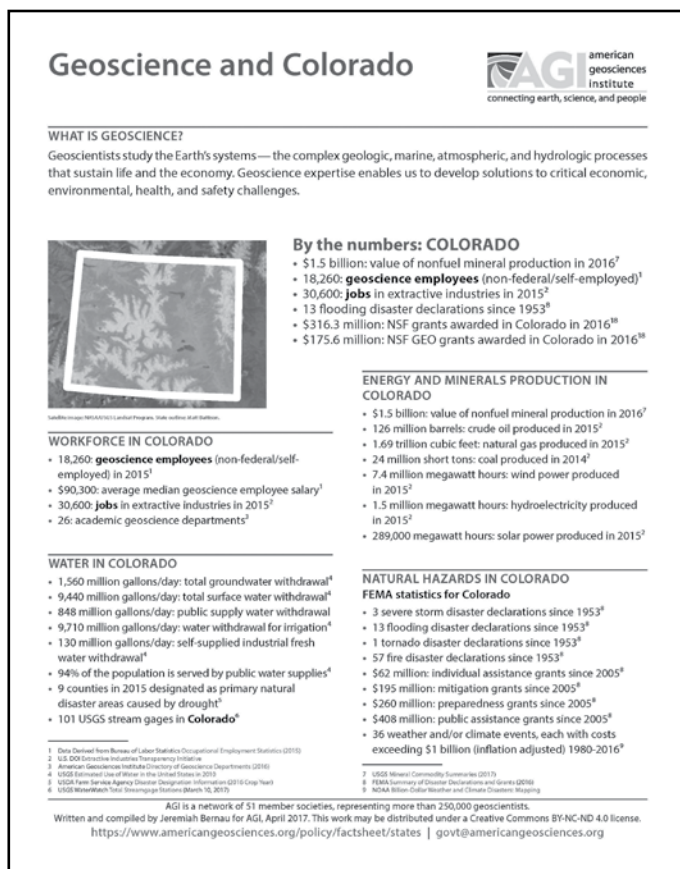


Figure 1. Geoscience and Colorado state factsheet, containing information on the geoscience workforce, water, energy and minerals, natural hazards, and federal geoscience investment in Colorado.

## Highlighting the Applied Geosciences

State and local decision makers have asked for examples of how geoscience can be used to solve various challenges facing their communities. To fill this need, Critical Issues has collaborated directly with individual geoscientists and decision makers to produce a series of factsheets and case studies covering topics such as managed aquifer recharge projects; hazard monitoring and mitigation; intersections between geoscience and the built environment; and much more. We look forward to collaborating with many more geoscientists on these highly requested examples of applied geoscience.

## AGI Resources and Opportunities

- **AGI's Policy and Critical Issues website:** <https://www.americangeosciences.org/policy-critical-issues>
- **AGI's Geoscience Online Learning Initiative:** <https://www.americangeosciences.org/workforce/goli>
- **Internship opportunities:** <https://www.americangeosciences.org/policy/internships-and-fellowships>
  - *Both the Geoscience Policy and Critical Issues programs invite any students or recent graduates who are interested in learning about the legislative process as it relates to the geosciences or geoscience communication to apply for our paid internship opportunities at AGI headquarters just outside of Washington, D.C., available year-round (check the website for current deadlines and opportunities).*
- **Sign up for the Policy and Critical Issues mailing lists for the latest information and news:** <http://crm.americangeosciences.org/civircrm/mailling/subscribe>



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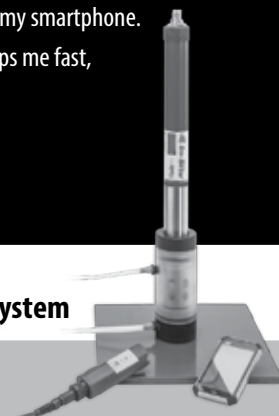
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# Demystifying Personal Brand for Resources Professionals

Dave Yeates, Design Thinking and Digital Strategist

*This article was originally published in the December 2017 edition of the AusIMM Bulletin and is available at [www.ausimmbulletin.com](http://www.ausimmbulletin.com). It is reprinted by kind permission of the Australasian Institute of Mining and Metallurgy and the author, who may be reached at [www.dwhy.com.au](http://www.dwhy.com.au).*

Perhaps the best way to start explaining what personal brand is, and why it is important, is by sharing a personal anecdote.

I once stepped into an elevator with a famous musician. I was startled and managed a smile and a nod to him as we stepped inside. My wife, oblivious to this person's fame, said 'Hi!' and followed up with some elevator small talk. As the musician disembarked at his floor and the doors shut, I looked at my wife in expectation: 'Do you know who that was?'

When discussing personal brand, it helps to have that simple question in mind: do people know who you are?

Personal brand applies to every professional in the working world – including those who work in the mining industry. When there is an appreciation of just how much a career can be developed and accelerated by taking control of that personal brand, it can help people rethink how they invest in it. A well-established personal brand can prove pivotal in finding new work, gaining the attention of your superiors or becoming recognized and acknowledged for your own technical expertise.

For technical professionals, it would be reasonable to expect a level of skepticism and criticism on this topic. For individuals focused on best practice and the continuous development of skills and knowledge, a conversation about 'personal brand' precipitates questions that may make them feel vulnerable, such as:

- 'How many followers do I have?'
- 'How famous am I?'
- 'How often do I speak in public?'

The pursuit of a 'personal brand' may seem overly self-serving; but let me reassure you: None of the 'metrics' associated with a successful public profile are linchpins in building a personal brand that can help you in your own career.

My wife had no idea who that person in the elevator was. And that's OK. Because to me, that guy was special – important even. So, the next time you're weighing up whether your personal brand is important, remember this: your partner may not recognise the people you look up to. But a crucial question to keep in mind is: what are you going to do for the small group of people who might be looking up to you?

As further explanation of how to build a strong personal brand, and why it is important, allow me to deconstruct some myths.

## Myth #1. You have to be famous or important

The funny thing with famous people is that, once upon a time, they weren't at a certain point in their career – some before their 'big break' and others afterward – they chose to invest in a personal brand that would ensure they were noticeable, memorable and interesting. Yes, celebrities do have strong personal brands; but they are not alone. Stop thinking about celebrities and start to think about interesting people in your own industry. What makes them interesting? It's not about being famous, rich or important – it's about being remembered for something.

## Myth #2. You need a high-profile, successful career

Well, if it's not fame, then it's success? Right? Wrong. The personal brand of a professional in the resources industry exists whether you're a first year graduate or a technical expert with 40 years' experience. It's the product of you 'doing your thing'. The difference between those with a powerful brand, and those with none at all, is the conscious decision to invest in it. This requires an investment of time, resources and risk-taking. It's not about a high-flying career; just find

## 'Personal brand applies to every professional in the working world – including those in the mining industry.'

your audience and be interesting to those you wish to influence or impress.

## Myth #3. You have to be a millennial (with Instagram)

Personal branding has been around long before Instagram, Facebook and YouTube. You don't need to be a tech-savvy, whimsical millennial who likes to travel the world and not commit to anything. While social media is beneficial in building connections and audiences, it is not the be all and end all of personal brand. In fact, a resources professional might instead build a profoundly powerful personal brand by simply showing up to every industry event and technical meeting. Capture attention and provide your audience with the gems they need from you. Do this and your age and proclivity to use Instagram becomes secondary.

## Myth #4. You can't be yourself

Some clever people have managed to build extraordinary careers out of caricatures of their lives or personalities. But that work and that commitment takes serious effort made possible by the talented few. A strong personal brand may be more easily built around a genuine and interesting personality. Again, think about the people you know, or know of, in your industry – people you might not call celebrities, but who

*Continued on page 29*

# World Leading Economic Geologist Appointed as SFI Research Professor at University College Dublin and as New Director of iCRAG

Minister of State for Community Development, Natural Resources and Digital Development, Seán Kyne TD, has announced the appointment of Professor Murray Hitzman, CPG, a world leading economic geologist, as a Science Foundation Ireland (SFI) Research Professor at University College Dublin (UCD) and as the new Director of the Irish Centre for Research in Applied Geosciences (iCRAG), an SFI Research Centre co-funded by the European Regional Development Fund and industry partners.

Professor Hitzman, who was responsible for building and directing the largest economic geology research group in the United States at the long-established and highly respected Colorado School of Mines, has several decades of global experience. His key research achievements have centred on the development of new generic models for both established and poorly understood classes of metallic mineral deposits.

Professor Hitzman, who is moving to Ireland following his position of Associate Director for Energy and Minerals at the US Geological Survey,

has a proven record as an ore-finder and mine developer, primarily for copper, lead, zinc, gold, and rare earth minerals, across Europe, North & South America, Australia/Oceania and South America.

Professor Hitzman will lead a new €4.7 million research programme at the UCD School of Earth Sciences, supported by Science Foundation Ireland. The programme will employ 16 researchers over 5 years, and is focused on studying the geology, geochemistry and geophysical signature of mineral deposits in the Irish zinc-lead orefield and other mineral systems across Europe and Africa.

Making the announcements last night at the 2018 Prospectors and Developers Association of Canada (PDAC) international convention in Toronto, Minister Seán Kyne TD, said, *"I am delighted by the appointment of Professor Murray Hitzman as Director of iCRAG. Professor Hitzman is one of the world's leading economic geologists with an exceptional track record of research and discovery of mineral deposits. His experience also includes the hydrocarbon sector. He will shape iCRAG's research programme, which will place Ireland at the forefront*

*of geoscience research. This is an exciting development for iCRAG and demonstrates Ireland's ability to attract leading international geoscientists."*

Professor Hitzman's research programme will complement, build upon and significantly extend the raw materials research of iCRAG, broadening and deepening Ireland's research on its zinc-lead orefield, and establishing, for the first time, major research initiatives on European and globally significant mineral systems.

For further information contact Micéal Whelan, Public Affairs Manager, UCD Research and Innovation, e: [miceal.whelan@ucd.ie](mailto:miceal.whelan@ucd.ie), t: +353 1 716 4003 or Dr Fergus McAuliffe, iCRAG Communications Manager, e: [fergus.mcauliffe@icrag-centre.org](mailto:fergus.mcauliffe@icrag-centre.org), t: +353 1 716 2941.

<http://www.ucd.ie/innovation/newsevents/news/2018/march/murrayhitzmanappointedatucdandicragannounced/>

## Demystifying Personal Brand *(continued from page 28)*

maintain their own professional profile and respect across their industry. Who are they? What makes them interesting? What makes them known and respected? Chances are they have strong sense of self-belief, and are good at combining their best work with a personality that people want to get to know.

### **Myth #5. You need to be a speaker, author or entrepreneur**

Some of the most powerful personal brands in the world are the senior executives in the corporations around us. They've built excellence into their career by delivering value consistently, invested in their profile, become interesting

and noticeable in some way and have used all of those things to ensure people value their thoughts, opinions and insights in the workplace. Professionals don't have to be keynote speakers or entrepreneurs to have a personal brand. You already have one.

### **Summary**

Here are some key points to remember when thinking about your own personal brand:

- it's not about being famous, it's about being remembered
- it's not about a high-flying career, just be interesting to someone
- focus on the audience, let the channels choose themselves

- capture attention and give your audience the gems they need from you
- combine your best work with a personality that people want to get to know
- be yourself
- invest in your profile.

It is worth thinking about your own personal brand and the sphere of influence you command today. Where do you do excellent work? Where are people listening to you? Where do you need to grow, both in expertise, and in profile?

Beginning with these questions will give you a solid starting point to commence developing and investing in your own personal brand.



# The Future of Critical Minerals

**Aaron W. Johnson, MEM-2783**  
[awj@aipg.org](mailto:awj@aipg.org)

On December 19, 2017, the United States Geological Survey (USGS) released Professional Paper 1802: “*Critical mineral resources of the United States—Economic and environmental geology and prospects for future supply.*” The next day, President Trump signed executive order #13817, which outlines a federal strategy to provide secure, reliable, supplies of critical minerals. On December 21, Secretary of the Interior, Ryan Zinke signed a secretarial order directing bureaus within the Department of the Interior to begin identifying immediate domestic sources of critical minerals. These actions reflect an increasing interest in the role that minerals and mineral-related commodities play in the economic health and welfare of the United States.

The United States is not alone in having a renewed interest in critical minerals. In 2014, the European Union initiated the Horizon 2020 program, a research and innovation program that provided €80 billion (about \$110 billion) to support research and innovation across a wide variety of science and social science disciplines, with the aim of driving economic growth and creating jobs. Raw materials were a specific focal area of Horizon 2020 with about €660 million (\$900 million) made available for research focusing on all aspects of the raw materials supply chain, from exploration and development to recycling and post-mining remediation.

The European Federation of Geologists (EFG) proposed two ambitious research projects under the Horizon 2020 banner. The first, INTRAW, focused on developing a raw materials observatory that would provide cutting edge information on raw materials, at all points along the raw materials supply chain. AIPG was a collaborating partner, helping to identify persons that are experts in raw materials, assisting in the development of the institute, and disseminating information about the institute as development moved forward. In November, 2017, the International Raw Materials Observatory launched, with the immediate goal of providing state-of-the-art reporting of the global status of the raw materials supply chain. The second, KINDRA, focuses on developing a common terminology for groundwater resources and attempts to qualitatively and quantitatively assess groundwater resources in the EU. Both proposals focus on understanding critical natural resources. These programs were initiated in 2015, and both are nearing completion. As result, it is clear that the EU is more advanced with respect to assessing their current resources and anticipating future needs than the United States.

What does this increased interest in critical minerals mean for geologists in general, and for members of AIPG?

The answer to that question lies in the aforementioned USGS professional paper and in recent budget talks within the Department of Interior. Generally speaking, a critical mineral is one that has important economic uses, and for which we currently have no viable substitute. In addition, to be considered a critical mineral, the mineral commodity must also be subject to a potential disruption in supply. In Professional Paper 1802, the USGS identified 23 critical minerals. The United States relies on imports for more than 50% of the nation’s supply of 20 of the 23 minerals. China, Russia, South Africa, Brazil, and Canada are our primary sources of imported minerals, with China providing a plurality of imported resources.

In a recent budget summary briefing, Department of Interior (DOI) Associate Deputy Secretary James Cason outlined specific budget priorities and goals within the DOI. Among those goals was to increase revenue generation from energy, mineral, timber, and grazing resources on federally held lands. Taken in combination with President Trump’s executive order and Secretary Zinke’s secretarial order, it is reasonable to conclude that federal support for mineral exploration and production will increase. Whether or not the renewed interest in domestic production results in an increase in financial support remains to be seen. Regardless, in the near term the climate appears to be more favorable for exploration on federal lands.

While it is likely that increased interest in exploration can provide a boon for both exploration geologists and those who work in permitting and remediation, with increased activity comes additional potential for adverse impacts on public lands. These impacts often are poorly understood by the general public, many of whom still view extractive industries through a 19th century lens, and are unfamiliar with modern exploration and extraction methods. AIPG members are well-positioned to provide important information to all stakeholders if and when additional exploration on federal lands commences. Moving forward, it is my hope that AIPG Sections and members will play an important role in providing the best available information and sound advice to policy makers, land managers, and the general public with respect to exploration for and extraction of mineral resources on public lands.

I hope each of you has a safe and productive spring.

Best Regards,

Aaron W. Johnson





# Let the good times roll (until they don't)!

R. Douglas Bartlett, CPG-08433  
dbartlett@clearcreekassociates.com

Since 2018 began, it has been hard to take my eyes off the stock market reports. Consistent steady rises continued through 2017 and into January 2018. Then, as you all know, things changed and a correction to stock prices unfolded rapidly with some stomach-churning plunges. Markets change – good times are followed by bad which are followed by good – and the cycle continues. This brought to mind my career as a geologist because many of us, especially those new to the profession, are strongly influenced by market fluctuations.



Right now is a good time to get into geology as many sub-disciplines of geology are hiring. The Bureau of Labor Statistics reports that “the employment of geoscientists is projected to grow 14 percent from 2016 to 2026, faster than the average for all occupations” (<https://www.bls.gov/ooh/life-physical-and-social-science/geoscientists.htm>). Drillers are busy – a good indication that geologists are also busy. When things are good, it is often hard to consider the opposite condition – markets plunge, investment dries up, and employers stop hiring.

I have experienced 4 or 5 of these cycles during my 40 years as a geologist. Each one is nerve racking, but none more so than the one I experienced as a young, 20-something geologist in the early 1980's. In the late 1970's economic geology was booming – gold hit an all-time high in November 1980 that, when adjusted for inflation, was near \$2,500

per ounce (today, the price of gold is about \$1,350/oz). Gold exploration was at a fever pitch which is why I found myself 500 miles deep in the Amazon jungle in the fall of 1980 – when the



price of gold spiked. Using an Empire hand drill, we evaluated a promising gold placer deposit. I spent two long months in the jungle (pictured above), and then returned (weighing much less) to my job as a consulting geologist in Denver. Just months later, the writing was clearly on the wall – better start looking for another job because the bottom fell out of the metals market and geologists were getting laid off in droves.



That was how fast things turned around at that time of apparent plenty for geologists. Instead of looking for a new job, I decided it was time to head back to school and get a Master's degree in Geology. Which brings me to the subject I really wanted to touch on with this column – preparing for the next downturn! Everyone needs a plan or at least recognition that another downturn

will happen, for sure. The good times will end, the party will be over, and we all will need to make some adjustments.

If you are starting out as a geologist, it doesn't hurt to start thinking about your long term future and how economic cycles will impact your career. If a downturn hits, many people get tense, anxious, or depressed as their source of income suddenly becomes less than certain. Don't panic! Here's what you can do.

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***First, don't put your head in the sand during the good times. Visualize the possibility that a downturn could happen tomorrow and decide what you would do. Are there skills that you can begin to learn now during the good times that would help you in a downturn? Can you build a rainy day fund to tide you over? The earlier you start, the easier it is to save enough to provide that cushion in the event of a job loss.***

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Most importantly, recognize an economic downturn as an opportunity. Besides challenging, change can be invigorating to one's career. In my case, it spurred me to go back to school and burnish my geology skills through additional formal education. It would be easy to just continue to get that paycheck every two weeks and avoid all the hard work involved in education – whether formal or informal. But the possibility of the loss of a job is a good incentive to get out of your comfort zone and expand your horizons. Do what you can while times are good so you are ready when they're not so good.

There are many online educational courses that you can easily fit into a busy schedule. AIPG is developing a number of webinars (go to <http://aipg.org/onlinecourses>) as part of the Geosciences Online Learning Initiative (GOLI). Besides learning new skills, you can also earn Continuing Education Units (CEUs). Most of these courses take an hour or two of your time and can introduce you to other aspects of a geologic career that you may not have thought about. There are courses on improving employment placement for students, mineral resources estimation, developing high resolution LNAPL conceptual site models, understanding geologic

hazards, an introduction to landslides or mass wasting, understanding global energy resources, making a good PowerPoint presentation, and several courses on professional ethics taught by AIPG's renowned ethics expert, David Abbott. There are currently 17 courses provided on AIPG's website and more on the way. Take advantage!

Finally, get involved in societies such as AIPG so that you can meet other professionals. The contacts you make in these organizations can be invaluable when you are looking to make a change – whether due to a downturn or because you think it is time for a change. Becoming an active participant

makes you stand out against your peers that do not participate. I have loved every minute of my time participating in AIPG, the Society of Mining Engineers, the American Society of Civil Engineers, the Arizona Hydrological Society, the Denver Region Exploration Geologists Society, among others. Make sure to join and participate in both a local organization and a national society – they provide different but equally important benefits. Please plan to attend AIPG's Annual Conference to be held in Colorado Springs, September 8-11, 2018 (<http://aipg.org/2018Conference>).

May the cycle be with you!



## “Tracking the Global Supply of Critical Materials”

*webinar is now available to watch*

The webinar on “Tracking the Global Supply of Critical Materials” organized by the American Geosciences Institute took place on January 26, 2018. It was co-sponsored by the European Federation of Geologists (EFG) and its president, Vitor Correia, was one of the key-speakers. It had a total of 754 registrants and 400 live attendees from 48 different countries. Ph.D. Nedal Nassar (Chief of the Materials Flow Analysis Section in the National Minerals Information Center at the U.S. Geological Survey) was the other speaker in this discussion about the global supply of critical materials and the challenges it is facing.

The key topics addressed during the webinar were:

- How critical materials are monitored around the world from U.S. and EU perspectives
- Examples of how mineral criticality evolves over time in response to demand, politics, and technology
- How these monitoring data can be used

The webinar was recorded and is available at the link below:

<https://www.americangeosciences.org/policy-critical-issues/webinars/tracking-global-supply-critical-materials>

*\*INTRAW is funded under the European Commission's Horizon 2020 EU Research and Innovation Programme, for a period of 36 months (February 2015 – January 2018). Under the coordination of the European Federation of Geologists (EFG), INTRAW brings together an international consortium of 15 partners with extensive experience in research, innovation, education, industry, trade and international networking across the entire raw materials value chain. INTRAW also counts on the support of 24 third parties and more than 40 experts from across Europe, Australia, Canada, Chile, Japan, South Africa and the United States.*

**Contact:**

**Coordinator – European Federation of Geologists (EFG)** - Vitor Correia, President, [efg.president@eurogeologists.eu](mailto:efg.president@eurogeologists.eu), Isabel Fernández Fuentes, Executive Director, [isabel.fernandez@eurogeologists.eu](mailto:isabel.fernandez@eurogeologists.eu)

# Department of Interior Briefing on the FY 2019 Trump Administration Budget

*An Update from Our Executive Director, Aaron W. Johnson, Ph.D.*

On February 12, 2018, the American Institute of Professional Geologists was invited to participate in a conference call by James Cason, Associate Deputy Secretary in the Department of Interior. Mr. Cason gave a briefing on and question and answer session about the FY 2019 Trump Administration Budget as it relates to the activities of the Department of the Interior.

During the briefing, Mr. Cason focused on four priorities within the Department and outlined specific measurable goals within those priority areas.

## **1. DOI Infrastructure spending**

According to Mr. Cason, the DOI hopes to build dedicated funding to address infrastructure needs within the Department. Currently, the Department faces deferred maintenance costs of \$15-18 billion spread primarily among the National Park Service (\$11.6 billion), the US Fish and Wildlife Service (\$1.4 billion) and the Bureau of Indian Affairs (\$600-700 million). Deferred maintenance includes upgrading and repairing overtaxed infrastructure at National Parks and updating and upgrading buildings and access points at National Fish and Wildlife Refuges. At the BIA, infrastructure spending will focus on Tribal schools and assessing and improving dam safety.

## **2. Tribal Sovereignty:**

Within the BIA, primary areas of focus will include upgrading and increasing capacity of Indian schools, addressing opioid issues, engaging in tribal water rights negotiations, and improving the safety of dams and other infrastructure.

## **3. Reorganizing the Department of Interior**

The President's budget allocates \$18 million to begin the reorganization process. Within the reorganization, the focus will be on taking personnel from Washington, DC and Denver, CO, and shifting those positions to provide more personnel in the field. The goal is to provide more face-to-face opportunities between federal land managers and local constituencies. The DOI considers employees in Washington DC, and Denver to be far removed from managed lands. During this call, no details of the reorganization were discussed.

## **4. Revenue Generation:**

The Department of the Interior has revenue generation from existing infrastructure as a primary goal. Potential changes include focusing on revenue generating opportunities on federal lands related to energy, timber, grazing, and minerals.

While no specific decisions have been made, it is likely that efforts to generate revenue will come from an energy dominant point of view and will require capitalizing on energy and mineral resources. At this time it appears that the royalty structure for hard rock mining will not change. The fee and royalty structure for energy resources is under review.

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*During the subsequent question and answer session a few items of interest emerged.*

*1. The new infrastructure fund is not envisioned as a pool of money to be used to buy additional land. The inclination of the leadership in the DOI is to buy no new land. However, the DOI would like to increase access to public lands for sportspersons and outdoor enthusiasts. In these cases new easements to provide better access would be acceptable.*

*2. The DOI has increased efficiency and decreased EIS/NEPA statement preparation times as a goal moving forward.*

*3. The DOI has very little flexibility within specific line items of the budget that ultimately is approved by congress.*

*4. While this is the President's proposed budget, congress ultimately decides which budget line items to fund and to what degree. The next step in the process will be to begin the appropriations process.*

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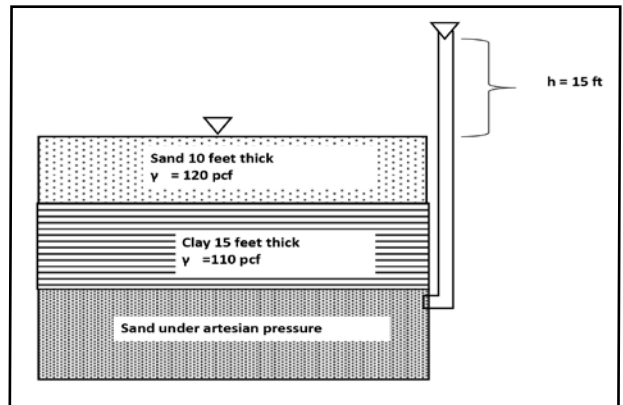
If AIPG is invited to participate in additional briefings, I will be certain to give the membership an update.



**Robert G. Font, CPG-03953**  
**rgfont@cs.com**

1. A petroleum source rock contains type III kerogen. Upon maturation, what hydrocarbon product would we expect this lithology to be likely to yield?
  - a) Light, high-quality oil.
  - b) Crude oil with some natural gas.
  - c) Mainly gas with very little oil.
  - d) Kero what? You mean there are “types” of this “kero” stuff?
  
2. In the stratigraphic record, in which geologic period did the first land plants appear?
  - a) Cambrian.
  - b) Silurian.
  - c) Cretaceous.
  - d) Land plants? Man, I’m a carnivore; none of that “green stuff” for me! Where’s the meat, I say!

3. Consider a horizontal stratigraphic sequence consisting of 10-foot layer of upper sand overlying a 15-foot layer of clay. In turn, the clay overlies a sand under artesian pressure. The water in the underlying sand has a head ( $h$ ) of 15 feet above the top of the upper sand unit. Let the water table be at the top of the sand. Recall that the unit weight of water ( $\gamma_w$ ) is 62.5 pcf. Let the saturated unit weight of the sand ( $\gamma_{ss}$ ) and the clay ( $\gamma_{sc}$ ) be 120 and 110 pcf, respectively. At what hydraulic head ( $H$ ) would boiling or the quick condition occur?
  - a)  $H = 18.7$  ft
  - b)  $H = 16.9$  ft.
  - c)  $H = 20.6$  ft
  - d) Dude, the only “boiling” I care about is a shrimp or crawfish boil!



4. (Question by David M. Abbott, CPG-04570). In the Township-Range system, a “section” nominally contains this number of acres:
  - a) 40 acres.
  - b) 160 acres.
  - c) 640 acres.
  
5. (Question by David M. Abbott, CPG-04570). In the Township-Range system, sections 16 and 36 are commonly:
  - a) Reserved for agricultural use
  - b) Known as school sections.
  - c) Available for homesteading



## Kelsey Lua Boltz, CPG-1626

*Scottsdale, Arizona*

*March 31, 1930 - October 9, 2017*

Kelsey Lua Boltz (87) passed away peacefully, in the arms of his family, on Monday, October 9, 2017. Kelsey leaves behind his devoted wife of 54 years, Barbara (Bradstreet) Boltz; his son, Karl; daughter, Andrea; and grandchildren, Kai, Luc, Gloria, Rebekka and Kelsey R. He was a hero, mentor, supporter, and friend to his children and was adored by his five grandchildren.

Kelsey was born in Springfield, Ohio, on March 31, 1930, to parents, Earl F. Boltz, Sr. and Bessie Eidson Boltz. At the time of his birth, Kelsey's family lived in a converted, one-room chicken coop. At age 5, Kelsey and his family moved to Colorado.

As a young teenager his family settled in Phoenix, Arizona. Kelsey attended North Phoenix High School and Phoenix College. He excelled academically and played baseball competitively, in both high school and college.

After obtaining his undergraduate degree, Kelsey attended and graduated from the Colorado School of Mines (CSM). Thus, he began a sixty-five-year career as a geological engineer and entrepreneur. Kelsey founded numerous companies across the globe, both private and public. He was a lifetime member of the Geological Society of America and the American Institute of Professional Geologists.

Kelsey lived life with pure gusto. Over the years, he availed himself of life's many opportunities. He was a professional baseball player, pilot, outdoorsman and musician, and played in baseball's minor leagues (1950-1952), for both the Pittsburgh Pirates and the Philadelphia Phillies, using the earnings to pay his tuition at CSM. He earned his private pilot license at age sixteen and over the years, accumulated over 6,000 hours of pilot-in-command flight time. Kelsey began flying aerial acrobatics competitions at the age 70. He also purchased and flew two Spanish fighter jets, one of which he eventually donated to an air museum in Indiana.

Kelsey could not serve in the armed forces. He had siblings, relatives, and many friends that did, and he always held deep respect for their sacrifices to defend our freedoms. They were his heroes.

Kelsey was a gifted musician. With the Hawaiian Heirs, Kelsey recorded four albums of traditional Hawaiian music.

Kelsey was straight-shooting, even-keeled, well-loved, and admired by many. He set a magnanimous example to family and friends, as he was always willing to help those with a deserving need.

In lieu of flowers, memorial donations in memory of Kelsey can be made to the Colorado School of Mines Foundation at this link: [http://giving.mines.edu/s/840/start\\_foundation.aspx](http://giving.mines.edu/s/840/start_foundation.aspx) Thank you!

*Published in The Arizona Republic from Jan. 14 to Jan. 28, 2018*

## Charles (Chuck) Bryan Reynolds, CPG-2490

*Albuquerque, New Mexico*

*December 5, 1931 - January 29, 2018*

Charles Bryan Reynolds (Chuck) passed away peacefully in his own home in Albuquerque on January 29, 2018. He is survived by two children from his first marriage, Tom Reynolds and Mary Davidson, both of Albuquerque, and two grandchildren. He is also survived by a stepson, Doug Bolich, and two step-grandchildren, from his second marriage.

He was born in the Panhandle of Texas on December 5, 1931, and moved to Albuquerque with his family in 1936 to escape the Depression. He was a graduate of Albuquerque High School in 1949. Chuck earned a BS degree and an MS degree in Geology from UNM in 1953 and 1954, respectively. He also met and married Ann Lindhardt in 1950, while they were students.

Chuck worked as a geologist and geophysicist for Chevron Oil Company for 18 years. During that time he and his family lived in Australia and South America, and he worked all over the world. One of his professional accomplishments during those years was to participate in the discovery of oil at Barrow Island in Australia, which for many years was one of the largest producing oil fields in the Pacific. He returned to Albuquerque in 1973, to start his own company specializing in engineering and environmental seismology, and to be near his mother, who had lived alone since his father died in 1961. His first wife Ann ran the company with him until she passed away in 1984, after which he married Irene Barber, also a practicing geologist in Albuquerque. They ran the company until 2003, when she passed away. Chuck Reynolds played an important part in developing the new science of shallow seismological exploration. Chuck was an active participant in the community throughout his life. He was most recently a member of Saint Michael and All Angels Episcopal Church, and he had been a member of the Albuquerque Geological Society and the American Institute of Professional Geologists for decades.

**Answers:**

1. The answer is choice “c” or “Natural gas with very little oil.” Type III kerogen is derived from land plants in coaly sediments.

Type I kerogen tends to yield light, high-quality oil. The kerogen is derived from algae in lagoonal and/or lacustrine environments.

Type II kerogen constitutes the main source of crude oil and is derived from marine microorganisms and plant debris.

2. The answer is choice “b” or “Silurian.”  
 The Cambrian marks the time when most of the major groups of animals appear in the fossil record. It distinguishes the start of abundant marine life able to generate hard parts. Plants in the Cambrian were mostly simple one-celled algae  
 Forests of ferns, cycads and conifers were present in the Cretaceous. Angiosperms or the first flowering plants appeared in this period

3. The answer is choice “c” or [h] = 20.6 ft]. The proof follows:

The total stress (P) the pore-water pressure (u) and the effective stress (P') at the base of the clay are:

$$P = (10 \text{ ft}) * (120 \text{ pcf}) + (15 \text{ ft}) * (110 \text{ pcf}) = 2,850 \text{ psf} \tag{1}$$

$$u = [(10 + 15 + 15) \text{ ft}] * (62.5 \text{ pcf}) = 2,500 \text{ psf} \tag{2}$$

$$P' = P - u = 2,850 - 2500 = 350 \text{ psf} \tag{3}$$

The head that would give rise to boiling (H) is:

$$[(H + 10 + 15) \text{ ft}] * (62.5 \text{ pcf}) = 2,850 \text{ psf} \tag{4}$$

Solving (4) for H:

$$(25 + H) * (62.5 \text{ pcf}) = 2,850 \text{ psf}$$


$$H = [(2,850 - 1,562.50) \text{ psf}] / (62.5 \text{ pcf}) = 20.6 \text{ ft} \tag{5}$$

Equation (5) is the answer that we seek. At a value of H = 20.6 feet, then P' = 0 at the base of the clay and the “boiling” condition should be expected to occur. Bad news, paisan!

4. Answer by David M. Abbott, CPG-04570: The answer is choice or “640 acres” or one square mile.  
 5. Answer by David M. Abbott, CPG-04570: The answer is choice “b” or “known as school sections” which were given to the states on statehood to support public education

**AIPG Membership Totals**

	As of 2/1/2017	As of 2/1/2018
CPG / Active	3,056	2,981
Honorary Member	0	14
CPG / Emeritus	502	513
Prof. Member	35	37
Associate Member	55	66
Young Professional	131	131
Student Adjunct	3,590	2,935
<b>TOTALS</b>	<b>8,309</b>	<b>7,607</b>

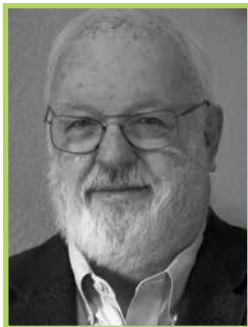


*Share the Geologist's View!*

One of the best things about being a geologist is experiencing people, places, and things in a way that many others never do.

We see the world from a different perspective from the roadcut along a busy highway that many consider “just rock” to the most beautiful features on the planet and beyond. We seek to understand the history of earth, the reasons why formations exist, and how it all impacts our lives.

We see the world through a different lens. Many of you record your view of the world with a camera, and we encourage you to share the work we do and the beauty and wonder of our world as seen by a geologist. email to: [aipg@aipg.org](mailto:aipg@aipg.org)



### Topical Index-Table of Contents to the Professional Ethics and Practices Columns

A topically based Index-Table of Contents, "pe&p index.xls" covering columns, articles, and letters to the editor that have been referred to in the PE&P columns in Excel format is on the AIPG web site in the Ethics section. This Index-Table of Contents is updated as each issue of the TPG is published. You can use it to find those items addressing a particular area of concern. Suggestions for improvements should be sent to David Abbott, [dmageol@msn.com](mailto:dmageol@msn.com)

Compiled by David M. Abbott, Jr., CPG-04570  
5055 Tamarac Street, Denver, CO 80238  
303-394-0321, [dmageol@msn.com](mailto:dmageol@msn.com)

## Geoscience Workforce Growth in a Dynamically Changing Economy

Christopher Keane and Maeve Boland of AGI recently published "Dilemmas of promoting geoscience workforce growth in a dynamically changing economy".<sup>1</sup> They state, "The geosciences as an occupation are experiencing substantial change, with a combination of economic cycles, mass retirements, and rapid technological innovation. For the next generation of geoscientists, flexibility and well-defined competencies will be key to employment resilience." However, geoscience employment has changed dramatically from the 1960s and 70s when 70% of geoscientists were in the petroleum business. When oil prices fell in 1986, as in previous downturns, large numbers of petroleum geoscientists became unemployed. Some were able to transition to environmental or hydrologic jobs, but the available positions in these areas soon filled. The development of horizontal drilling methods and improved hydraulic fracturing techniques led to a new boom in the petroleum sector, including related environmental and hydrogeology jobs but this boom ended in 2014. The mining industry also runs through boom and bust cycles as well as changing focus: uranium in the mid-70s until the Three Mile Island incident, then copper, then gold, etc. But the fluctuating petroleum business was the best indicator of geoscience enrollments.

The Master's degree has become the main degree needed in the private sector. This means at least a 6-year academic commitment that coexists with 5- to 10-year cycles in the various geoscience industries. Also affecting the academy are efforts to increase degree completions in minimum time and cost cutting

in order to control tuition increases. Given the employment cycles, acquiring a broad geoscience-area base coupled with advanced math, chemistry, and physics is needed to provide students and early graduates with the flexibility to enter into and stay in a changing employment environment.

Perhaps it is time to look at AIPG's geoscience education requirements. AIPG's *Education for Professional Practice* was last updated in February 2007 and is due for an update. Specifically, I believe that basic chemistry, physics, and statistics, should be added along with increasing the total number of qualifying semester or quarter hours. Perhaps looking at different career tracks like GIS should also be considered. I urge students and young professionals to read Keane and Boland's paper and reflect on what constitutes a broad geoscience-area base along with a foundation in other basic sciences. Contribute your ideas as comments on this topic.

## Demystifying Personal Brand for Resources Professionals

David Yeates' article, "Demystifying personal brand for resources professionals" appears elsewhere in this TPG issue. Your "personal brand" is your professional reputation that is based on those who know who you are and what you can do. As Yeates points out, it is about being remembered and about being interesting. There are a variety of ways of building a personal brand. Publishing is one way. You will recognize the names of our long-term Student Columnists Nancy Price, Stephanie Jarvis, and Kristina Portabib if you've been reading the TPG for the past decade or so. Likewise, you'll recognize the names of Michael Urban and our various editors. Participation

as a member of a Section and National Committees or regular participation in Section and National meetings assist in building name recognition and reputation. Becoming a recognized expert in a particular area is another way. Again, there are lots of ways to build a personal brand and it pays to do so.

## Ethical but Upsetting Geoscience Research

Thomas Pözlner and Florian Ortner's paper, "Ethical but upsetting geoscience research: a case study" addresses an issue that will become increasingly important.<sup>2</sup> Examples of such research include hydrocarbon exploration near population centers, including those where the population is moving into traditional exploration and development areas, nuclear waste repositories, and geohazards. Geoscience studies on such topics are not ethically wrong simply because someone is upset by the study or its conclusions, although such upsets should be recognized. Pözlner and Ortner's example involved an investigation of the impacts of climate change on geohazards in areas of high topographic relief that are popular tourist destinations, and may have a relatively high population. Pözlner and Ortner's example led to one hypothetical option of abandoning the present development in some of these areas. When the local news media reported this, the local population and its political leaders simply did not want the option discussed and demanded that the research be stopped.

The classic example of an ethical but upsetting scientific study is the subject of Henrik Ibsen's *Enemy of the People* (1882, available from several web sites). The protagonist is a doctor in a small, southern Norwegian town who discovers that the town's spa, which is the town's economic base, is polluted. His disclosure

1. <http://www.annalsofgeophysics.eu/index.php/annals/article/viewFile/7411/6812>, accessed 2/16/18.

2. <http://www.annalsofgeophysics.eu/index.php/annals/article/view/7506>, accessed 2/16/18.

of his findings leads to ostracism of the doctor and his family.

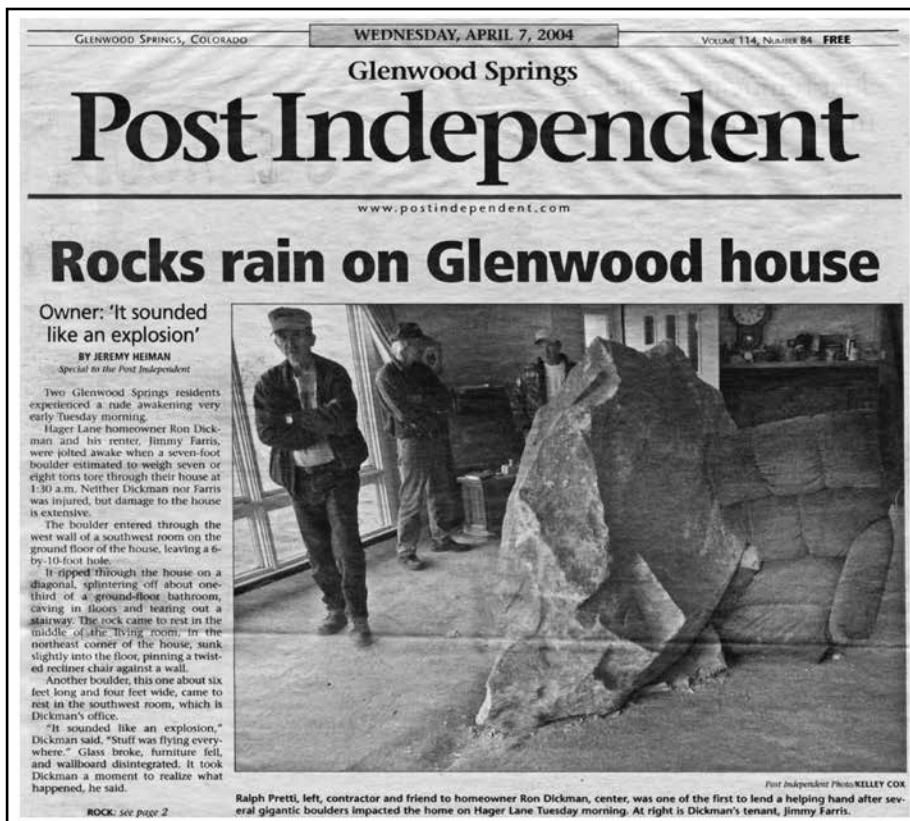
A US example of this would be to observe that because of pervasive down-to-the-coast faulting and resultant elevation decreases, sea level rise, and demonstrated adverse hurricane impact, development along the Gulf Coast should be restricted and that rather than rebuilding, Houston, New Orleans, etc. should be moved north to higher ground. I can already hear the roars of disapproval and outrage the previous sentence can produce. But the elevation decrease, sea level, rise, and hurricane impacts are well known. Are the consequences of this really being addressed?

Here in Colorado, rockfall is a real problem in areas of higher relief and the Cretaceous shales are well-known for slumping. But real estate developers don't want to hear about such things even when things occur such as that illustrated in the picture to the right from the Glenwood Springs, CO, *Post Independent* for April 7, 2004.

**Geoethics Papers**

The two preceding topics discussed papers published in the *Annals of Geophysics*, v. 60, 2017 by the International Association for Promoting Geoethics (IAPG). Other papers from this volume that are available for free download currently (Dec '17) are:

- A Concept of Society-Earth-Centric Narratives by Martin Bohle, Anna Sibilla, and Robert Casals I Grails
- Delivering Sustainable Development Goals: The Need for a New International Resource Governance Framework by Edmund Nickless
- Furthering Ethical Requirements for Applied Earth Science by Martin Bohle and Erle C. Ellis
- Geoethics in Science Communication: The Relationship between Media and Geoscientists by Franco Foresta Martin and Silvia Peppoloni
- Geoethics: ethical, social and cultural implications in geosciences by Silvia Peppoloni and Giuseppe Di Capua
- Geoscience Engagement in Global Development Frameworks by Joel C. Gill and Florence Bullough
- Geosciences at the Service of Society: The Path Traced by Antonio Stoppani by Stefania Lucchesi
- Green Mining – A Holistic Concept for Sustainable and Acceptable Mineral Production by Pekka Nurmi



On the Contribution of Philosophical and Geoscientific Inquiry to Geoethics (qua Applied Ethics) by Thomas Pözlzer

Public Policies, Social Perception and Media Content on Fracking: An Analysis in the Spanish Context by Emilia Hermelinda Lopera-Pareja, Ana Garcia Laso, and Domingo Alfonso Martin-Sanchez

Some Fundamental Issues in Geoethics by David M. Abbott, Jr.

The Cape Town Statement on Geoethics by Giuseppe Di Capua, Silvia Peppoloni, and Peter T. Bobrowsky

The Role for a Large Scientific Society in Addressing Harassment and Work Climate Issues by Billy M. Williams, Christine McEntee, Brooks Hanson, and Randy Townsend

The range of topics in these papers provides an example of the relatively new and growing field of geoethics. These papers and others that will be included in this volume and published shortly can be downloaded for free from <http://www.geoethics.org/geoethics-ag2017> and select the title, accessed 12/7/17.

**Geoethics and Sustainability**

In my January 2018 column (165) I included the *Geoethical Promise* and associated *Fundamental Values of*

*Geoethics*. The last two points of the *Fundamental Values of Geoethics* are:

- Ensuring sustainability of economic and social activities in order to assure future generations' supply of energy and other natural resources;
- Promoting geo-education and outreach for all, to further sustainable economic development, geohazard prevention and mitigation, environmental protection, and increased societal resilience and well-being.

I commented, "The aspiration to ensure the sustainability of the supply of energy and other natural resources for future generations conflicts with the fact that the supplies of energy and other natural resources are depletable, that individual deposits have a limited extent."

The November 2017 issue of the *European Geologist*, v. 44, contains four papers addressing aspects of this problem. They are:

- Thompson, J., Eagle, L., & Bonham, O., Resources for future generations—understanding earth and people
- Langefeld, O., Future mining—thoughts on mining trends
- Grennan, E.F., and Clifford, J.A., Resource sustainability—geology is the solution



Rokavec, D., Mezga, K., & Melitica, S., How to increase future mineral supply from EU sources

Grennan and Clifford's paper, Resource sustainability—geology is the solution, addresses the sustainability issue directly and honestly. Their abstract states:

The question of resource sustainability was developed during the late 1960s and lies at the core of a number of alarmist reports compiled at that time, none of which had a geological perspective. The public perception of geology is that it has little, if any, impact on their everyday lives. This is, of course, a fallacy. Geology is one of the central factors that impacts, and needs to be considered, across a range of

public policy issues and it is noteworthy that in all of these reports exploration risk is never considered. At present Europe is dependent on imports of raw materials from countries which do not necessarily have good environmental standards. If Europe really wants a quality environmental future, it must encourage the discovery of its own resources and not develop policies that inhibit their development. Europe can only ensure a secure, and sustainable, supply of raw materials for its industrial base by doing this.

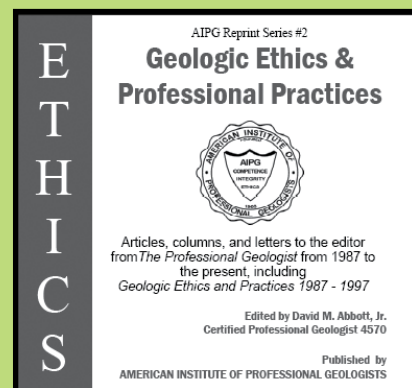
Thompson, Eagle, and Bonham's paper addresses the need for public education in order to properly address

the sustainability issue. They observe, "To succeed, we [the general public] must fully understand the earth, from the critical processes that concentrate resources to the environment and climate that support life. Simultaneously, we [the extractive industries] must engage broadly with people to fully understand needs and concerns, inform effective policy, and provide the knowledge to support future generations." I've inserted my definitions of "we" in the quote. Public education and understanding is critical and this needs to come from the extractive industries (mining, petroleum, recycling, etc.). Only then can sustainability be properly addressed.

**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&p index.xls file from the [www.aipg.org](http://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](http://www.aipg.org).



**Members,**

***Please notify headquarters if you know of a member who has passed. We would like to honor our members in remembrance.***

***Message from Central Michigan University Student Chapter on Attending the 2017 Annual Meeting in Nashville***

This past fall five our student members attended the AIPG National Conference in Nashville, TN. It was without a doubt one of the best things we have done in our college career! For most of us it was our first time being to a conference of this caliber. The atmosphere was fun and inviting, and we plan to send students to Colorado Springs this upcoming Fall.



Michael J. Urban, MEM-1910

# Holes in the Earth

Being swallowed up by the Earth is a terrifying scenario most of us do not often ponder. Yet occasionally, holes in the Earth do open up and claim whatever conveyances or structures (e.g., homes, vehicles, roads, etc.) may reside on and near a mistakenly presumed solid surface underfoot. Such instances may cause us to question – and rightly so – the certainty of the expression *terra firma*. A few recent examples of sinkholes, to be considered later in this article, have prompted an excavation of this topic here and now. While sinkholes may occur for a variety of reasons, there are generally a few predominant geologic, topographic, or weather-related conditions associated with their occurrence.

## What are sinkholes?

A sinkhole is a depression in the ground usually produced by water erosion. Geologically speaking, sinkholes tend to be small and shallow (a few tens to hundreds of feet in diameter and depth), formed by the dissolution and collapse of primarily limestone or gypsum rock below the ground surface (Easterbook, 1993). Sinkholes tend to form randomly as groundwater erodes or dissolves cavities in rock, which weakens the structural integrity leading to collapse.

Most frequently, sinkholes are associated with what is known as karst topography – a landscape riddled with caves, depressions, and groundwater sources that serve to dissolve the surrounding rock. Rainwater tends to be slightly acidic (pH of 5.5-6) due to mixing with atmospheric carbon dioxide as it forms droplets and precipitates down to the ground. When this acidic water accumulates in subterranean pools and within the pore spaces in limestone, it destroys the rock and carries the dissolved constituents away leaving initially small voids and eventually larger cavities. Humid tropical conditions favor karst landforms, explaining the greater incidences in states like Florida. [Artificial sinkholes may also form as a result of burst water pipes and other human-induced activity.]

## Where are sinkholes found?

Sinkholes may be found in various locations around the world, but in the United States, a few significant karst localities, either surface or subsurface, include (in alphabetical order): Florida, Kentucky, Minnesota, Missouri, North Carolina, Tennessee, Texas, Wisconsin and others [refer to the karst map in Weary & Doctor, 2014]. Many of these are associated with calcium carbonate marine deposits (e.g., limestone, dolomite), but others may also be associated with evaporite deposits like halite (i.e., rock salt) and gypsum. Additionally, even a few other sites are linked to volcanic rocks and sediments that may, under certain circumstances, exhibit karst-like characteristics (i.e., pseudokarst). In totality, just over 25% of the United States consists of soluble or erodible rocks that can or do manifest karst or pseudokarst characteristics (Weary & Doctor, 2014).

## Recent Occurrences

Local, regional or state authorities may retain records of sinkholes, and a few places, like Fountain, MN, for example, may even proclaim status as a “sinkhole capital of the U.S.” (CBS Broadcasting, 2014). But, even though each year several sinkholes make the news (many in Florida), there is no national database of sinkhole incidence (USGS, n.d.). Already this year (2018), sinkholes have made the news; at the time this article went to press (February), sinkholes damaged or affected a retirement community in Florida (January) and a residential street in Rome, Italy (February), among others.

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*One of the more vividly recollectable sinkholes in recent years made national news for opening up directly beneath the National Corvette Museum in Bowling Green, Kentucky, a little over four years ago on February 12, 2014 (National Corvette Museum, 2018). Sinkholes occasionally make their way into global news as well: scientists recently announced a dense concentration of 49 sinkholes, previously undocumented, in a 230 square-mile plot of the Shaanxi Province in northwest China, perhaps the world's largest (National Geographic, 2016).*

---

## Summary

As with many geological phenomena, it is in our best interest as citizens to be aware of the natural hazards that may be present in our communities. Sinkholes are just another example, along with swelling soils, river flooding, earthquakes, radon gas, landslides, and more. Do you know if sinkholes are a problem where you live? If not, it might be worth investigating further.

**Featured resources:** The United States Geological Survey (USGS) provides a resource (Alpha, Galloway, & Tinsley III, 2000) for students and teachers to explore more about karst features with its report and model suitable for classroom use located at the URL: <https://geomaps.wr.usgs.gov/parks/cave/karst.html>

Additionally, the USGS has generated a map of karst landscapes around the United States that may also be of interest to educators and geologists alike. The map, along with the report titled *Karst in the United States: A digital map compilation and database* (Weary & Doctor, 2014), and specific details about the geologic contexts of the formations and deposits associated

with our national karst landforms, may be obtained at: <https://pubs.usgs.gov/of/2014/1156/pdf/of2014-1156.pdf>

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# TALES FROM THE FIELD

## An Unexpected Surprise

**Peter Dohms, CPG-07141**

Every effort is made in the following account to be deliberately vague about the location described and the individuals involved; you will understand why.

It was the mid-1970s and I was approaching 10 years of professional experience as a mineral exploration geologist. One day a young man visited our office in Tucson with a submittal (my employer at the time made it a practice to make at least a cursory examination of submitted properties). The price of uranium was up and the young man had a good story about his father's property. We made a date to meet near the location where he would lead me in.

In preparing for the field visit, I dug out the 1950's vintage scintillation counter (left over from when our predecessor company operated a uranium mine in SE Utah), found replacement dry cell batteries, made sure the instrument was still capable of detecting ionizing radiation, and dug out some references on the general geology of the south-central Arizona area in question.

The young man and I met at the appointed place and time and caravanned out to the site, a dusty field camp occupied by his father's new wife, plus a number of dogs and cats. The father was "in town" on business. We then drove around the several hundred acres of interest, checking for ionizing radiation in the leucocratic quartz-feldspar pegmatite bodies that had been open-pit mined for silica flux sold to a nearby copper smelter. Lunch of chili, frijoles and tortillas was provided by the step-mother.

After lunch, we hiked up to the largest of the small mining pits, which overlooked the camp, and I activated the scintillation counter to check the face while he watched the road. By this time I was convinced that the pegmatite bodies were

uranium-free, since the only time the needle moved off zero was when I held it against my wristwatch. Just as I was muttering, "not even crustal abundance" to myself, he called out, "Here comes my father," having seen an approaching heavy dust cloud on the road.

I walked over to the edge of the pit to look down just as 4 vehicles came roaring into camp, scattering across the parking area with doors flying open and a dozen men running in all directions, some in uniform, all heavily armed. One of them shouted, "There's two of them up on the hill," and sooner than soon we were covered with submachine guns. Our hands went in the air and we carefully followed their instructions.

It turned out that the father's "business" in town had consisted of selling a few kilos of marijuana to an undercover drug enforcement officer. After the arrest was done, the officer rounded up representatives of Federal, State and County law enforcement agencies and they rode out to camp to see where the "main stash" was secreted. Given the surrounding 50,000 acres of empty desert, they didn't have much chance of success.

Once they determined that the two of us were harmless, we were allowed to go on our way. The English author Samuel Johnson once said, "*When a man knows he is to be hanged... it concentrates his mind wonderfully.*" I am here to tell you that when a geologist sees a submachine gun pointed at his stomach, it is also an incentive to concentrate wonderfully. While I reported this story to my boss, it did not make it into my report.

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## Tales from the Field

Have an interesting field experience? Of course you do! Send in your field (or office) tale to us, and we will share it in the TPG. E-mail your tale to [aipg@aipg.org](mailto:aipg@aipg.org).

# Texas Section of AIPG Holds GeoDayz Learning Event

John Berry, P.G., CPG-4032

On February 24th and 25th the Texas Section of AIPG held two days of practical demonstrations and lectures called GeoDayz, hosted by Hydrex Environmental in Nacogdoches, TX, on the applications of geological techniques to environmental investigations and assessments. The 76 attendees, of whom 56 were students from Stephen F. Austin University, the University of Houston, UT Dallas, UT San Antonio, and Richland College, came from as far away as Alabama and San Antonio.

GeoDayz support was provided by [Hydrex Environmental](#), including founder Glen Collier, P.G., C.P.G., and many other [staff members](#): financial support came from a number of instruments manufacturers, laboratories, drilling companies, a bank, and other industry sources ([Sponsors](#)).

Supporting Sponsors facilitated the AIPG Texas Section lecturers and Texas Section Board members who provided planning and additional financial support for GeoDayz – 2018 via their respective companies and universities ([more](#)).



Donny Smith, Assistant Manager, Hydrex Field Services, operating a Geoprobe crawler-mounted rig that was used to demonstrate hollow-stem auger drilling, direct-push technology, and monitor well installation



Glen Collier, Founder & Senior Hydrogeologist, Hydrex introducing the weekend's events, with John Chapman, GIS Coordinator / Programmer, Hydrex (plaid shirt), Christina Keim, REM, Biologist, and Lisa Siceloff – Geologist (in glasses)

Although the weather was not particularly co-operative as it was late February in Texas, students were enthusiastic and engaged. Rain and wind precluded some of the field demonstrations, such as using a drone to acquire aerial imagery, but participants were still able to watch several methods of drilling and sampling boreholes (hollow-stem auger, hand auger, GeoProbe direct-push) and of geophysical logging techniques (SP, SP-R, Gamma, Induction). We also learned about equipment and techniques for low-flow purge groundwater sampling and core and sediment sample logging and associated protocols.

Excellent class-room demonstrations were given of the use of drone imagery for stockpile and landfill surveying and

of the use of resistivity mapping and a GIS system to study and display in three dimensions the extremely complicated subsurface geometry of the Wilcox group. In the latter case, lateral variation of the Wilcox is so extreme that this level of effort is necessary when it comes to locating water wells: one can go from 80 feet of sand to nothing in less than 200 feet horizontal distance. Participants also learned, again via lecture, the basics of GIS systems and of the use of soil science for wetlands mapping.

Participants were also introduced to stormwater control and monitoring, including Stormwater Pollution Prevention Plans (SWP3s), good housekeeping, best management practices, and spill prevention methods. Further talks were presented on Phase I and Phase II Environmental Site Assessments, and on environmental project management by Michael D. Campbell, P.G., P.H., C.P.G. of [I2M Associates, LLC](#), Houston, TX, and Henry M. Wise, P.G., C.P.H., of [SWS Environmental Services](#) in La Porte, TX, both senior officers of the AIPG Texas Section.

This included a very detailed description of sampling methods, analytical requirements and the treatment of samples between their acquisition and their analysis. It emphasized the strict adherence to regulations and standards, as well as the need for speed in many cases, that are inherent in this kind of work.

A review was also presented of the impact of growth faults in the Houston area and along the Texas Gulf Coast as part of Phase I environmental site assessments, and a review was presented of an unusual Phase II project involving multiple monitoring well installations, logging and sampling of oil-field brine and associated groundwater leading to the conclusion that a rural home-owner practiced excessive use of halite in their home-water softening system that drained into a subsurface environment via the septic system that did not have sufficient soil thickness for the leachfield. This was underlain by

a thin glacial till and a shallow fractured sandstone below that permitted recirculation of high chloride concentrations in the groundwater to the home's water well and drinking water supply.

At lunchtime guest lecturer Prof. Kevin Stafford of the Geology Department at Stephen F. Austin State University ([more](#)) gave a very informative presentation on "Remote Sensing and Geophysical Characterization of Evaporite Karst Geohazards for Spatial Delineation and Improved Infrastructure Development within the Delaware Basin, West Texas". He described the application of a variety of techniques to mapping shallow caves that have begun to seriously affect the stability of highways in the area.



Guest lecturer Kevin Stafford, Ph.D. of SFASU describing groundwater flow in the Delaware Basin of west Texas during his talk on mapping evaporite karst Geohazards in the basin and at the surface.

The standard of all the presentations was very high and the level of hospitality equally so. This old exploration hand felt at the end that he had received a basic introduction to almost all of the equipment and techniques used in hydrogeology and environmental geology, with the one exception of a rigorous course in the modeling of groundwater plumes: for that I would have to go back to graduate school! It seemed to me that for both students and those who might be seeking to change careers, Geodayz provided an excellent introduction to the variety of equipment and knowledge that would be used in environmental work, and a foundation for the selection and acquisition of more specific training.

The Texas Section of AIPG intends that this shall be just the first annual GeoDayz, and that it will be held at a different location around our giant State of Texas every year. I want to thank all concerned for the extremely well planned



Michelle Transier, Hydrex Geologist, demonstrating low-flow purging, with Nathan Echart, Manager, Hydrex Field Services (standing behind Michelle) and attendee Jess Landrendeau, Panola County Groundwater Conservation District Geologist (on the right).



At the mixer on Saturday evening at the Fredonia Hotel: Bo Kirkland – Student, SFASU (black shirt with cap), Glen Collier and Clayton Collier, REM, PWS), General Manager, Hydrex (on the right). Student attendees from University of Houston in background.

and executed event – it was well worth a 500-mile round trip to take part in, and I'm sure that the students felt the same.

Watch the News page of the [AIPG-TX.org](http://AIPG-TX.org) website for follow-up information on the Final Guidebook for the GeoDayz - 2018 event, as well as for additional training opportunities ([more](#)).



Michael D. Campbell and Henry M. Wise presenting perspectives on environmental project management, training programs, case histories, and preparations for future employment opportunities.

## *Students and Members!*

Events like GeoDayz are a great opportunity for both students and members alike. They offer a forum for learning, networking, and building unity in our profession and organization. Kudos to Texas for this successful event!

We know the other sections have offered similar opportunities, and we encourage you to share your experiences in the TPG! If your section has not held such an event, we also encourage you to give it a try!

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# Appeal for Your Support of the Foundation of the AIPG

The Foundation of the American Institute of Professional Geologists received many donations as part of the end-of-year appeal. The Foundation also received funds from a successful silent auction at the annual meeting in Nashville. We are very appreciative of these donations and the interest in the Foundation. In anticipation of funding several undergraduate scholarships and the Siok Graduate Student Scholarship and other programs in 2018, the Foundation is seeking your support.

The Foundation supports a variety of programs of the American Institute of Professional Geologists (AIPG) that include student scholarships, educational programs aimed at practitioners, the public, and policy makers and, on occasion, some special needs requested by AIPG. The Foundation is engaged in exclusively educational, scholarship, and research programs. The Foundation may also support public information forums, public education meetings, teacher seminars and geological seminars for other professionals such as engineers, architects, planners and others; thus coordinating the expertise of several professions for a better understanding of the geosciences and global issues. The Foundation is proud to be able to serve AIPG and the geosciences by providing financial support for these programs. The Foundation also looks forward to supporting other programs and endeavors as possible in response to requests from the AIPG membership and executive board.

We ask you to continue supporting the Foundation with monetary contributions, and gifts-in-kind for the annual silent auction to raise funds, to be used primarily to fund scholarship and young professional initiatives, and other Foundation programs. The Foundation relies on the support of generous donors. Your donation will be acknowledged by name in future editions of AIPG's The Professional Geologist magazine and on the Foundation web page.

Information about donations is on the Foundation web page of the AIPG web site <http://aipg.org/foundation>. You may donate on-line or send your donation check by mail to:

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If you have any questions or comments about the Foundation, please contact me for additional information.

Thank you for your support of the Foundation so the Foundation may support AIPG and the geosciences. Your continued interest and support is greatly appreciated.

**Barbara Murphy, CPG**  
Chairperson, Foundation of the AIPG  
480-659-7131 office phone  
[bmurphy@clearcreekassociates.com](mailto:bmurphy@clearcreekassociates.com)

## Announcement

### SILENT AUCTION 2018

**Barbara Murphy, CPG**

**Chairperson, Foundation of the American Institute of Professional Geologists**

The Foundation of the American Institute of Professional Geologists will hold a Silent Auction on Sunday, September 9, 2018 at the Welcome Reception of the AIPG Annual Meeting in Colorado Springs, Colorado for the benefit of the Foundation and its programs. Please consider donating an item for the silent auction. Popular items last year included rock and mineral specimens, fossils, vacation home visit opportunities, old classic geology books and geologic maps, jewelry, and other items that geologists enjoy and appreciate. This is a great opportunity to pass along some items for others to enjoy, and to generate funds for the Foundation of the AIPG. More details about the silent auction will be available on the AIPG web site and Foundation of the AIPG web page.

*The Foundation of the American Institute of Professional Geologists is a 501(c) (3) organization. Contributions are tax deductible*



# Application of Bioengineering to Slope Stabilization in Sri Lanka with Special Reference to Badulla District



Balasuriya



Jayasingha

A.D.H. Balasuriya<sup>1</sup>, Pathmakumara Jayasingha<sup>2</sup> and W.A.P.P. Christopher<sup>1</sup>

<sup>1</sup>Uva Wellassa University, Badulla

<sup>2</sup>National Building Research Organization, Colombo 05

## Abstract

Bioengineering is the application of engineering technology to biological systems or vice versa. It includes the use of vegetation in engineering layout to protect natural terrain and man-made systems from slope failure and soil erosion issues. The objective of this research is to explore suitable bioengineering plants and their use for slope stabilization in Sri Lanka, instead of using a non-ecological solution such as concrete. According to the research results, most of the sites were excavated in well graded clay soil types, and had slopes greater than 45°, which had a higher tendency to fail. However, by applying bioengineering (the use of vegetation) they were much more stable. After analysis of morphological traits of plants and their suitability for geotechnical applications, several native plants were chosen as suitable for use in slope stabilization projects using bioengineering in Sri Lanka.

**Key words:** Bioengineering, slope stabilization, soil erosion, factor of safety, Sri Lanka

## 1.0 Introduction

Bioengineering is the application of engineering technology to biological systems or vice versa. In this case it refers to the combination of biological, mechanical, and ecological techniques to reduce or manipulate erosion, preserve soil, and stabilize slopes using vegetation or a combination of living things, such as plants, and non-living materials. Plant roots increase the slope stability by holding soil particles together and decreasing soil erosion. The tensile strength of the roots is an important factor in soil reinforcement and slope stabilization (Lewis et al. 2001, Zhang et al, 2014)

## 2.0 Objective

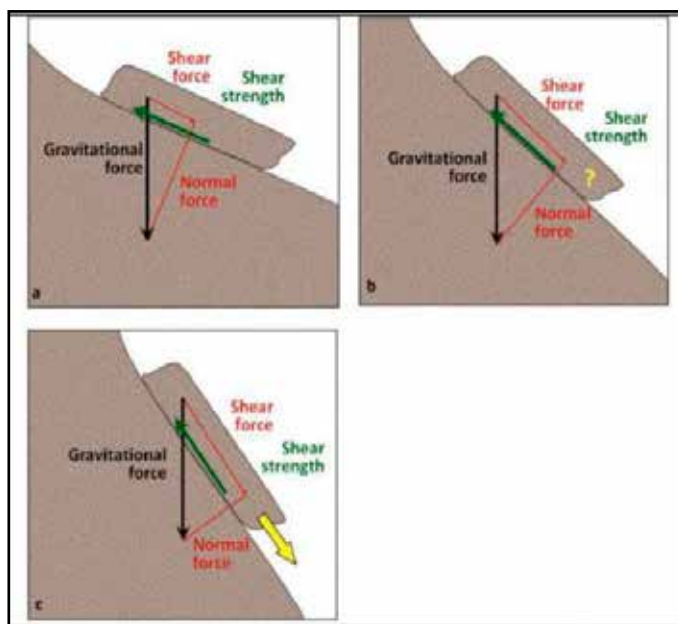
The objective of this research is to identify plants which increase soil stabilization in Sri Lanka. Badulla district was selected due to the presence of severe erosion and the abundance and frequency of landslides. Additionally, there are many slopes in the district that could be expected to fail, but because of a dense vegetation cover have been stable. Observations suggest that certain plant species might be effective alternatives to non-ecological engineered solutions for slope stabilization.

## 3.0 Theoretical Considerations and Empirical Evidence

Conventional methods for slope stabilization have drawbacks such as unsightliness and higher cost. Therefore, alternative methods, such as soil nailing and soil bioengineering, for stabilizing slopes warrant investigation.

### 3.1 Factors Determining Slope Stability and the Factor of Safety

Slope stability is ultimately determined by two factors: the angle of the slope and the strength of the materials underlying it, Figure 1 from Steven (2014) shows how the component of gravity in the direction normal to the slope decreases, and the shear component (directed parallel to the slope) increases as the steepness of the slope increases. In (a) the shear



**Figure 1:** Differences in the shear and normal components of the gravitational force on slopes with differing steepness. The gravitational force is the same in all three cases discussed in the text, (a) Stable, (b) Unstable, and (c) Failure.

force is substantially less than the shear strength, so the mass is stable. In (b) the shear force and shear strength are equal. Thus the mass may or may not move. In (c), the shear force is substantially greater than the shear strength and the mass is very likely to move (Steven, 2014).

A slope failure situation exists when resisting and driving forces are equal and the factor of safety equals 1. Erosion management is intended to provide slope stability to guard the face of the slope and to reinforce the slope underneath the surface by interlocking soil debris with a complex matrix of roots (Yam, 1978).

The stress–strain behavior of soil and rock was modeled using a Mohr–Coulomb model, in which the non-associated flow rule was used.

$$S = C+C_r + \sigma \tan \phi' \dots\dots\dots(i) \text{ (Li et al, 2016)}$$

Where S is Soil shear strength (kPa), C is Cohesion of soil (kPa),  $\sigma$  is Stress normal to shear plane (kPa),  $\phi'$  is Effective friction angle(°),  $C_r$  is additional cohesion due to plant roots (kPa).

Factor of safety (FoS) is a commonly used index to describe the stability of a slope. The factor is expressed by the ratio of the fully mobilized soil shear strength to the mobilized stress. FoS for an unsaturated root soil slope considering a unit area is given as:

$$FoS = \frac{C_s + C_r + (\gamma h \cos^2 \beta + W_t \cos \beta) \tan \Phi' - U_w \tan \Phi^b}{(\gamma h \cos \beta + W_t) \sin \beta} \dots\dots (ii) \text{ (Leung et al, 2015)}$$

Where  $C_s$  is the true soil cohesion,  $C_r$  is the root cohesion,  $\gamma$  is the unit weight of the rooted soil,  $h$  is the thickness of the sliding mass measuring from the ground surface,  $\beta$  is the slope gradient,  $W_t$  is the unit overburden due to the plants (kPa),  $\Phi'$  is the effective soil friction angle,  $U_w$  is the soil matric suction value,  $\tan \Phi^b$  indicates how the shear strength increases with increasing matric suction (Leung et al, 2015).

According to equations (i) and (ii), when cohesion ( $C_r$ ) due to the presence of plant roots increases, it causes the overall factor of safety to increase. When the shear stress is greater than the combination of forces maintaining the object on the slope, the object will move down-slope. If the shear stress overcomes the cohesion forces keeping the particles together, the particles will separate and move down-slope. The likelihood of down-slope movement increases with steeper slope angles which increase the shear stress, and by any factor that reduces the shear strength or frictional resistance. This is regularly expressed as the safety factor, the ratio of shear strength to shear stress. Shear strength consists of the forces keeping the material on the slope and encompasses the friction and cohesion forces binding the rock or soil together. If the safety factor becomes less than 1.0, slope failure is expected to occur (Steven, 2014)

**3.2 Particle Size for Slope Stability**

If the particles are well-sorted or well-rounded, or both, then cohesion is weak. Saturated sediments tend to be the weakest of all because the effective stress (Terzaghi, 1925) is lowered by the hydrostatic pressure of the water. When the material becomes saturated with water, the angle of repose is reduced to very small values and the material tends to flow like a fluid. This is due to the water flow between the grains and

eliminates grain-to-grain frictional contact; and also reduces the interlocking potential (Stephen, 2013)

**3.3 Engineering Functions of Vegetation**

Vegetation stabilizes slopes in various ways: catching raindrops, armoring the soil surface, and reinforcing, supporting, anchoring, and draining the soil. Vegetation can be used to enhance slope balance in a number of ways; such as by mechanical reinforcement, controlling erosion, increasing the infiltration ratio, decreasing runoff, and soil moisture adjustment (Shrestha et al., 2012).

**3.4 Beneficial Effects**

The beneficial effects of vegetation on the mass balance of slopes are:

- (1) Root reinforcement: roots automatically reinforce a soil via switch of shear strain inside the soil to tensile resistance inside the roots (Li et al, 2016)
- (2) Soil moisture depletion: evapotranspiration and interception in the foliage can restrict buildup of tremendous pore water pressure,
- (3) Buttressing and arching: anchored and embedded stems can act as buttress piles or arch abutments to counteract downslope shear forces,
- (4) Surcharge: weight of plants can (in certain instances) increase balance through elevated confining (ordinary) pressure on the failure surface.

Table 1, from Barker (1995), details the advantages and disadvantages of various groups of plants for slope reinforcement based mainly on the density of the surface cover they provide, the depths of their roots systems, the cost of installation and of the maintenance required.

Type	Advantages	Disadvantages
Grasses	Versatile and cost effective. Wide range of tolerance. Quick to establish. Good dense surface cover	Shallow rooting. Regular maintenance required
Herbs	Deeper rooting. Attractive in grass sward	Seed expensive. Sometimes difficult to establish
Shrubs	Robust and fairly cost effective. Many species can be seeded. Substantial ground cover. Deeper rooting. Low maintenance. Many evergreen species.	More expensive to plant. Sometimes difficult to establish.
Trees	Substantial rooting. Some can be seeded. No maintenance once established.	Long time to establish. Slow growing.

Considering soil, bioengineering has advantages that rock and cement do not have. As an example, plant life can provide air pollutant uptake and carbon sequestration. Plants additionally offer visual benefits such as distraction screening, steering and navigation enhancement, and aesthetic pride (Lewis et al, 2001).

**4.0 Materials and Methods**

Literature study and field investigations were the main methods employed for the study. A few plants were previously recognized in the literature, based on past research on bio-engineering applications in Sri Lanka. Using the Landslide Hazard Zonation Map provided by National Building Research Organization of Sri Lanka, fifteen sites of high hazard and medium hazard landslides on steep slopes in Badulla district were selected and investigated in the field, using ArcGIS 10.2 for compilation and analysis of results (Figure 2). Scientific identification of the plants and the description of specific morphological characters were done in the laboratory as was

geotechnical analysis of soil (i.e. Sieve analysis) to select the most suitable plants for bioengineering purposes.

## 5.0 Results

Most of the selected slopes were steep slopes (Slope angle  $>45^\circ$ ). It was observed that their steepness increased with the altitude. Soil types in the selected slopes were clay, silty, and sandy clay loam etc. They contained a considerable amount of moisture. Clay and clay-bearing soil types have a higher tendency to slip. In addition, the water content in the soil in the Badulla area increases during the local rainy season from September-February. Sieve analysis showed that most of the soil types were well graded, the constituent grains being equal in both size and shape. This allows greater soil porosity, which increases instability as previously discussed. Thus, the selected areas have a high tendency to slip and the slopes are unstable due to soil type and sorting. The locations of the slopes studied, their steepness, and the soil type and grading are given in Table 2 on page 49: In Figure 2 and Table 2 coordinates are given in decimal degrees to three decimal places (i.e. to the nearest 100 m on the ground).

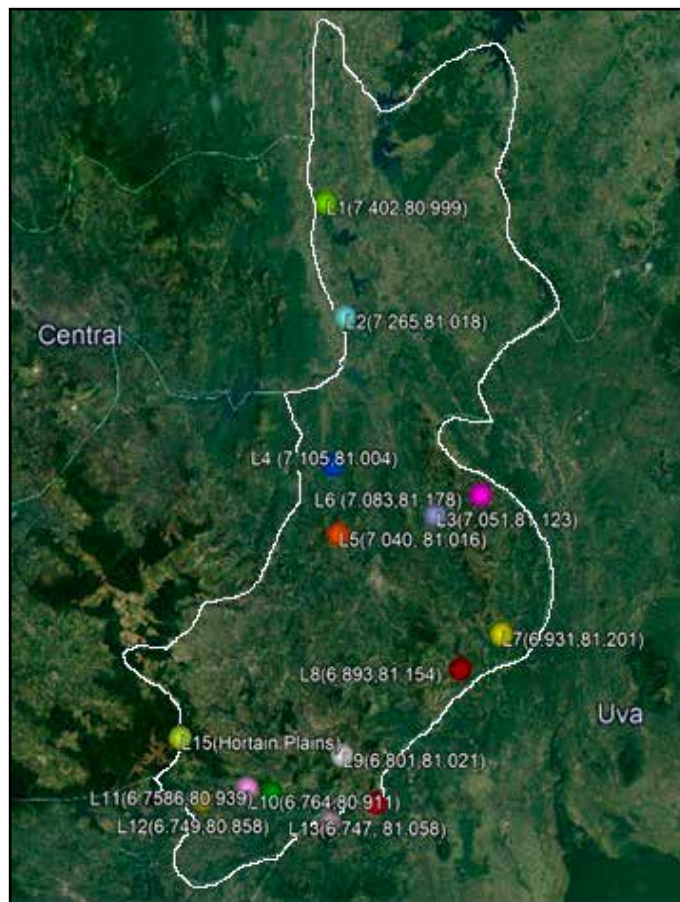


Fig. 2: Site selection map: base map courtesy of Google Earth, overlay created in ArcGIS 10.2

## 5.1 Ground Covers and Soil Stabilizers

### 5.1.1 Clay Loam, Sandy Loam and Sandy Clay Loam

*Lunularia cruciate*, *Sporobolus heterolepis*, *Poa labillardierei* (tussock grass), *Miscanthus sinensis*, *Gleichenia linearis*, *Asplenium sessilifolium*, *Pteridium aquilinum*, *Desmodium heterophyllum*, *Desmodium* Sp., *Blooming Nelu* (*Strobilanthes* Sp.), *Lamiaceae* Sp., *Imperata cylindrical*, *Digitaria sanguinalis*, *Hemerocallis fulva* (Day lilies), *Ageratina riparia*,

*Lamiaceae* Sp. & *Austro eupatorium inulifolium* were observed in the field to support slope stabilization, erosion control, and water infiltration. Their roots can reach moisture at greater depths than other grasses and annual vegetation during seasonal or climatic droughts. They have fibrous root systems which bind soil particles and increase soil cohesion, and thus shear strength of the soil mass helps protect against slope failures. Also, the dense growth of these plants makes a massive ground cover, forming a canopy which prevents high velocity impacts of raindrops against soil, causing soil debris to crumble and compact, reducing infiltration capacity, and leading to erosion by overland flow. Additionally, the deep roots remove water from soil; and therefore, they are suitable for preventing soil erosion slope failures.

*Juncus prismatocarpus*, *Juncus usitatus*, *Mimosa pudica* & *Arachis pintoii* were identified mostly in sandy loam and sandy clay loam. *Mimosa pudica* & *Arachis pintoii* spread via rhizomes that produce long tap roots at the nodes. They grow in most well-drained soil and are rather drought tolerant once established, making them additionally appropriate for dry, sandy regions. Properly installed plants can be difficult to eradicate due to the deep developing roots. The root system causes an increase in soil cohesion due to the covering behavior of the plant which lessens water infiltration and strongly decreases saturation during rainy seasons.

*Digitaria sanguinalis*, like other Poacea (grass) species makes a ground cover which reduces water penetration into the soil, and it prevents soil being heavily saturated during rainy periods. This plant has a fibrous root system which binds soil particles and increases cohesion of soil. The leaves of *Digitaria sanguinalis* have a hairy upper surface which causes water to drain downwards. Therefore, this plant can be applied to a bioengineering slope stability solution.

### 5.1.2 Silty Clay, Clay and Clay Loam

*Bouteloua dactyloides*, *Wedelia trilobata*, and *Microstegium vimineum* were identified for this study. These plants grow well in wet, well-drained, fertile soils, clays, sands or loams and might tolerate saline soils. They form an excellent, dense ground cover. These species are excellent for erosion control on slopes, banks and soil retention by roots and the stems come in contact with the soil. They prevent water infiltration and promote downward drainage of water; therefore, soil water absorption decreases. The extensive root system holds the soil at a higher strength, which increases soil cohesion.

*Bouteloua dactyloides* develops numerous fine roots that are tough and wiry, penetrating into the soil 4 to 6 inches, and strongly bind the soil particles.

## 5.2 Anchors

### 5.2.1 Clay Loam, Sandy Clay and Sandy Loam

*Indocalamus tessellatus*, *Bambusa guangxiensis*, *Ochlandra stridula*, *Aundinaria densifolia*, Bamboo types and *Osbeckia octandra*, *Osbeckia lanata*, *Osbeckia parvifolia* and *Artemisia argyi* were identified for this study. Bamboo roots are thin and fibrous and can penetrate 2-3 feet into the slope. The rhizome, which is the part of the plant that actually spreads, usually stays fairly shallow, less than 12 inches. The underground root system of bamboo is very similar to that of the culm. It can be described as an underground culm growing horizontally in the soil. This underground culm is the rhizome. All bamboo plants come under Poaceae family. For soil erosion prevention and slope stabilization these bamboo roots play a major role with increasing cohesion. *Osbeckia* plants' tap root and finer roots

**Table 2: Soil Type, Slope Angle and Soil Grading in Selected Locations**

Location Number	Coordinates of the Location (Lat., Long.)	Soil Type	Slope Angle (°)	soil type
L1	7.402, 80.999	Sandy Loam	>45	Well Graded
L2	7.265, 81.018	Silty Clay	40	Well Graded
L3	7.051, 81.123	Silty Clay	35-40	Poorly Graded
L4	7.105, 81.004	Silty Clay	30	Well Graded
L5	7.040, 81.016	Silty Clay	40	Well Graded
L6	7.083, 81.178	Clay	45	Well Graded
L7	6.931, 81.201	Sandy Loam	55-60	Well Graded
L8	6.893, 81.154	Sandy Clay Loam	65	Well Graded
L9	6.801, 81.021	Silty Clay	35-40	Well Graded
L10	6.764, 80.911	Silty Clay	45	Well Graded
L11	6.7586, 80.939	Clay Loam	35	Well Graded
L12	6.749, 80.858	Silty Clay	45	Poorly Graded
L13	6.747, 81.058	Clay Loam	35	Well Graded
L14	6.726, 81.004	Clay Loam	40	Well Graded
L15	Horton Plains	Clay Loam		

strongly bind the soil particles. The tap root has the strength to bind the soil and increase the cohesion to some depth.

**5.2.2 Sandy Clay Loam**

*Calliandra calothyrsus* is a fast-growing tropical tree. It prevents the soil erosion encountered in deforested areas. Its rooting system is composed of deep tap roots as well as lateral roots that enhance good soil structure (CABI, 2017). It is effective for soil erosion control. Additionally, it has strong potential for anchoring soil by way of deep roots, so it reduces soil mass failures, consequently increasing soil stability. *Calliandra calothyrsus* protects soil with the aid of decreasing runoff on a steep (35% to 60%) slope (Ashish et al., 2005).

**5.2.3 Silty Clay and Clay Loam**

*Agave*, *Chrysopogon zizanioides* (Vetiver), & *Cymbopogon nardus* were identified for this study. Agave has a complex root system that reduces soil moisture and strongly binds the soil particles. It thus reduces the water content in soil and acts as a ground cover. The agave root system, which includes a network of shallow rhizomes, is designed to help the agave efficiently seize moisture from rain, condensation, and dew. *Chrysopogon zizanioides* (Vetiver), & *Cymbopogon nardus* reduces the speed of the subsurface flows, reducing the erosion process and avoiding the activation of the landslide process. Further, where rock is fractured underneath, Vetiver will work as anchors. Vetiver, as a natural soil nail, binds the soil particles together as soon as it is established. It increases the shear strength of the soil thereby preventing it from sliding or slumping (Eboli, et al., 2011, & CABI, 2017)

*Adenantha pavonina* has a very strong tap root and fine roots. The tap root penetrates deep into the soil and binds it strongly. It grows into a large tree and has a considerable evapotranspiration. It reduces water content in soil, which is especially important in the rainy seasons.

**5.3 Anchors and Evaporators**

**5.3.1 Silty Clay and Clay Loam**

The plants identified are *Gliricidia sepium*, and *Paspalum dilatatum*. *G. Sepium* are a fast-growing early succession plant species that take advantage of slash-and-burn practices in its

native variety. It has a considerable evaporation and it reduces the water content in soil by evapotranspiration. In addition, it has a robust root system which binds soil very strongly. The strong tap root can go through fractures inside the rocks and anchor the root to the soil or rock particles; and for soil erosion, it has widely spreading roots. With them it increases the cohesion of soil so that the shear strength increases. It has good propagation methods, and less maintenance is needed. This plant has a high value in bioengineering applications. *Paspalum dilatatum* plants also act as a soil stabilizer with their rhizome and widespread fine roots. With the deep root system, they increase cohesion and remove a considerable amount of water by evapotranspiration (IEWF, 2017)

**5.3.2 Trees in Clay Loam and Sandy Clay Loam**

*Rhododendron arboreum*, & *Symblocus sp. Rhododendron* is an important genus growing at high altitudes. Rhododendrons grow well in free, open, well-aerated, acidic soil with lots of humus to retain moisture. Rhododendrons also help in preventing soil erosion on the steep slopes of high altitude regions. The plants have a strong root system that can go through rock fractures and thus has a high anchoring potential. Hair roots increase the soil cohesion and the shear strength, which prevents erosion. Additionally, it has large leaves which evaporate large quantities of water, thus decreasing soil moisture content (Ashish et al., 2005).

**5.4 Trees that Prevent Soil Erosion Using the Fallen Leaves or Needles as a Soil Cover**

**5.4.1 Clay Soil**

*Pinus roxburghii* needles and *Syncarpia glomulifera* leaves act as a ground cover. When raindrops fall directly onto the soil floor without first being intercepted via plants or other materials at the soil floor, the strength of the raindrops may additionally disintegrate soil aggregates into small debris.

**6.0 Conclusions**

*Imperata cylindrica*, *Mimosa pudica*, *Wedelia trilobata*, *Bouteloua dactyloides*, *Arachis pintoii* (see Figure 3 above), *Gleichenia linearis* (see Figure 4), *Desmodium* Sp, *Microstegium vimineum*, *Digitaria sanguinalis*, *Lunularia*



Figure 3: Dense ground cover of *Arachis pintoi* (Location 12)

*cruciata*, *Sporobolus heterolepis*, *Asplenium sessilifolium*, *Miscanthus sinensis*, Goose Grass, Tussock grass, *Strobilanthes*, Blooming Nelu, and *Pteridium aquilinum*, *Bouteloua dactyloides*, *Juncus prismatocarpus*, *Ageratina riparia*, *Hemerocallis fulva*, *Lamiaceae*, *Austro eupatorium inulifolium*, *Ageratina riparia*, *Osbeckia octandra*, *Ageva*, *Chrysopogon zizanioides*, *Artemisia argyi*, *Cymbopogon nardus*, *Adenantha pavonina*, *Calliandra*, *Juncus usitatus*, *Juncus prismatocarpus*, *Indocalamus*, *Oclandra*, *Osbeckia lanata*, Dwarf Bamboo species, *A. densifolia*, *Gliricidia sepium*, *Paspalum dilatatum*, *Rhododendron arboreum*, and *Symblocus* Sp were chosen as bioengineering applicable plants in Sri Lanka. These plants will be planted in unstable slopes in the future in Sri Lanka, in order to prevent slope failures using the most suitable bioengineering methods for ideal locations. Using bioengineering avoids the use of unaesthetic concrete structures.

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Figure 4: Ground cover of *Gleichenia linearis* (Location 7)

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**Senior Author:** A. Divomi H. Balasuriya

*Divomi is a geoscientist with the degree of BSc. Mineral Resources and Technology (Special) from Uva Wellassa University, a state university in Badulla, Sri Lanka. The “Special” in the title of her degree means that she has taken the degree as an English medium student. She is presently an advanced degree student in the Department of Science and Technology, Faculty of Science and Technology at Uva Wellassa University.*

**2nd Author and 1st Author’s Thesis Advisor:**

Dr. Pathmakumara Jayasingha, BSc (Sp) hons, MSc (Env. Sci), PhD (Eth Sci)

*Dr. Jayasingha is a Senior Geologist with the National Building Research Organization in Colombo, the historic capital of Sri Lanka.*

Continued from page 25

However, today the spacing is down to 10 to 20 acres per well, i.e. 32 to 60 wells every square mile. Moreover, although multiple-well drill pads have certain advantages, it means drilling continues in one spot for many months, rather than drilling a well and moving on. And, drilling is encroaching on neighborhoods, and vice versa. Further, most homeowners don't get royalties because they don't own the mineral rights. All of this gets people's attention.

For me, it is crucial to find out what opponents' issues actually are, in order to effectively deal with them. If someone wants to ban fracking because of truck traffic in their neighborhood, it is doubtful that the best science in the world is going to assuage them.

Sincerely,  
Vincent Matthews, III; CPG-11610

*Matthews is the retired Director of the Colorado Geological Survey and in retirement served on the "Special Scientific Committee on the Health Effects of Unconventional Oil and Gas Development in the Appalachian Basin". Early in his career, he served as an executive in four publicly-traded, natural resource companies.*

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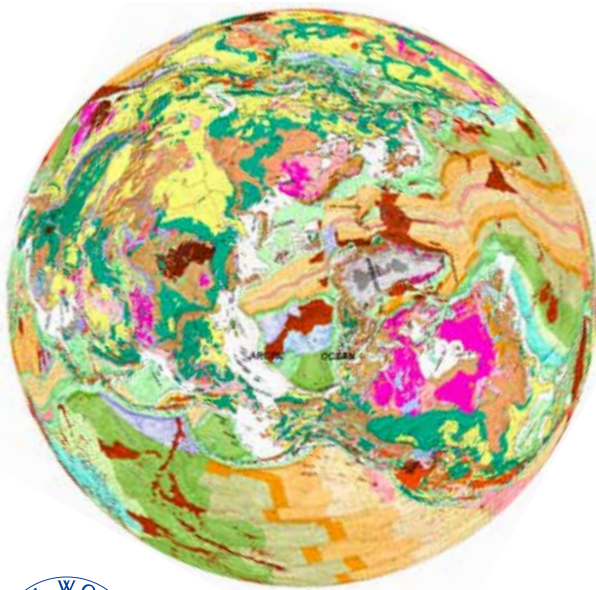
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