Student Scholarship Essay Winners

Questions of Diversity

Peer Reviewed Article:

Expansive-Soil Geohazards
YOU’RE INVITED...

AIPG
Awards Dinner Cruise on Lake Champlain – The Spirit of Ethan Allen

at the Annual Meeting in Burlington, Vermont

Monday, Sept. 16, 2019

Time: 5:00 pm – 8:45 pm

Registration includes transportation to/from the boat, dinner, and the cruise. Cash bar.
See Meeting Registration p. 5

Photos to the left

AIPG fun at Southeast Geological Society of America Meeting

AIPG Members showing off their swag.

Students from Berry College

The prizewinners with their new AIPG goodies.
On the Cover: The Ajo Mountain range in Organ Pipe Cactus National Monument. The volcanic range is located in the extreme southwestern corner of Arizona and the Monument shares a border with Mexico. The lithologies include a bottom rhyolite unit overlain by flows of breccia and ash-fall tuff, capped with more rhyolite. Early people used volcanic rock for tools and the abundant mica to amend clay used for pottery. Photo Courtesy of Dawn Garcia, CPG-08313
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.

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.

For AIPG news and activities go to www.aipg.org.
The Foundation of the American Institute of Professional Geologists will hold a silent auction at the AIPG annual meeting Welcome Reception on Sunday, September 15th starting at 5:30 pm at the Exhibit Area of the annual meeting at the Double Tree by Hilton in Burlington, Vermont. We hope you will consider a donation to the silent auction to raise funds in support of the Foundation for AIPG programs, scholarships, internships, and various initiatives. We also encourage you to come the annual meeting and bid on items at the auction.

We appreciate some advance notification to help us plan for the numbers and types of donations. Please bring items to the annual meeting registration desk prior to the silent auction or you may make arrangements to contribute items in advance if you are not going to be able to attend the meeting by contacting Barbara Murphy. Additional information and donation forms are provided on the AIPG web site: aipg.org/foundation

If you have any questions about the silent auction, please contact:

Barbara Murphy  
Clear Creek Associates  
6155 E. Indian School Rd. #200  
Scottsdale, AZ 85251  
480-659-7131/480-659-7143 fax  
bmurphy@geo-logic.com

We look forward to seeing you at the Silent Auction for an evening of fun and friendship and an opportunity to support the Foundation of the AIPG.

Barbara Murphy  
Chairperson, Foundation of the American Institute of Professional Geologists

THANK YOU FOR YOUR SUPPORT

The Foundation of the American Institute of Professional Geologists is a 501 (c) (3) public foundation, qualified to receive contributions in support of educational programs. Contributions and gifts-in-kind are tax deductible.

Together,  
We can achieve great heights.  
Please support the Foundation of the AIPG.
# 2019 Conference Schedule - Burlington, Vermont

## Saturday, September 14, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 am – 12:00 noon</td>
<td>Conference Registration</td>
</tr>
<tr>
<td>8:00 am – 12:00 noon</td>
<td>AIPG Executive Committee Meeting (open to all registrants)</td>
</tr>
<tr>
<td>9:00 am – 5:00 pm</td>
<td>AIPG Student Career Workshop (free)</td>
</tr>
<tr>
<td>12:00 noon – 1:00 pm</td>
<td>AIPG Luncheon (free/full registrants; $20/students)</td>
</tr>
<tr>
<td>1:00 pm – 4:00 pm</td>
<td>AIPG Advisory Board Meeting (open to all registrants)</td>
</tr>
<tr>
<td>4:00 pm – 4:30 pm</td>
<td>AIPG 2019-2020 Joint Executive Committee Meeting &amp; Business Meeting (open to all registrants)</td>
</tr>
<tr>
<td>4:30 pm – 5:30 pm</td>
<td>AIPG Foundation Meeting (open to all registrants)</td>
</tr>
<tr>
<td>5:00 pm – 6:30 pm</td>
<td>Student Networking Event with Professionals (open to all registrants/cash bar)</td>
</tr>
<tr>
<td>7:00 pm – 9:00 pm</td>
<td>2nd Annual AIPG Geo-Trivia Night (open to all registrants/win prizes!)</td>
</tr>
</tbody>
</table>

## Sunday, September 15, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 am – 5:00 pm</td>
<td>Conference Registration</td>
</tr>
<tr>
<td>8:00 am – 4:00 pm</td>
<td>Field Trip — “Greatest Hits” Outcrops of the Champlain Valley Belt of West-Central Vermont</td>
</tr>
<tr>
<td>9:00 am – 5:00 pm</td>
<td>Field Trip — Operating Mines/Quarries in the Vermont Valley</td>
</tr>
<tr>
<td>10:00 am – 4:00 pm</td>
<td>Exhibitor and Poster Set-up</td>
</tr>
<tr>
<td>5:30 pm – 8:00 pm</td>
<td>Silent Auction (to be held during the Welcome Reception-sneak peak 5:30)</td>
</tr>
<tr>
<td>6:30 pm – 8:00 pm</td>
<td>Welcome Reception — Exhibit Area Open (complimentary for all registrants)</td>
</tr>
<tr>
<td>9:00 pm – 11:00 pm</td>
<td>First Ever AIPG Retro Arcade Tournament (downtown Burlington, details coming soon)</td>
</tr>
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</table>

## Monday, September 16, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:15 am – 8:00 am</td>
<td>Section Delegate Meeting (open to all registrants)</td>
</tr>
<tr>
<td>7:30 am – 4:00 pm</td>
<td>Conference Registration</td>
</tr>
<tr>
<td>8:00 am – 4:00 pm</td>
<td>Field Trip — Landslide Hazards at Jeffersonville and Smugglers’ Notch</td>
</tr>
<tr>
<td>8:00 am – 4:00 pm</td>
<td>Field Trip — Economic Geology of the Granite Dimension Stone Industry</td>
</tr>
<tr>
<td>8:30 am – 10:00 am</td>
<td>Plenary Session</td>
</tr>
<tr>
<td>10:00 am – 5:00 pm</td>
<td>Exhibits Open</td>
</tr>
<tr>
<td>10:30 am – 4:00 pm</td>
<td>Technical Sessions</td>
</tr>
<tr>
<td>12:00 noon – 1:30 pm</td>
<td>Luncheon with Keynote Speaker Marjorie Gale, State Geologist of Vermont (complimentary for all registrants)</td>
</tr>
<tr>
<td>5:00 pm – 8:45 pm</td>
<td>AIPG Awards Dinner Cruise on Lake Champlain - The Spirit of Ethan Allen (all attendees welcome with additional fee)</td>
</tr>
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</table>

## Tuesday, September 17, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 am – 3:30 pm</td>
<td>Conference Registration</td>
</tr>
<tr>
<td>8:30 am – 5:00 pm</td>
<td>Technical Sessions</td>
</tr>
<tr>
<td>9:00 am – 2:00 pm</td>
<td>Field Trip — Geology of Western Vermont</td>
</tr>
<tr>
<td>10:00 am – 3:30 pm</td>
<td>Exhibits Open</td>
</tr>
<tr>
<td>12:00 noon – 1:30 pm</td>
<td>Luncheon with Keynote Speaker (complimentary for all registrants)</td>
</tr>
</tbody>
</table>

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DoubleTree by Hilton Burlington Vermont, 870 Williston Road, Burlington, VT 05403
(802) 865-6600 or (855) 686-8875 — Rate $139+ tax per night

*Schedule as of 3/2019 - go to www.aipg.org and select ‘Events’ for additional information*
Registration

NAME ___________________________ COMPANY ___________________________

NAME FOR BADGE ___________________________

EMAIL ___________________________ PHONE ___________________________

ADDRESS ___________________________

CITY ___________________________ STATE ___________________________ ZIP ___________________________

SPOUSE/GUEST NAME FOR BADGE ___________________________

EMERGENCY CONTACT NAME ___________________________ EMERGENCY CONTACT PHONE ___________________________

**REGISTRATION FEES** *(Full registration includes the ExCom Meetings, Welcome Reception, Technical Sessions, Poster Sessions, Exhibits, and Lunch and Breaks on Saturday, Monday, and Tuesday)*

<table>
<thead>
<tr>
<th>Registration Type</th>
<th>Early Bird (Through 9/31/19)</th>
<th>Registration (After 9/31/19)</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td>AIPG Member Full Registration</td>
<td>$425</td>
<td>$525</td>
<td></td>
</tr>
<tr>
<td>Non-Member Full Registration</td>
<td>$475</td>
<td>$575</td>
<td></td>
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<tr>
<td>Young Professional Full Registration (must be AIPG YP Member)</td>
<td>$325</td>
<td>$425</td>
<td></td>
</tr>
<tr>
<td>Daily Registration</td>
<td>$250</td>
<td>$350</td>
<td></td>
</tr>
<tr>
<td>Spouse/Guest Full Registration / or Welcome Reception Only</td>
<td>$225 / $45</td>
<td>$325 / $45</td>
<td></td>
</tr>
<tr>
<td>Student Registration Career Workshop Only Saturday, 9/14/19</td>
<td>$20</td>
<td>$20</td>
<td></td>
</tr>
<tr>
<td>Student Full Registration without Saturday / Full Registration with Saturday</td>
<td>$145 / $165</td>
<td>$145 / $165</td>
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</tr>
<tr>
<td>Student Daily Registration</td>
<td>$95</td>
<td>$95</td>
<td></td>
</tr>
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</table>

**TOTAL AMOUNT DUE**: $ ______________

**FIELD TRIPS** *(must be registered for the conference)*

<table>
<thead>
<tr>
<th>Field Trip Description</th>
<th>Amount</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Greatest Hits” Outcrops of the Champlain Valley Belt of West Central Vermont (Sunday, 9/15/19, 8:00 am - 4:00 pm)</td>
<td>$99</td>
<td>$99</td>
</tr>
<tr>
<td>Operating Mines/Quarries in the Vermont Valley (Sunday, 9/15/19, 9:00 am - 5:00 pm)</td>
<td>$99</td>
<td>$99</td>
</tr>
<tr>
<td>Landslide Hazards at Jeffersonville and Smugglers’ Notch (Monday, 9/16/19, 8:00 am - 4:00 pm)</td>
<td>$135</td>
<td>$135</td>
</tr>
<tr>
<td>Economic Geology of the Granite Dimension: Stone Industry (Monday, 9/16/19, 8:00 am - 4:00 pm)</td>
<td>$99</td>
<td>$99</td>
</tr>
<tr>
<td>Geology of Western Vermont (Tuesday, 9/17/19, 9:00 am - 2:00 pm)</td>
<td>$99</td>
<td>$99</td>
</tr>
</tbody>
</table>

**TOTAL AMOUNT DUE**: $ ______________

**SOCIAL EVENTS • DONATION**

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Welcome Reception <em>(Sunday)</em> (please check if attending, included with registration)</td>
<td>$70</td>
<td>$70</td>
</tr>
<tr>
<td>AIPG Awards Dinner Cruise on Lake Champlain - The Spirit of Ethan Allen (Monday, 9/16/19, 5:00 pm - 8:45 pm)</td>
<td>$70</td>
<td>$70</td>
</tr>
<tr>
<td>Make a Donation to the Foundation of the AIPG for the Student Career Workshop</td>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

**TOTAL AMOUNT DUE** *(from all sections)*: $ ______________

**PLEASE CHECK METHOD OF PAYMENT**

- Check Enclosed (payable to AIPG)
- Visa
- Master Card
- American Express
- Discover

(Credit cards are processed in US dollar amounts only)

Card No. ___________________________
Expiration Date ___________________________
CVV ___________________________

Required: Credit Card Billing Address (If different from above: street, city, state, and zip)

Hotel Information: DoubleTree by Hilton Burlington Vermont, 870 Williston Road, Burlington, Vermont, 05403, (802) 665-6600, (855) 665-8675. When making reservations, be sure to use the group code “AIPG Annual Conference” to receive the reduced conference rate of $139+ tax per night, which will be honored until 8/28/19.

Cancellation Policy: You must send written notification of registration cancellation by mail, email, or fax to the AIPG office. Registrations received by 8/31/19, will receive a refund of their payments minus a $60 processing fee. No refunds can be issued for cancellations after 8/31/19, 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.

www.aipg.org
I am really looking forward to our Annual Meeting in Burlington, Vermont. I strongly recommend going as both the program and the field trips sound excellent, the country is beautiful, and the leaves will just be turning. For those who are interested in the early history of both the United States and Canada this area has a lot to offer: it was the scene of important campaigns during the Revolutionary War. In an important sense, these campaigns determined the history of both countries.

Just as important to us as a profession, this area and New York State just across the lake, as well as the adjacent southern part of Quebec, may be regarded as the cockpit of early geology in North America. It is where the work of Amos Eaton (1776-1842), Ebenezer Emmons (1799-1863), and James T. Hall (1811-1898, “The Founder of Modern Geology” and of the New York State Geological Survey), as well as, on the Canadian side, William Logan (1798-1875, founder of the Canadian Geological survey) overlapped. Logan and Emmons both recognized the frontal thrust of the Appalachian Mountains, Logan’s Line (or Emmons’ Line, Fig.1), which runs along the valley of the St. Lawrence and then past Burlington to the Hudson Valley. Eaton’s 1830 Geological Map of New York extended into the Burlington area of Vermont: he was appointed Professor of the Medical College at Castleton, Vermont in 1820. I think the romance of Logan’s Line was one of the things that first interested me in Geology. Come and enjoy this wonderful historical, geological and scenic region!

In this issue of TPG we also showcase the essays written by the students who have received scholarships this year from AIPG. The essays are remarkably well-written, and they highlight the idealism and enthusiasm of the new generation of geologists. To me it is remarkable how many of the students came to geology rather late in their college careers: there is a theme of an early interest in, and curiosity about, nature, followed by a lack of certainty about the course of study in college, and then a sudden awakening to their real interests when they encountered, sometimes by accident, their first course in geology. It seems there are some remarkably good and inspiring geology teachers in American universities.

We have a concentration of articles that center around various aspects of diversity. David Abbott’s column and Jessica Davey’s piece both focus on an example of a disparaging comment about the roles of women, whereas Heidi Harwick’s focusses on the support that she has received both at school and at work as a time-constrained part-time student. Shirley Mensah discusses the benefits that speaking several languages brings in terms of a broader cultural understanding.

We also have a set of great articles that discuss aspects of engineering geology (Nygård, Jeanty and Gooding). Although I couldn’t manage to get an article on the Revolutionary War campaigns in the Burlington area, we do have an excellent article on the influence of geology on the siting of Civil War Camp Nelson in Kentucky, our newest National Monument, and the campaigns waged from it (Spalding).

Finally, a very important article by Howald is actually a blueprint for becoming an entrepreneur in the mining exploration business. We solicited this article because we believe that for many professionals, especially young professionals, the prospect of starting one’s own company is daunting, the mechanics are mysterious, and the skills required seem to be unattainable. We hope that this article will show that it isn’t all that complicated, and inspire many to “take the bull by the horns” and become entrepreneurs.
Editor’s Note: The connection between rising CO₂ levels and climate warming

Sometimes I see statements that increasing levels of CO₂ and methane will not have any further effect on Earth’s climate, because the major CO₂ absorption band near the wavelength of the peak of Earth’s emitted radiation, 15 µm, is fully saturated (i.e. can absorb no more energy).

The average albedo of the earth is about 30%, so 70 percent of the sun’s radiation is absorbed, directly and indirectly (through plants) heating the Earth’s surface. This is re-radiated at longer wavelengths, in the infra-red part of the spectrum, with a peak at 15 (microns, 10⁻⁶m). Carbon Dioxide in the atmosphere absorbs radiation in several bands near this peak (the bands are centered at 9.4µm, 10.4µm, and 11.4-20.0µm, thus heating the atmosphere.

Fig.1 is a schematic rendering of the spectrum of outgoing fluxes at the top of the atmosphere with current concentrations of O₃, CH₄ and N₂O (long-dashed curve). The area under the curve is proportional to the flux of outgoing energy. The solid curve shows the shape and size of the CO₂ absorption band at current CO₂ levels. Note that it has a ‘W’ shape with a narrow central peak at wavenumber 680 cm⁻¹ or 15 µm. The absorption of CO₂ in the atmosphere is saturated in the center of the absorption (the twin bottoms of the ‘W’). The effect of increasing levels of CO₂ is to increase absorption in the wavelengths of the outer limbs of the ‘W’, regions in which CO₂ is less strongly absorbed. As that happens, even though the ‘W’ cannot get deeper, it gets wider as more and more energy is absorbed at the wavelengths of its outer limbs. Its area on the graph is thus increased, meaning that CO₂ is absorbing more of the Earth’s outgoing radiation (8% if CO₂ doubles versus 6% at present levels of CO₂) hence warming the atmosphere more than before.

Of course, this is a gross oversimplification. The absorption band structure of CO₂ is more complicated. There also forward feedback mechanisms (a warming planet means a more moist atmosphere, which further speeds things up because water vapor is a better absorber than CO₂). Cloud cover may be expected to increase, and we do not yet understand the effect of clouds on the Earth’s radiation budget very well.

References


Zhong, Wenyi, and Joanna D. Haigh, 2013, The Greenhouse Effect and Carbon Dioxide. Royal Meteorological Society: Weather, v.68, no.4, pp. This article gets into the gory guts of the topic: the language is clear but it requires a lot of patience to understand many of the figures.
Dear Editor:

The Second Quarter 2019 of TPG (pg. 13) contains a letter by Peter Dohms, CPG-07141 that presents a graph of the average near-surface temperatures of the northern hemisphere during the past 11,000 years that references two studies dated 1969 and 1995. If he wants others to appreciate his degree of skepticism concerning recent climate changes it would be more forceful that he present an updated version of this graph.

I present a figure with Information published since 2004 that comes from 18 different peer reviewed studies. This graph shows with a high degree of certitude that the average Northern Hemisphere temperature has risen rapidly to unusually high temperatures since the 19th century.

Peter Dohms’ observations of beach strand lines indicating extensive changes in sea level in the recent past – changes that relate to his figure - are interesting. Again he should cite some peer reviewed articles concerning these observations if he wants others to fully understand and accept his level of skepticism concerning climate change and the possible related effects.

Sincerely,
Frederick E. (Gene) Simms Ph.D.
CPG-10292

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**Reconstructed Northern Hemisphere Annual Temperature during the last 2000 years**


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Dear Editor:

Response to Comments

The purpose of my Letter to the Editor in the Jan-Mar 2019 issue of the TPG was to spur discussion on the role geoscientists should play in mitigating the impacts of climate change and not to open a debate on its causes. Unfortunately, comments to my letter were presented in the Apr-Jun issue of the TPG that ignored my request, and opened a debate on anthropogenic causes of global warming. This does not serve the profession or the community at large.

Most members of AIPG are adept in their specialized areas of expertise, but it is not unusual for many (especially more senior geologists) to reflect on the history of the earth with a certain degree of naivety. We have a tendency to blow-off climate concerns as fleeting events in the normal course of Earth’s vast geologic history, and we support our pre-existing beliefs with confirmation bias.

Here are the facts. Earth’s climate is changing rapidly, and the physics of the causes are well tested, well documented in peer-reviewed journals, and well-recorded in the geologic record. These causes are now also “publicly” acknowledged by major oil companies. There is no debate on the causal issues within the climate science community; all other major science organizations recognize climate change as a settled science. As for the claim that the current warming appears to be “nothing special,” proxy data from 21st century research not only show that global temperatures are already close to levels never experienced by man, but require us to travel back millions of years to the Pliocene. If we continue burning fossil fuels at the current rate, we will reach CO₂ levels as high as the Eocene when earth was in a “hot house” climate state, sea level was much higher, and billions of humans had not yet evolved to live near the sea.

We cannot remain blind to the impacts that we are already experiencing. As long as we continue to focus on debating the science, rather than accepting the impacts and preparing earth science professionals to deal with those impacts (as highlighted in red my earlier letter), then I question the viability of AIPG’s future in the scientific community.

Drew Diefendorf, CPG-3598

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Dear Editor:

Please pass my congratulations to David Abbott. Also send my thanks to Peter Dohms for a thoughtful response to climate change hysteria.

Joe Wojcik, CPG-07776

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**LETTERS TO THE EDITOR**

Graphic from the International Panel on Climate Change Report as presented by the National Centers for Environmental Information. Greyscale reconstructions that are indirectly determined are “proxy” data from tree rings, ice cores, fossil pollen, ocean sediments, corals and historical data. Recent actual temperature measurements are in black. Data sources are presented at the National Centers for Environmental Information web site.
Expansive-Soil Geohazards: An Empirical Index for Texas Counties

Author
James L. Gooding, MEM-3070

Abstract
A simple index for the relative likelihood of expansive-soil damage, including effects of soil plasticity and drought-flood cycles, is formulated for Texas counties from publicly-available, online data for soil engineering properties and rainfall time-series. A dimensionless scale on which index values rise from zero toward or beyond 1.0 indicates the counties most likely to experience expansive-soil effects. For the 39 most populous Texas counties, the range of index values is 0.02-1.40 although 18 counties cluster within the range of 0.80-1.20. The index is proposed as a quick screening tool to inform decisions about whether more detailed field or laboratory studies are advisable for expansive-soil geohazards.

Keywords: Geohazard, expansive soil, hazard index, soil expansion

Expansive-Soil Geohazards and Environmental Variables
Shrink-swell forces related to expansive soils are well-known geohazards encountered when building foundations and roadways in Texas (for example, Wise and Hudson, 1971; Hudak, 1998). Engineering studies have demonstrated that the expansive forces also depend upon repeated cycles of wetting and drying (see, for example, Nowamooz and Masrouri, 2008). Therefore, the key variables include the widely recognized soil engineering properties of liquid limit (LL) and plasticity index (PI) along with some measure of the magnitude of cyclical precipitation swings. However, to date, no standard variable has been established for quantifying precipitation cycles in the context of shrink-swell processes.

Elegant formulations for shrink-swell potential have been developed after meticulous laboratory analyses of soil mineralogy and cation-exchange capacity (Thomas and others, 2000). Even so, such detailed information is not available for most areas and therefore does not facilitate rapid screening of expansive-soil hazards. Risk management plans for geohazards are most effectively addressed in an iterative manner where preliminary screening is used to determine the need for, and to prioritize, more detailed studies before investment decisions are made either to avoid development of an asset or to invest resources in mitigations to reduce asset risk. Accordingly, a method to use widely available geoscientific data to quickly screen the likely expansive-soil damage potential would add value to geohazard assessments.

An Empirical Index Calibrated for Texas
Texas is subject both to major droughts and floods, resulting in environments of cyclical drying and wetting of naturally clay-rich soils across diverse landscapes. During 2011-2015, Texas experienced a widespread and intense drought (NDMC, 2019) that led to renewed attention to road damage caused by expansive soils (TXDOT, 2012). Road repair costs during the drought are at least partly reflected in the road maintenance expenditures by counties (TXDOT, 2013). Those expenditure data are publicly available and therefore offer an opportunity to test correlations of damage costs with soil-environment variables. (Alternative damage metrics, such as building foundation repair costs, are not available in authoritative public databases.)

Road maintenance costs during the most intense period of the 2011-2015 Texas drought were tested as a dependent damage cost (D_C) prospectively driven by independent geoscientific
attributes, including soil plasticity index (PI), climate-normal annual precipitation (CNP) and normalized inter-annual rainfall extreme (NRE); each of the variables is defined in Table 1 and all of the input data are available online at the publicly-accessible sources as cited.

For the 39 most populous counties in Texas (i.e., ≥ 100,000 people per county), simple bivariate plots showed that DC covaries directly with PI and CNP but inversely with NRE. An unweighted combination of the three independent variables yields a linear trend of DC vs. (PI + CNP)/NRE (Figure 1) with a correlation coefficient of R = 0.421 that surpasses the critical value of 0.325 at the 95% confidence level (α = 0.05 for n - 1 = 38); the null hypothesis (i.e., that no predictive relationship exists) can be excluded.

Other attempts at both linear and non-linear multivariate analyses produced alternative relationships that were mathematically more complex but not statistically more compelling. Indeed, the relationship in Figure 1 might be viewed as surprisingly strong considering that road maintenance costs used in the regression probably were influenced by other uncontrolled variables such as absolute ages of roadways and roadbed construction methods. Therefore, based on Figure 1, the following formula can be used to relate expansive-soil road damage to soil-environment variables:

\[ D_C = 4.19_{46} (PI + CNP) / NRE + 6.47_{57} \quad [1] \]

Equation [1] can be used to calculate model-dependent proxy values, re-defined as D CM, for any Texas county using readily compiled values of PI, CNP and NRE. To further refine D CM into a general-purpose, dimensionless index representing relative likelihood, denoted as D RL, the model results are scaled to an effective range with recognized lower (D E1) and upper (D E2) threshold values for expansive-soil activity:

\[ D_{RL} = (D_{CM} - D_{E1}) / (D_{E2} - D_{E1}) \quad [2] \]

Engineering studies have shown that expansive-soil damage typically begins at PI = 5 and is highly probable for P ≥ 35 (for example, Wang, 2016). As the lower threshold for expansive-soil activity among the Texas counties, a combination of PI = 5, CNP = 10 in/yr and NRE = 25% yielded a value of D E1 = 8.99. As the upper threshold — where expansive-soil activity would be virtually assured — a combination of PI = 35, CNP = 35 in/yr and NRE = 25% yielded a value of D E2 = 18.22. (Note: NRE = 25% is near the average for all 39 of Texas counties that were studied.)

Application of Equation [1] and [2] gave the distribution of dimensionless D RL values shown in Figure 2; an example calculation is included in Table 1. The horizontal distribution of values from zero to one reflects the different degrees to which each county’s index rises toward the threshold for highly likely expansive-soil hazards; index values closer to zero are less likely to be affected whereas index values approaching

### Table 1. Variables in the Expansive-Soil Empirical Geohazard Index for Texas

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Definition</th>
<th>Calculation or Standardization</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>D C</td>
<td>Damage Cost for a specific type of loss caused by expansive soils</td>
<td>Annual county-based road Contract Maintenance expense normalized to total lane-miles of road ($Thousands per mile).&lt;sup&gt;A&lt;/sup&gt;, &lt;sup&gt;B&lt;/sup&gt;</td>
<td>TXDOT (2013)</td>
</tr>
<tr>
<td>CNP</td>
<td>Climate-Normal Precipitation</td>
<td>Annual total precipitation (inches per year), averaged over the years 1981-2010, for an individual county.&lt;sup&gt;C&lt;/sup&gt;</td>
<td>NCEI County Time Series</td>
</tr>
<tr>
<td>NRE</td>
<td>Normalized Rainfall Extreme</td>
<td>Absolute average of the maximum and minimum values (expressed as percentage of CNP) in the three-year moving average of annual precipitation excesses or deficits over the years 1996-2018.&lt;sup&gt;D&lt;/sup&gt;</td>
<td>NCEI County Time Series</td>
</tr>
<tr>
<td>PI</td>
<td>Plasticity Index</td>
<td>Average of all soil PI measurements reported for an individual county.&lt;sup&gt;E&lt;/sup&gt;</td>
<td>NRCS Web Soil Survey</td>
</tr>
<tr>
<td>D RL</td>
<td>Relative Likelihood of Expansive-Soil Damage</td>
<td>Example for Galveston County: PI = 26.3, CNP = 51.45, NRE = 29.7. D CM = 4.19 (26.3 + 51.45) / 29.7 = 17.4. D RL = (17.4 – 8.99) / (18.22 – 8.99) = 0.91</td>
<td>Index proposed in this study</td>
</tr>
</tbody>
</table>

Notes:
A. Alternative normalizations to daily vehicle miles (DVM) and per capita DVM did not significantly change the resultant correlations.
B. TXDOT separately reports Construction, Contract Maintenance and Non-Contract Maintenance annual expenses. Per TXDOT definitions, Contract Maintenance expenses appear to capture most of the actual road-repair costs.
C. The 1981-2010 time period is the current definition of the climate-normal period. For the 39 counties studied, CNP ranged from 10.19 in/yr to 57.26 in/yr with an average of 34.43 in/yr.
D. The 1996-2018 time period represents the range of greatest self-consistency per measurement and reporting standards adopted by the U.S. National Weather Service in 1996. For the 39 counties studied, NRE ranged from 18.0% to 39.2% with an average of 26.2%.
E. For the 39 counties studied, average PI ranged from 14.1 to 33.9 with an overall average of 24.9; PI was directly correlated with LL with a linear R² = 0.8718.
or exceeding one (1.0) are most likely to be affected. But it should be noted that \( D_{RL} = 1 \) is not an upper limit. Indeed, the Weibull distribution model indicates that 72% of the model population should occur at \( D_{RL} \leq 1 \) but that 28% should occur at \( D_{RL} > 1 \) (Figure 2). (Although the Weibull distribution is not necessarily the best statistical fit to the data, it is the model that is most frequently referenced in failure-rate analyses.)

Among the 39 counties studied, the lowest index value was 0.02 (El Paso County, in far west Texas) and the highest value was 1.40 (McLennan County, in central Texas). The Weibull distribution model of all values peaks near an index value of 0.70 although a total of 18 counties cluster within the index range of 0.80-1.20 (Figure 2).

Applications and Limitations of the Index

The \( D_{RL} \) index presented here is not meant to be a predictor of actual damage costs from expansive-soil movements. The index formulation was based upon one particular type of hazard outcome — road damage — and for the purpose of evaluating relative likelihood rather than absolute financial consequence. Instead, \( D_{RL} \) is suggested as an easily calculable index that can assist geohazard analysts in quickly ranking Texas locations according to their relative likelihoods to experience expansive-soil effects.

As a reconnaissance tool, a \( D_{RL} \) value might serve to inform whether more work-intensive field and laboratory studies are needed for a particular location. Because the index is heavily weighted on PI, and the National Resources Conservation Service (NRCS) Web Soil Survey provides insights into PI values differentiated within parts a county, the index could be made useful at scales smaller than the county-wide scale used in the current study. With reasonable modifications and appropriate compilation of input data, the index might also be useful in some locations outside Texas. Indeed, the availability of county-wide PI, CNP and NRE data for all U.S. states should make the \( D_{RL} \) index approach easy to test in any state.

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A Coy Rock Avalanche

Ingvild Haneset Nygård

Ingvild Haneset Nygård is a Norwegian hydrogeologist and environmental geologist with a Masters degree from the Norwegian University of Science and Technology. She is a former participant at the Western Michigan University Hydrogeology Field Course the summer of 2015 and is currently working at Norconsult in Norway. She is also a board member of the Norwegian chapter of the International Association of Hydrogeologists.

Has The Man fallen yet?

In the late spring of 2015 the warmth of the sun had finally returned, the snow had almost melted, and green leaves were slowly starting to bloom once more. I was on an excursion with my classmates in the western part of Norway, in Romsdalen (Map-Fig.1), with the majestic mountains towering over the bottom of the valley. I was thrilled to observe some spectacular views like Trollveggen (translation: the troll wall) and Trollstigen (translation: the troll ladder) during the ride along Romsdalen valley, but there was also an excited atmosphere in the bus, because we were about to see the unstable rock mass called Mannen (translation: The Man).

The conversation in the bus went on about how dramatic the last couple of days of October 2014 had been. Those days when the whole of Norway had held its breath and all eyes, cameras, lasers, and radars were pointed towards Mannen. The days when the rock mass moved 300 mm. The days when you continuously F5’ed (updated) the webpage named “Has The Man fallen yet?” (https://www.harmannenfalt.no/index.html) and kept up-to-date on all articles the media wrote about it. That day when families for the first time evacuated from their homes because of the red danger signal. Little did they then know that this would be only the first time of many over the years that they would have to evacuate due to the unstable rock mass.

The Man

The Man got its name from the man-shaped boulder on the top of the mountain. It rises about 1300 meters (4300 feet) above sea level and consists of dioritic to granitic gneiss and migmatite, with a varied content of sillimanite, quartz and kyanite. Due to the deep and open fractures in the upper part of the mountain, a volume of between 120,000 m$^3$ and 180,000 m$^3$ (i.e. 350,000 to 500,000 tonnes) of massive rock is estimated to have loosened from the bedrock. It is assumed that the loose masses will one day slide out as a huge rock avalanche to cover the bottom of the valley. The slide will affect settlements, the railway and the road passing through the valley. A rock slide like that could also dam Rauma, the river that flows through the valley, which could lead to a potentially disastrous dam breach and following flood.1 Because of the hazard the mountain causes, the mountain has been monitored since 2006.2 Veslemannen (translated: The Little Man) is a small part of the unstable mountain area that moves with a higher velocity than the

Fig. 1: Location Map with place mentioned in text labeled. Courtesy Google Earth.
Monitoring the Man

The Man is continuously monitored with multiple types of instruments. A GPS-network with 8 antennas is placed all over the rock masses. A laser system is monitoring movements in the upper part, there are extensometers, geophones, cameras, tiltmeter, 2 ground based InSAR-radars, 2 boreholes with instruments and a weather station. The instruments measuring the surface movements and the deep boreholes make it possible to cover different parts of the mountainside. The infrastructure is robust and is designed to transmit continuously, including when parts of the monitoring instruments are broken due to a rock mass slide. In addition to the monitoring system, there is also a focus on the timing of warnings. The discussion amongst the responsible geologists about when to warn depends for the most part on threshold values, experiences from other cases worldwide, and good expertise. The advice from the geologists may have major consequences for those who are affected.\(^4,5\)

Åknes

Norway is known for its steep mountains and deep fjords. Along with this spectacular nature comes a somber reality. The Man is but one out of seven unstable mountainsides in Norway that is considered as a high-risk object and is under continuous monitoring. Åknes is located by Sunnylvsfjorden and is another monitored mountain side. The estimated volume of the rock mass from a rock mass slide will create a tsunami which will destroy several settlements along the fjord. The tsunami will become amplified due to the depth of the fjord and the tall and narrow mountainsides, and it is estimated that the wave may reach as high as 85 meters. The people living by these fjords will have only a few minutes to evacuate. This scenario is dramatized in the movie “The Wave”. Therefore, monitoring and warning routines are vital for the affected people. The monitoring consists of seismographs, georadar, lasers and reflectors, geophones, cameras, metrological instruments, extensometers, electrical resistivity surveys, GPS, boreholes and video inspections of the boreholes. There is also an ongoing project concerning drainage. The aim is to try to stabilize the mountainside by draining it to eliminate frictionless sliding planes due to the high-water content. The study and surveys will include new boreholes and instruments and focus on how the water flows in the mountainside and whether it is possible to drain the water or not. Let us hope that the project gives good results.\(^5,6\)

Places to study rock mass slides and geohazards in Norway

There are many places to study rockslides and related geohazards in Norway. Amongst the most common places are: The Norwegian University of Science and Technology, the University of Oslo, The Arctic University of Norway, Western Norway University of Applied Sciences and the University of Bergen, all of which offer international courses at different levels, as well as various field courses.

Epilogue

Back in the Romsdalen valley in the late spring of 2015, the bus finally makes a stop and we step off to check if The Man had fallen or not. He hadn’t and he hasn’t yet!

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NIBS Report Builds Foundation for Hazard Mitigation Efforts

Julia Jeanty

Julia is a 2018 graduate from the University of Florida with a dual degree in Environmental Geosciences and Sustainability Studies, as well as certificates in Geospatial Information Analysis and Meteorology and Climatology. Most recently, Julia worked at the American Geosciences Institute as a Geoscience Policy Intern and then as a Talent Pool Intern at the American Geophysical Union.

NIBS Report Builds Foundation for Hazard Mitigation Efforts

Wildfires, floods, hurricanes, tornadoes: 2017 was no stranger to the full-forced havoc that natural disasters can wreak on a nation. 2018 was no better. These two years were the costliest on record for weather-related disasters in the United States, amounting to over $400 billion in damage. Perhaps even more daunting than this figure is the difficulty of determining how best to reduce it: natural hazard mitigation spending is not closely monitored, making it very difficult to track the efficacy of mitigation measures and thus hindering attempts to implement them.

With the goal of promoting mitigation efforts, the National Institute of Building Sciences (NIBS - https://www.nibs.org) released its Natural Hazard Mitigation Saves: 2018 Interim Report in January 2019. This report, issued in collaboration with a consortium of federal agencies and other organizations, quantifies the cost savings for implementing four sets of mitigation strategies, including: beyond code requirements (surpassing minimum building code requirements in new buildings set by the International Code Council (ICC - https://www.iccsafe.org), adopting I-Code requirements (designing buildings with best-practice codes set by ICC), infrastructure (making water, wastewater, electricity, telecommunications, roads, and railroads utilities and transportation systems more resilient), and federal grants (provided by FEMA, EDA2, and HUD to strengthen existing buildings on state and community-wide scales). For these mitigation strategies, cost savings are determined for four natural hazards: riverine and coastal flooding, hurricanes, earthquakes, and fires at the wildland-urban interface (WUI).

The 2018 report builds on a widely used 2005 NIBS report entitled Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, which found that every $1 that FEMA invested in natural hazard mitigation between 1993 and 2003 saved $4 in future recovery costs. The 2005 report also found that $3.5 billion in mitigation spending will save society about $14 billion in future building repair costs, content losses, direct and indirect business interruption, deaths and nonfatal injuries, and environmental and historical value. The 2018 report provides a more comprehensive assessment of the savings resulting from mitigation measures, and aggregates and compares them across national, state, and local levels. The 2018 report also has a broader focus, including elements absent from the 2005 report, such as injury and loss of life, while also using advances in disaster modeling to improve its precision.

NIBS quantifies savings using benefit-cost ratios (BCRs), which compare the successes of mitigation measures to the cost of their implementation. Benefits include reductions in future deaths, household displacement, PTSD, loss of business revenue, and public and emergency facility damage. Higher BCRs reflect more cost-effective measures. The utility of this report reaches across sectors and scales, and may appeal to insurance companies, appraisers, architects, civil engineers, builders, government officials, homeowners, businesses, and universities.

Table 1 illustrates the BCRs for each hazard type and mitigation measure detailed in the NIBS report. Adopting I-Code requirements is the most cost-effective mitigation measure overall, showing particularly high returns for wind and earthquake hazards, for which highly effective building strategies have been developed in response to major events in the U.S. and internationally. Federal grants are the second most cost-effective measure: over a period of decades, effective implementation of federal grants is expected to save each state at least $10 million, with savings in more populous or hazard-prone states exceeding $1 billion. Hurricane surge is perhaps the most attractive hazard for future mitigation research.

Mitigation Measure | Beyond Code Requirements | Adopting I-Code Requirements | Infrastructure | Federal Grants |
--- | --- | --- | --- | --- |
Overall Hazard Benefit-Cost Ratio | 4:1 | 11:1 | 4:1 | 6:1 |
Riverine Flood | 5:1 | 6:1 | 8:1 | 7:1 |
Hurricane Surge | 7:1 | N/A | N/A | Too few grants |
Wind | 5:1 | 10:1 | 7:1 | 5:1 |
Earthquake | 4:1 | 12:1 | 3:1 | 3:1 |
Wildland-Urban Interface Fire | 4:1 | N/A | N/A | 3:1 |

yielding the most return on investment for surpassing building codes but also having the least data available to determine the most effective mitigation strategies.

**NIBS and Hazard Legislation**

Money, expert guidance, and public support are three constraints that legislators operate under when considering hazard mitigation. The Natural Hazard Mitigation Saves: 2018 Interim Report helps guide federal, state, and local decision-makers in their disaster mitigation considerations and, given limited available funds, may help focus their efforts on the most effective hazard mitigation measures. The interim report shows that by implementing beyond code requirements and federal grants alone, over 600 deaths and 1 million cases of nonfatal injuries would be prevented within a span of 23 years. According to David Applegate, associate director for natural hazards at the U.S. Geological Survey (USGS), the federal government has made significant strides in prioritizing natural hazard legislation in the last several years. He gives the disaster recovery reform portion of the FAA Reauthorization Act of 2018 (H.R. 302) as an example of one such effort. Applegate believes that this bill “shows how we can invest in avoiding future disasters, which potentially has very significant implications for how federal dollars can be invested in future mitigation efforts,” and notes that “the NIBS report is coming out at a good time to bolster the case for various investments.” The FAA Reauthorization Act of 2018 includes a provision on natural disaster recovery reform, providing funding for both pre-disaster mitigation efforts and post-disaster assistance for communities to maintain building code standards.

Sometimes, mitigation means having more information, faster. The National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act of 2018 (H.R. 6650) provides funding for seismic activity monitoring, earthquake impact studies, and community earthquake resilience improvements. Section 6 of the bill states that the USGS must provide Congress with a five-year plan to manage the Advanced National Seismic System (ANSS), which provides emergency-response teams with live updates during emergency situations. Applegate believes that this is crucial because of the difficulty and importance of effective communication during large seismic events. A strong ANSS will help provide the best possible situational awareness for response teams so they can focus and prioritize their responsibilities.

**The Future of Hazard Mitigation**

The future of natural hazard mitigation is unclear, but it is becoming increasingly clear that proactive mitigation methods yield results. Applegate stressed that “it is easy for [legislators] to focus on the response side of disasters; that’s where everyone’s focus is. There is an increasing recognition that we cannot simply respond our way out of disasters. Mitigation is an important part of the overall resiliency equation, and there is a lot more to be done.” Gabe Maser, vice president of federal relations at ICC, echoes these sentiments while noting that U.S. natural disaster mitigation efforts are improving.

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Common Mistakes in Groundwater Resources Development

Barney Paul Popkin, Consultant

Barney Paul Popkin is a water, wastewater, environmental and waste management consultant with over 50 years of experience in the U.S. and internationally. Mr. Popkin has an AB in Geology and MS in Hydrology. He worked as a hydrologist for several major U.S. firms, and as an advisor and consultant to the U.S. Agency for International Development, Asian Development Bank and World Bank.

There are a great many ways to damage a successful groundwater resources development program. Often well drillers, pump providers, equipment vendors, sales and service personnel, and even hydrologists are unclear that aquifer tests or pumping tests provide useful information on the transmissivity, permeability (hydraulic conductivity) and storativity (storage coefficient) of the aquifer, well tests provide useful information on well efficiency through its specific capacity, while pump tests provide useful information on pump performance (horsepower, flow rate, and hydraulic heads, lifts and gradients) under ideal laboratory test conditions. Pumping tests, well tests and pump tests are not the same. Word to the wise!

Here are a few ways to challenge groundwater development that I’ve encountered during my 50+ year career in the USA and abroad.

- Siting water wells close to each other, roads, energy sources, or other conveniences rather than where the groundwater conditions are most favorable. A good rule of thumb is to provide 500 lateral feet between pumping wells. Of course, water wells could be located close together but such wells should not be pumped simultaneously or while the others are recovering their pumping-water levels to static levels.
- Siting wells within the recharging influence of soil, surface water or groundwater contaminants, such as: agricultural runoff, which produces pesticides and fertilizers; landfills and cemeteries, which produce contaminating leachate; leaking aboveground or underground fuel storage tanks or pipelines, which produce petroleum contaminants, and commercial, industrial and mining and refinery areas, which produce hazardous waste streams, etc.
- Drilling wells with mud and not developing the well to remove the mud which is otherwise a barrier to optimal groundwater-flow into the well. I like using biodegradable foams, water, and reverse rotary.
- Drilling a crooked or non-straight water well which makes it tough on a vertical shaft turbine pump. Straight-hole centering devices are readily available or constructible.
- Completing water wells with improperly selected well screens that produce turbulent groundwater flow to the well, reducing the well’s potentially higher yield, and increasing operating costs, well and pump maintenance, repairs and downtime. Sized V-notched steel well screen is the best and most efficient, although it’s the most expensive.
- Screening too much or too little of the subsurface to supply water to the well. Too much screen is a wasteful cost, too little diminishes the well’s potential capacity. Screening for a zone of unacceptable water quality can diminish the supplied water quality and perhaps lead to abandonment of the well.
- Installing an insufficient amount of water wells to meet demand, thus causing downtime for repairs,
re-development and cleaning, as well as well and pump failure.

- Installing inappropriate water well pumps because they are cheaper or more available, but unable to meet water demand.

- Providing inadequate energy supply, water and energy meters and controls. If the situation is blessed so that suction pumping is an option, skipping intake check valves leads to re-priming and pumping delays.

- Inadequate water-level, pumping rate, energy use, and water quality monitoring records, leading to missing the opportunities to early recognize when repairs and redevelopment and cleaning may be needed to prevent later more expensive repairs and redevelopment and cleaning.

- Improperly sealing the well head to protect the water well from surface and near-surface contamination, allowing contamination of the well and of the aquifer.

- Improperly abandoning the well, which may also lead to surface-water contamination of the well and the aquifer.

Finally, note that water temperature impacts water viscosity and aquifer permeability: very cold groundwater flows more slowly than very warm groundwater, so that water-well discharge in very cold weather may be measurably lower than during very warm weather. And, note that if you want to increase water well yield, you need to increase the saturated thickness of the screened interval or vertical open area, not the diameter of the well. You might increase the well diameter for convenience of pumping equipment, but not to increase well yield.

Geologists play a unique role in disaster mitigation as their responsibilities may fall either in preventing future damages or responding to current disasters. Seismologists, meteorologists, volcanologists, and spatial epidemiologists primarily focus on researching the genesis of disasters in their respective fields, whereas sedimentologists, climatologists, and biogeochemists may focus more of their attention on the aftermath of natural disasters. By combining a wide breadth of geoscience knowledge on pre- and post-disaster mitigation with legislative and industry knowledge, disaster mitigation can become a more informed and productive process over time.

What’s more, there is ample opportunity for geoscientists to assist in advising on federal grants and infrastructure mitigation measures. Floodplain managers can use funds from the Flood Mitigation Assistance (FMA) Program to create flood maps to assess what areas are particularly susceptible to flooding and advise what structures need to be updated or demolished. Hydrologists can counsel city planners on which water treatment facilities are most vulnerable to wastewater intrusion. Social geographers can cooperate with community members to gain valuable stakeholder insight as to what mitigation measures might be most effective in their communities. Geologists can work with building scientists to conduct land surveys and determine which areas require soil stabilization and which existing buildings need to be retrofitted using funds from the Pre-Disaster Mitigation (PDM) Program. Geoscientists have the potential to revolutionize natural disaster mitigation, and it is crucial that they work to collaborate with other industry specialists to help ease the burdens that future disasters might cause.

Legislators are responding to demands from both the citizenry and the scientific community to get ahead of natural disasters before catastrophe strikes. With comprehensive disaster mitigation legislation, backed by research from agencies like FEMA, USGS, and NOAA, the U.S. can work to protect its most vulnerable communities while ensuring long-term fiscal savings. Investing in disaster mitigation will not only increase the nation’s safety but also improve its economic resilience for years to come.

References

Jennifer Davis, SA-4207
Miami University, Ohio – OH Section

I have a rock from every single place I have ever visited. That’s not an exaggeration. Every vacation, every field trip, I keep a rock and add it to my collection. My passion for rocks began at an early age. As a kid, I could not stop picking up rocks. Something about these little pieces of the Earth astonished me. Every single rock that I picked up had an entirely different shape, a different combination of minerals, and a different structure than the one before it. I filled every jacket pocket, every pants pocket, every backpack, and every nook and cranny in between with rocks every single place I went. Even in my own backyard, I would explore the creek in the woods just to find more. Sometimes on my hunt for rocks, I would come across something that southwestern Ohio is famous for: fossils. The first fossil I ever found was a brachiopod from that very creek near my house.

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My collection of rocks and fossils now includes specimens from locations spanning the globe. I keep them all over my house: outside on the porch, in my bedroom, in the kitchen, in the living room, and in my car. Over the years, I have come to realize that these rocks and fossils tell a story about the history of our planet, a story that is still being pieced together. All of these rocks and fossils help to paint a picture of the past and to me, a chance to be a geologist and paleontologist means that I can contribute to this picture to help us understand more about what came before us.

All of these rocks and fossils help to paint a picture of the past and to me, a chance to be a geologist and paleontologist means that I can contribute to this picture to help us understand more about what came before us.
As a geology major in college, I’m constantly learning more and more about the rocks and fossils that I have collected over the years. The rocks that I first fell in love with because of their beautiful colors and intriguing shapes are now the very same rocks that I love because of their fascinating structures and detailed stories of their origins and past. The fossils preserved in these rocks tell me what kinds of life forms existed in the past and how they lived and died ages ago. Piecing together this history is one of my passions in life; understanding the distant past is not only captivating, but it helps me to understand the inner workings of our planet.

With every geology class that I have the opportunity to take, I obtain a better understanding of the details preserved in each and every one of the rocks. A rock that appears to have swirls in it now tells me about the folding it underwent; a rock with inclusions of another mineral tells me about its history as it cooled. A fossil of a brachiopod tells me what this part of southwestern Ohio used to be like and what used to live here. Each rock carries information stored within it. As a geologist, I will have the ability to unlock that information and translate it for the benefit of humankind.

Elyse Dilloway, SA-9891
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San Diego is known, among other things, for its picturesque beaches. One could never imagine that the sweeping sand dunes are trucked in from industrial quarries. If the city of San Diego didn't spend the effort on keeping its beaches picture perfect, such beaches would not exist. It has been many years since the San Diego river carried enough sediments downstream to naturally replenish the beaches, so the city has fine-grained sand trucked in to make sure there’s a beach to go back to. This is the beauty of geology and earth science: it’s like getting a behind the scenes look at seemingly unremarkable phenomena. I want to be a geologist because I love being able to see the how and why of earth’s processes, learning about the forces behind natural phenomena, and because I want one day to be able to spread my enthusiasm for earth science to everyone.

I didn’t get a taste of earth science until my senior year of high school, in environmental science class. I’d known about rocks, and that there was a rock cycle, but that was the extent of my knowledge. My interest was piqued by the chapter on paleoclimate sciences. It blew my 16-year-old mind to learn that scientists could determine the details of ancient climates from oxygen isotopes in ice and deep ocean cores. That was it. I decided I wanted to make paleosciences my life’s passion. I’d never taken a formal earth science course before, but I knew that I would love it once I dipped my toes in. I still can’t describe the excitement I feel when I go on road trips or even just around San Diego county and I can think to myself, I know how that mountain got there. I know why that river flows through this valley. I know what kind of rock this is. Understanding the history of the landscape makes it all the more beautiful.

I chose paleontology as my major not because of Jurassic Park (although that has inspired me a little) but because of what it can tell scientists about the future. Everyone knows there is a phenomenon called climate change, but the heated debate people get into is whether or not humans are accelerating it, and whether or not they should do something about it. Paleoclimatic evidence tells scientists that yes, humans are accelerating the global warming rate. Whether or not humans should try to stall this rate or reverse it is an entirely different moral debate (but we probably should, if we don’t want to all go to Mars). Not only can scientists perform comparative studies of today’s climate with that of thousands of years ago, but it is possible to construct very accurate climate models from millions of years ago. A combination of historical geology, geochemistry, and paleontology turns fragments of evidence into whole pictures of ancient environments. Some people may think the earth’s history is mysterious and elusive, but...
it’s really not. A person just has to know how to fit the pieces together.

There was a point in my life when I believed climate change was a non-issue. My right-leaning family had convinced me that it was a naturally occurring process and had been going on since the dawn of time. These assertions were true, but they weren’t the whole truth. Pursuing the whole truth rather than a portion of it has become increasingly dire in the age of the internet, especially with “fake news” being such a hot topic on major media sites. Scientific research is the only thing that can remedy this trend, and my intention is to publish research that’s accessible to the common, school educated person. If I hadn’t had good teachers to explain the complex processes of Earth to me in layman’s terms, I probably wouldn’t care about it as much as I do today. I intend to become a part of the generation of scientists that changes the way non-STEM people see the world. By this, I mean I want to open the window of truth completely rather than only leaving part of a propaganda in view.

I could have chosen to be an engineer, a physicist, a biologist, or any other STEM major, but I want to be a geologist. Humans wouldn’t be here if the Earth hadn’t been here first. I believe that learning about the Earth and its history will teach people how to respect it, which will lead them to take care of it. It isn’t easy to stomach the idea that humans as a species are responsible for the deterioration of life on Earth, but if people don’t start to understand the facts, the future will only be worse for the biota. I want to become a geologist so I can convince people to care about the planet that gave them life.

I started my collegiate career in computer science, I enjoyed the ability to be creative, problem solve, and develop new technologies. I had two highly sought-after internships with Thomson Reuters. I learned a lot at Thomson Reuters. I also maintained my passion for earth science but, I also gained interest in other fields.

Last summer, I had a hands-on, full-scale field experience studying abroad in Costa Rica. I worked through many project scenarios, for instance, trekking through mosquito-ridden, tortuous muddy trails, sloshing across knee-high, stagnant water in a dark cave, and scaling 15-feet high roadcuts in pursuit of the perfect stratigraphic column. A small town by the name of Vara Blanca continues to resonate with me and is the fuel for my desire in becoming a geologist. Here, I witnessed how the understudied eruptive history of Poás Volcano located within this town can leave local communities vulnerable and unprepared for future eruptive activity. The temporary closing of the national park it resides in has impacted many families and local businesses, causing a significant economic decline and decrease in the quality of life. Many locals have had no other choice but to find work elsewhere, turning this once-bustling and popular tourist destination into a quiet, forgotten town. I was able to meet many of the locals that opted to stay, and they remain optimistic in hopes that new research can provide clearance for reopening the park, revitalizing the prosperity of the town. From this firsthand experience, I learned how important it is to have a geologic narrative of our world to assess and manage risks properly.

In our capacity of geologists, we are at the forefront of advancing science and technology, and it is our duty to provide our services and diligence to ensure the well-being of our communities. I want to be a geologist because my passion in this subject allows me to do more than just exist—my efforts in crisis management can help educate local communities, ultimately saving lives as a result of warning and natural disaster training. By understanding the complexity of our geologic world, we, the science community, can work together to ensure that future generations can live safely and in prosperity.

Elizabeth Evenocheck, SA-9961
Winona State University, MN - MN Section

Growing up in Minnesota, I have always been a science kid connected to the environment. In the fall, I scrounged around my neighborhood looking for interesting rocks. I had to hold my pants up from the weight of all the precious pebbles in my pockets. In winters, I spent days building complex snow forts and sled runs, perfecting slopes, angles and surface conditions. When the sun started warming things up, I shoveled melting snow and slush into fascinating stream tables. At the time, I did not know it was the start of my hydrology career. In spring, I collected and planted maple seeds, watched them sprout and transplant them all over my backyard, where some still grow today. In the summer, I examined pond water with my little microscope, caught bugs, dug holes— it didn’t matter which season – I have always been connected to science and the environment. That deep connection still holds true today as I graduate college with a degree in geoscience.

Between playing in slush and working with flume and stream tables there has been quite a journey. I have always maintained my passion for earth science but, I also gained interest in other fields.

I started my collegiate career in computer science, I enjoyed the ability to be creative, problem solve, and develop new technologies. I had two highly sought-after internships with Thomson Reuters. I learned a lot at Thomson Reuters. I also accomplished a lot for them. I could see that career path opening up ahead of me.

Then I took the class “Earth and Life Through Time” and it was like I was suddenly reintroduced to that little girl with her pockets full of pebbles. I was hooked. I have no doubt that I could have been successful in a computer science career, but geoscience continues to pull me in. I was even more convinced that geoscience was the right field after I conducted research in the Black Hills, SD. Getting to spend ten days in the field and solve a problem that has never been solved before...
there was no looking back. I became a teaching assistant for several classes. I was selected to present my research at the Geological Society of America conference in Seattle and to legislators at the Capitol in St. Paul. Being able to apply what I have learned in the classroom to the real world and being able to share with others the knowledge I have learned confirmed my pursuit of geoscience. It wasn’t just that I was passionately interested in the science. I believe the geosciences are critical to understanding, protecting and reshaping our changing environment. I immersed myself in all of my geoscience courses. After taking hydrogeology, geochemistry, and watershed, water became a passion.

What could be better than helping my state, my country, the world, by protecting clean water? Currently, my goal is to be able to apply my knowledge, my skills, and my passion as a hydrologist. Looking down this career path now opening up ahead of me, I can see me becoming a mentor to others interested in the field, become a resource people can reach out to, and help others see how critical it is that talented people work in the geosciences. And maybe even eventually, I can nudge along some other little kid with a pocket full of pebbles.

Kevin Hatton, SA-9807
SUNY-Stony Brook, NE Section

I first became interested in geology while away at a Boy Scout summer camp in Rhode Island. One of the troop leaders pointed out the various rock types and landforms while out on a hike. He gave me a baseball sized chunk of quartz from a large vein and that has since become the foundation of my collection. I did not know it, but a fire started in my heart that would remain an ember for another eight years.

I went through middle school and high school collecting more rocks on trips and adventures that I took, but I still only considered it a hobby. When high school came to an end, I went with the class I enjoyed most recently, physics, as my major. After one semester I had the opportunity to take an extra class, and I saw that geology was an option. I took the course and sealed my fate. My geology professor noticed my joy when answering questions or completing labs and informed me of an NSF program, GEOCORE at the school. From there I was hooked. I can remember the feeling of relief and happiness when I realized I wouldn’t need to search anymore: I had found what made me happy. My time at Suffolk County Community College helped me find that ember within me and helped it grow to a hearty campfire. I call it a campfire because I finally felt like I had friends with the same passion and curiosity as me as well as constantly hearing terrible puns and bad jokes. It was with these friends that I embarked on my first geologic adventure, to Big Brook Park in New Jersey (where all the fossils in my collection are sourced, oddly enough.)

My time at Suffolk came to an end, but with every ending there is a new beginning. I got accepted into another program at my next institution, Stony Brook University, where I was able to conduct geophysical research during the summer. After the program ended, I migrated into the Stable Isotope Geochemistry laboratory where my campfire grew into a roaring inferno. I have been working there ever since. My time is spent cleaning beakers, preparing samples, organizing lab equipment and analyzing samples by laser ablation. I have found ages for fluorite and carbonate samples as well as creating isotopic maps of samples. This is truly amazing work and every day I am excited to do more. I have even started my own research project on dating fossilized wood samples from the Turkana basin to create better constraints on the time interval during which protohumans were evolving in the region. This is an amazing project to be working on and I should have results in time to produce a poster for my school’s undergraduate research symposium.

I never would have thought that what I did as a hobby could be a career that has so many opportunities. Through Stony Brook I have not only started my own research but was invited to attend my first geology conference, the New England Intercollegiate Geological Conference (NEIGC) (which was one of the best weekends of my life). I have also had the opportunity to attend many lectures from professors in related fields and attend many meetings and operations of workers in geological companies.

It took many years, but the passion inside me for geology only needed someone to help fan the flames. For that I will be forever grateful to Sean Tvelia and Darryl Butkos, who were my first geology professors. They reached out to me about getting more involved with geology and I could only hope to be as inviting and resourceful as they were to me.

Kelsey Hewett, SA-8977
Wayne State University, MI – MI Section

Growing up I was a curious child who was full of questions. Much to my mom’s chagrin, I followed up every inquiry with “why?” That young kid has since grown up with the same level of curiosity. Luckily, I had a family which challenged me to answer my own questions. But there was still one question I couldn’t answer until recently, why geology?

A career as a geologist is something that has occurred rather recently for me. It wasn’t until two years ago that I discovered that I had found my calling. Reflecting on my memories, it’s hard to ignore the strong influences that led to where I am now. Being surrounded by a family of scientists, researchers, and educators, I was exposed at an early age to an environment that encouraged me to dare to dream. Some people know at a young age what their lifelong career will be; I was not one of those lucky few. I never collected rocks along the shorelines of one of the Great Lakes with my family, nor did I have a bookshelf collection of mineral specimens. While there were no childhood memories that were directly related to the field of geology, I was able to gain exposure to many of the sciences.

My time at Suffolk County Community College helped me find that ember within me and helped it grow to a hearty campfire. I call it a campfire because I finally felt like I had friends with the same passion and curiosity as me as well as constantly hearing terrible puns and bad jokes.
After a long day on campus, I can come home and proudly glance at that beautiful geode my grandfather has since given to me. It now sits near my fireplace, providing me much needed motivation and support. I will always continue to ask questions, but most importantly, attempt to understand the why’s our earth has to offer. One less question I have now is why I want to be a geologist. To be a geologist is to seek the answers to the many unknowns, and I hope to one day answer another eager mind’s “why?” when I become a geologist.

In my teenage years, I was clueless as to what I wanted to do with my life. Upon graduating high school, finding my purpose in life was a time of great reflection and uncertainty. It wasn’t until I became a young adult that I enjoyed finding the repetition and symmetry of nature intriguing. Every summer, I tended to my family garden which was full of sunflowers. The Fibonacci sequence and the golden ratio mesmerized me as they masterfully crafted the seed patterns within the sunflower head, along with the swirls in the succulents that adorned my windowsill. It was that last summer before I began college courses that I finally realized that I had known as a young girl what truly interested me. All those years of appreciation for nature’s ability to produce such perfect, geometric shapes along with the time spent staring at my grandfather’s geode was a subtle calling for me to get into the natural sciences.

Before I jumped into any big decisions, I spent that following fall and winter looking into topics I was interested in. Most often, I landed back to the same general result; geology. Surprisingly, up to that point, I had never asked my grandfather much about his professional life as a geologist. As I considered my own potential career, I sat with him many evenings learning about his time as a geologist for the State of Michigan and the different sub-disciplines of the geosciences. From there, I knew I needed to take the proper steps to obtain a degree in geology.

By the end of my first semester at Wayne State University, I was reassured that I was studying exactly what I wanted. I got excited to see the symmetry of the fluorite clusters and was able to visualize the golden ratio along the spiral of an ammonite shell fossil. I eventually learned to identify the other minerals in my grandfather’s geode. During this time, I didn’t know why I wanted to be a geologist. I just knew I had a passion and an eagerness to learn. It wasn’t until my petrology course that I had decided hard rock geology and a focus in volcanology were the fields that interested me the most. It was then that I immersed myself in learning as much as I could about geology.

Without geologists, petroleum fields would go undiscovered. Natural hazards like earthquakes, tsunamis, and volcanic eruptions would go unmonitored. Mankind’s unwavering mission to construct buildings that allow us to touch the sky wouldn’t rise more than a few stories without the expertise provided by a geologist. To be a part of such a diverse and critically important and demanding field of study is not only rewarding, but it allows me to continue to ask the question “why?”
from many different divisions of geology such as radiogenic isotope, paleomagnetic and paleocurrent data. This was a new and exciting way for me to learn about different kinds of data and how they can be utilized together to gain the most accurate results. I am looking forward to using a cumulative approach in the geologic research that I do.

Another reason why I want to be a geologist is so that I can make a difference in the world. I see geology as the most important tool in solving many of our world problems. As people are faced with natural disasters such as earthquakes, landslides, volcanic eruptions among others, geologists are the ones to contact to learn about mitigation techniques and possible future occurrences. Through exploration, geologists are able to find resources that are crucial to our survival and societal advancement. With geology, people can live healthier lives by knowing that their source of groundwater is uncontaminated. There are so many ways as a geologist that I can make a positive difference in someone’s life and that is something that I will always strive for. In my eyes, geologists are modern day heroes as our climate and environment is ever changing.

As the careers and degrees I considered as a freshman changed and evolved with time, it was a great relief to find a degree and department I felt that I truly belonged to. I will forever be thankful to CMU and the department of Earth and Atmospheric Sciences for giving me that sense of community as I grow as a geoscientist. As I learned about and became apart of AIPG I also found that same sense of community and the organization has opened my eyes to a larger society of other curious earth scientists. This leads me to another reason why I will be proud to call myself a geologist. I am beyond excited to be able to discuss findings and research among colleagues from across the U.S. and the globe. Having such broad connections will mean endless opportunities for geologic research and careers and, it will allow me to collaborate with so many different minds and people of different backgrounds. The geoscience community is one that I am excited to become more apart of and it has become a major part of why I wish to be a geologist.

Looking back on the times I traveled the U.S. with my family, I wonder why it took me so long to figure out that geology would be the right fit for me. I always had absurd amounts of shells and rocks that I was convinced I needed to take home at the end of each trip. Even then I thought of Earth’s materials as treasures. Those memories will always be held dear to me but I hope to gain even bigger and better experiences as I continue to travel the world as a geologist. I want to be a geologist because one area of science is not enough to satiate my curiosities, being a geologist will allow me to make invaluable connections with other scientists, and it will allow me to benefit the lives of others.

Shirley Mensah, SA-7566
Eastern Illinois University, IL/IN Section

The statement, “why I want to be a geologist” is one I never thought I would utter in my life or even think of sharing with others, looking back on a few years ago. I am pretty sure my 14 year old self would be proud of me today. She would be proud because this Ghanaian girl finally found something she wants to pursue with all her might. I say this because, even until the start of my high school journey, I had no idea what major I wanted to pursue in college or what career path I would like to take in the future. I just knew that whatever career path I took, I wanted it to be meaningful and extremely beneficial to my community. In the year 2007, an oilfield was discovered off the coast of the Western Region of my country, Ghana. It was indeed both a blessing and a challenge to the country. We had discovered oil but had no knowledge of how to engage in drilling and production. It was the country’s first exposure to an offshore oil rig; hence this would require experts to handle this oil reservoir.

In finding ways to curb this problem, the government resorted to employing people from other countries regularly to help in the exploration of the oil. Production of oil officially started in 2010, a year before I started high school. In the course of my high school, I came to knowledge that my country was not receiving a substantial amount of the profits gained from the oil production. In operation statistics, 35.48% of the profits go to Tullow Oil, 24.1% to Kosmos Energy, 23.4% to Anadarko, with Ghana only receiving 17.02%. Since these foreigners do almost 100% of the job, they get a bigger percentage of profits than my people get. According to the statistics of the World Bank, Ghana is described as a third world country. However, we are working diligently to achieve a first world status. As a developing country, Ghana needs all the resources it can find in its land to help its economy grow. Even though the country is rich in natural resources, there is a lack of implementation of policies to manage natural resources which leads to the misuse of these resources and slows down development. Similarly, giving away a substantial amount of revenue gained from oil to outsiders, as remuneration for their work, stagnates the country’s chances of development through the petroleum sector. There arose a great concern for the fate of the oil industry in the country, supposing foreigners should keep being in almost full control of it. A huge part of the population that expressed this concern was the youth. How can we help the oil industry ourselves when we have no experience or training in the field and in the country? This was the question often asked. To address this challenge, the youth of the country thought it best to venture out of the country to gain the knowledge, skills, and expertise needed for the oil industry. Hence, the youth has flooded into universities abroad, desperately seeking training in the petroleum sector. I am one of these youth, now a senior pursuing her degree at Eastern Illinois University. I decided to study in the US because I knew I would gain exceptional, world class education, and training in the oil field so I can return home able to contribute to my country’s development in this field.

Thus, I am also in pursuit of a geology degree, specifically in petroleum. My involvement on campus is also nurturing great leadership skills in me, aside the technical skills I
am receiving to help in the oil industry. I want to use these leadership skills in enforcing the implementation of policies to manage natural resources in my country. It is also the hope of the country that when the oil industry flourishes, all profits gained will be invested in development. Sectors of the country with pressing needs that can be improved with these profits are the poor sanitation issues, poor condition of roads which lead to frequent vehicular accidents, poor facilities in the health sector, and many more. Little by little, we believe that we will be able to address these needs and improve the country's standard of living. All hands are needed on deck if this goal of becoming a first-world country is going to be achieved.

This is why I want to be a geologist. I believe Ghana will be a better place someday and I want to contribute to my country’s effort of improving the lives of inhabitants, through the use of my acquired leadership skills and the practice of my profession as a petroleum geologist.

Rebecca Nesel, SA-9914
SUNY-Oswego, NE Section – Foundation AIPG funded

Everyone who decides to study geology has been led there by a different path. For me, that path was more like a windy dirt road, and not a straight paved sidewalk.

Entering my freshman year of college, I was not like a lot of my friends who knew what they were interested in. Even if I knew people that were in the ‘undeclared’ major group like me, they were pretty certain about what their interests were and what they wanted in life. First I decided to keep that undeclared label, but the more I kept it, the more pressure I felt to find my niche. Just as a watched pot won’t boil, a freshman with no idea what she wants will not wake up one day and know she’s ready for a big declaration.

I went along with my general education classes and as they dwindled down, I knew I needed to take some kind of action.

I decided to declare a major in Global and International Studies with a concentration on sustainability. Growing up in this generation, I think that a lot of people have formed a passion and interest for sustainability and the environment. Some people express this interest by studying chemistry, biology, ecology, or other sciences, but I have always just scrolled right past those options. I never believed myself to be the type of person that could succeed in science. I didn’t do well in my science classes in high school, I never enjoyed math, and I always gave myself reasons to doubt my intelligence or work ethic.

I still had a feeling that something was missing when I chose that major, but I thought there weren’t many other possibilities, as I was running out of time. A week before I was supposed to start the semester with the core classes, I was doing some browsing on the internet looking at different types of majors. I saw geology as an option and I had never really known anything about that before, nor that it was an option for me. As a child my family went on countless excursions in the woods and the mountains, where I was constantly curious at the world around me. Everyone else seemed so content with accepting that all of these mountains, rivers, oceans, continents, rocks, fossils, and everything else was just there. But I never grew out of that persistent “but why?” phase. I decided to switch my major, which involved an entire week of frantic emails, dropping classes, registering for new classes, and buying new books.

At first, I was scared that I had made the wrong decision, but as soon as I started my first class, Historical Geology, I knew I was in the right place. I quickly became friends with the other people in my major who are some of my best friends today, and learned what an amazingly close department of students and professors the geology department is. I was immediately intrigued by the subjects, and although I was nervous for the math, chemistry, and physics classes I had to take, I knew it would be worth it. Not only did the classes, professors, and other students reaffirm my decision, but so did all of the opportunities. I loved that there are so many different parts of geology to study, from studying climate change by looking at ice cores in Antarctica, to looking at thin sections of igneous and metamorphic rocks in a microscope to figure out the timeline of the formation of a rock. In geology, there are always opportunities to do something new. I have learned how to make petrographic thin sections and become proficient in optical mineralogy. I have been on overnight field trips with large groups of people, become confident in a laboratory environment, performed grain size analysis, learned how to do X-Ray Diffraction, how to use a Scanning Electron Microscope, performed geophysical surveys, interpreted geophysical data, worked independently on research, written two grant proposals, received a scholarship, and many other small victories.

The ubiquity of geology is what I love most. When someone asks me what I can do with a geology degree, I cannot think of one thing to say because there are so many options. Studying geology has given me the confidence that if I set goals, work hard and work smart, I can do anything I want. I can continue my education by pursuing a Master’s degree or a PhD, or I can find work right after my undergraduate studies in one of the many interesting fields. There is always going to be stress, big decisions, and uncertainty, but I am looking forward to what this journey will look like in hindsight. Choosing to study geology was the best decision for me, and there is no other choice for me but to become a geologist.

Shannon Sartain, SA-9945
Dartmouth College, NE Section

When the professor of my introductory Earth Sciences class— How the Earth Works—taught us about Marie Tharp and Bruce Heezen’s map of the ocean floor, I was bewildered. Not because of how dull their title, “World Ocean Floor,” was compared to that of Hess’ “Essay in Geopoetry,” and only maybe because of the vastness of the mid-oceanic ridges (I mean, look at those transform faults). I was shocked because Heezen’s name is first on the publication, when today, the map is well known to be Tharp’s creation. Marie Tharp was a legendary geologist, but her career was limited by her gender. While Heezen collected bathymetric sound data, Tharp stayed back at Columbia University because women weren’t allowed on the oceanic vessel. There, she used the data to single-handedly create the incredible map of the ocean floor, discovering the mid-Atlantic ridge, and further confirming the theory of continental drift (and the mechanism behind it— sorry, Hess).

I am thankful to grow up during a time in which science is more receptive to gender inclusion. I began research through Dartmouth’s Women in Science Project (WISP), a program designed to match first-year women with research mentors. In the past year, I have examined river mixing by extracting thousands of pixels from Landsat images; processed over 100
years of daily USGS discharge data for rivers in the Northeast; and used land classification techniques to assist my mentors in understanding how gold mining in the Amazon River basin impacts the concentration of sediment, and therefore, mercury. I attended the Google Earth Engine User Summit, an inter-

gational gathering of scientists, as the only undergraduate there and presented my team’s hackathon app to an audience of over 200 researchers. This hackathon experience would not have been the same without the emotional encouragement and technical support of a team comprised mainly of fellow female geoscientists. While the results of my research may be no different than those of a male student, I can’t deny the influence of my gender in shaping the experience I’ve had obtaining them.

Aside from wanting the world to have one more kickass female scientist, my passion for geology and Earth surface processes has also stemmed from my surroundings. Dartmouth is located in Hanover, New Hampshire, a small town nestled in the Connecticut River Valley. Rather than expecting us to learn from textbooks, our professors teach by using their classes’ lab periods to take field trips. I’ve learned about basaltic dikes by visiting Quechee Gorge, just a 10-minute drive from campus; where the gorge becomes extremely straight is where the water was able to erode through the relatively soft basaltic intrusion. I’ve seen the evidence of the Laurentide Ice Sheet as it carved out the CT River Valley; glacial striations line our hiking trails and a nearby golf course is actually an esker that was formed when the glacier steamrolled over Hanover. The land where Dartmouth sits was once occupied by glacial Lake Hitchcock and today, glacial varves lie all around our campus. In fact, the same glacier that formed these features continued to move south and then retreat, dumping a huge pile of sediment that is present-day Long Island, the place I call home.

So, why do I want to be a geologist? To one-up Marie Tharp? Of course not. To discover another feature that lies just under my dorm? No, though I wouldn’t rule it out. In fact, I want to be a geologist, because, akin to the name of my introductory Earth Sciences course, I want to continue to learn more about how the earth works, and to present the answers—at least some of them—in an interdisciplinary way. I want to be a geologist who studies more than just rocks; who creates 3D models that dance around my display and processes data using computing power geologists have never had before. I want to celebrate the start of Landsat 9 with a launch party (see what I did there?), take advantage of the high-resolution satellite images being produced by private companies, and scratch the surface of knowing how the four-billion-year-old structure of our planet will change as it warms at an increasing rate.

Beyond that, I want to be a geologist to encourage others to do the same. Geology is a field often occupied by those privileged enough to have been exposed to physical, outdoor activities from an early age—a population that is largely white, able, affluent, and male. However, like any other institution, the field will benefit from diverse perspectives. I hope to be one of them, and eventually teach in a classroom, making Earth Sciences welcoming and accessible to anyone. Because there must be a million more Marie Tharps out there, and we should be putting their names first.

Benjamin Thyer, SA-9928
The University of North Carolina at Chapel Hill, Carolinas Section

I remember wandering through Washington D.C.’s Smithsonian Museum of Natural History as a young boy, my thoughts racing through ancient and foreign environments as my feet carried me across thousands of years, from dioramas of the ocean floor teeming with unfamiliar life, to the early shores of the Ordovician, where I bore witness to the first plants struggling to put down roots on land. As I passed through the exhibits, the story of Earth unfolded before me—but I didn’t know at the time what I would write in the pages set aside for me. I did know; however, that I wanted to learn more and go deeper in the fascinating area of Earth science.

Before I declared my Earth science major, I had been a music major in my early college years. I always understood that music became infinitely more interesting the more someone learned about it. Although an untrained ear may understand the surficial beauty of a piece of music, a scholar of music can intellectually explore into the intricacies of harmony, form, and texture, and as a result is far more equipped to profoundly engage with the musical language of a piece—a highly satisfying endeavor. In much the same way, a geologist begins to understand rocks, structures, and landforms as songs of the earth, with stories to be told in the unfolding of their past. Geology teaches us to engage in the language of the earth, so that the richness of earth processes informs the observant geologist and elevates their love for the structure, landforms, and materials of the planet. Geology calls me because I want to get to know the earth better; I want to speak its language and to study the harmony of this blue sphere we call home.

The first time I heard this music of the earth was when I drove across the country to work for the National Historic Oregon Trail Interpretive Center as a GeoCorps Education Intern in Baker City, Oregon. That summer, my adventurous spirit led my weekend wanderings through the Cascades to the coast, through the desert landscapes and limitless skies of Eastern Oregon, Washington, and Idaho, to the forests and
glaciers of Olympic National Park and the concrete jungles of Portland and San Francisco.

The next year I was fortunate enough to take a field geology and research course on Big Bend National Park on the Mexican border in Texas. Thankfully, geology doesn’t fully relinquish its secrets until meeting in person, so we hopped boulders up a mountain to characterize a landslide, hiked through canyons searching for evidence of rifting, measured strike and dip of beautiful strata at the intersection of the Laramide and Appalachian orogenies, and veered off the trail in search of radial dikes in the open desert. The remarkably beautiful and fascinating harmony and form of earth processes that I observed in these two opportunities solidified my certainty that the study of geology was my destiny.

Later as I dug deeper into my geology classes at UNC Chapel Hill, I came to appreciate how scientists were able to read the earth’s history from fossils and formations like pages in a book, and then how they were able to relay it to the public. As I sat through fascinating lectures, I realized how important my professors were in my professional and personal development, and I yearned to be that source of inspiration for others one day— I realized that my dream was to become a university geoscience educator. Being an educator and academic would position me to be a voice speaking on behalf of the earth, by both guiding continued human development in an environmentally sustainable model, and by educating a number of students who would go out and do the same.

My interests currently lie in igneous petrology, plate tectonics, volcanology and mineralogy, but I’ve not met a breed of geology I didn’t enjoy. I have the fortunate problem of liking too many parts of geology.

Thankfully, I can be sure that no matter what sub-discipline I study in graduate school, it’ll be within the great umbrella of geological sciences, and that I can always continue to learn and investigate new, different, and exciting fields well into my career as a professor of geology. And for that I am so grateful, because every morning I will wake up with a smile on my face, and investigate new, different, and exciting fields well into my career as a professor of geology. And for that I am so grateful,

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That summer I was granted the opportunity to head into a land peppered with black bears, dark oceans filled with mammals larger than semis, and rivers that dipped and dodged through a maze of karst geology more intricate than a block of swiss cheese. This place was Prince of Wales, Alaska. I was there as a cave guide, but entering these caves never ceased to amaze me. I would witness layers of calcite that oozed like fluorescent snot and told stories of floods and chaos, or the bones of bears and fossilized critters that linked migration patterns that biologists had been trying to understand for years: I realized geologists were the detectives of an earth unseen. They are the ones on the front lines of discovery, covered in dirt and usually spotted wearing a flannel; they are the heroes of the underground. It was not until the summer of my junior year I was able to witness this at first hand.

As I trudged through the barracks of obtaining my bachelor’s degree, I recognized a uniqueness that geology possesses, unlike all other stem sciences. In the process I eventually added on a math minor and physics major to my degree plan. What these other classes taught me was indispensable and could only benefit me as a geologist, but it was all so defined. I always loved a good mystery growing up, rather it be in a movie or a book: I loved the idea of finding clues and hints to unravel a problem. Here lies the uniqueness: geologists are the detectives of an earth unseen. They are the ones on the front lines of discovery, covered in dirt and usually spotted wearing a flannel; they are the heroes of the underground. It was not until the summer of my junior year I was able to witness this at first hand.

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I want to be a geologist because I love a good story. If you were to hand a rock to most people they might “ooh” and “ahh” and exclaim “What a pretty rock”, but a geologist can transport you to a land of dinosaurs and abyssal plains where ferns grew over your head. I have an admiration for story tellers and a severe character flaw: I want to be the most interesting person in the room. I can’t imagine anyone better to be than a geologist. I hope one day to tell stories that inspire people, cause a mind to wander, and create a desire to decipher the anomalies of the natural world. That is why I want to be a geologist.
Announcement

Foundation of the AIPG
SILENT AUCTION 2019

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 15, 2019 at the Welcome Reception of the AIPG National Annual Meeting at the Double Tree by Hilton Hotel in Burlington, Vermont. The silent auction is to raise funds for the benefit of the Foundation and its programs. It is a festive event; a chance to catch up with colleagues, and an opportunity to support the Foundation. Please consider donating an item for the silent auction. Popular items last year included several amazing mineral/rock specimens and fossils, historic or classic geology books (including an 1844 edition geology book) and collector books, polished rock bookends and tumbled stones, handmade wood and stone carved pen, jewelry, antiques, a silver Jefferson Cup, local area food gift baskets, geology-themed coffee mugs and tote bags, stone wine chalices, and some brewery and distillery items. Be creative. This is a great opportunity to pass along some items for others to enjoy. So look around your office and your home for treasures that fellow geologists may appreciate. In 2018 and 2019, the Foundation provided funding of undergraduate and graduate student scholarships, and funding for several career programs/workshops for students and young professionals. We look forward to seeing you in Burlington and your support for the Foundation of the AIPG!

More details about this upcoming event and past silent auctions as well as other Foundation information are available on the AIPG web site, in The Professional Geologist magazine, and on the Foundation of the AIPG web page at www.aipg.org/foundation.

The Foundation of the American Institute of Professional Geologists is a 501(c) (3) organization. Contributions and Gifts-in-Kind are tax deductible.

Sage Gandolfo, SA-8203
University of Nevada, Reno - Funded by the Nevada Section

I began my geological endeavors from the day I could physically scoop up a handful of dirt and stick it straight in my mouth. My artist parents would yell at me “get that stuff out of your mouth!” but I would crawl away on my hands and knees and find more neat rocks that needed tasting.

I was born and raised in Reno, Nevada but I like to call myself a true native Nevadan for having scaled just about every mountain range and valley in the state. My parents are craftsmen as my mother recently retired teaching art and my dad is a professor at my university teaching photography and videography, and whose hobby is being a diesel mechanic. I grew up with a fond adoration for the arts and among painting, pottery, and knitting, my parents took my older brother and I camping almost every single weekend of my entire life. And this was no RV hookup camping. This was always rural Nevada somewhere many miles from other people where we rode our dirt bikes up every mountain range, rain or shine. We would often be north of Austin, NV where my family originates from.

I graduated a year early from my high school in 2014 and started college the same year as a Wildlife Ecology major in hopes that this career would always be outside in the mountains with my favorite pinyon pine and juniper trees. After taking Geology 101, I was hooked and changed my major excitedly. I soon became an officer of Mackay Rockhounds geology club, John Mackay club, and Mackay Muckers. I also joined the Society of Economic Geologists student chapter at UNR and traveled to Finland in May 2017, Japan in May 2018, Chile in December-January 2019, and finally Alaska this coming June, 2019.

My first internship was with Friends of Nevada Wilderness in 2016 where we trekked deep in the Forest Service wilderness areas all over NV. We carried pulaskis, axes, saws, and shovels on our backs and hiked 10-20 miles a day to restore the trails that we all enjoy hiking for hunting. Every 10 days we spent in the wilderness we either horse packed our gear in or just packed in on foot. I gained a considerable amount of appreciation for manual labor that summer.

"After taking Geology 101, I was hooked and changed my major excitedly."
The next opportunity in 2017 was interning for the Nevada Division of Minerals Abandoned Mine Lands program. The eight of us on the crew would head out into the field every week and track down shafts and adits that the old miners dangerously left in their day. We built barbed wire fences and marked everything we found across the entire state as safe or hazardous. I’ve never had more fun laboring around NV with copious amounts of BBQ and playing cards every night with some of the hardest working people I know.

After another year of grinding through college I was fortunate to land a Geology internship for Barrick at Turquoise Ridge in the summer of 2018. I spent the summer designing the three-year infill drill program and going underground with ore control. My family has a mining background out of Austin, NV so being able to see exactly what makes a mine function was really rewarding. I made many friends and great connections over my time at the mine and in Winnemucca and will be heading back to intern over the winter.

Field camp is what I have in store for the summer of 2019 after I graduate in May and I’m ecstatic to get out there and map. After field camp I plan to move to Montana and work for Stillwater-Sibanye Mining company. Wherever I end up, there has to be plenty of outcrop.

COLORADO SECTION REX MONAHAN GEOLOGICAL SCHOLARSHIP WINNER

Pengfei Hou, SA-9941
Colorado School of Mines, CO
Section - 2019 AIPG Colorado Section Rex Monahan Geological Scholarship awardee

Predicting the future is inherently difficult. However, we can make reasonable deductions about the foreseeable future by analyzing the trends in the past and at present. For geoscientists, the petroleum, mineral, and environmental sectors account for nearly half of the employment. The geoscientists employed by the government and academia at all levels essentially depend on the profit and tax generated by the petroleum, mineral, and other industries. There seems to be an increasing number of independent geoscientists who offer data management, processing, and analytics, education, or general consulting to other agencies or individuals. With the technological advancements in the 21st century, the scientific community and scientific research in general are experiencing some major transitions, such as in genome studies, nanotechnology, quantum computing, and artificial intelligence.

Geoscience is highly interdisciplinary, and involves studies in the atmosphere, hydrosphere, biosphere, and lithosphere. The advancements in other scientific disciplines will likely be borrowed and applied to Geoscience at a much faster pace in the future. Meanwhile, the growing population, economic development, and improving living standards of the world will increase the demand for energy, raw materials, geological hazard prediction, and environmental/climate change predictions, despite the increasing awareness of renewable energy, recycling, and sustainability. In my view, the most important area of employment of geosciences is related to marine geosciences, which includes marine petroleum and mineral exploration and development, marine environmental research and protection, and related academic, government, or consulting employment opportunities. The oceans hold a vast amount of natural resources which can support the world for hundreds of years or more. Everyone knows that 70% of the Earth is covered by oceans, but few know what the ocean floor looks like. We have mapped the Mars and the Moon at high resolutions, but only a fraction of the ocean floor to such a degree. A large part of marine geological processes are not known well due to difficulties in observation, high cost, and limited techniques and equipment etc. Another problem is the immense size of the geologic features under the ocean, such as large submarine fans, landslides, volcanos, subduction trenches, etc. It is difficult to grasp the big picture of these geological systems at our human scale. In the next decade, there will probably be more technologies for data collection, processing, and interpretation in marine geoscience. Underwater robots will be increasingly powerful. There will be a massive amount of data to deal with. Utilizing AI technology and developing some automated tools for data processing and interpretation will be essential. For example, automated lithofacies interpretation, well log correlation, and seismic interpretation will likely become accurate and efficient within the next decade, which will greatly improve the productivity of geological data analyses. The employment opportunities lie in these technological trends. On one hand, there will be a great demand for multi-disciplinary teams of geoscientists, electrical engineers and oceanographers to develop the needed tools. There will also be a great demand to integrate all geological information into one platform, which will require geoscientists to work together and formalize some unifying theories. On the other hand, the massive amount of data and increasing efficiency in automation will set geoscientists free from the tedious basic work and give them more time to think and work from an elevated perspective. We might be able to understand many marine geological processes in much more detail, such as submarine sedimentation, subduction, and hydrothermal vents. The progress will likely accelerate the next paradigm shift in geoscience in general.
Matthew Tello, SA-6837
Colorado School of Mines, CO Section

I feel that the most important area of employment in the geosciences by 2030 will be geological engineering. This is driven by two issues in the near future requiring specialized skill sets in geoscience and geological engineering: climate change and population growth.

Humanity continually faces the growing problem of land availability and preservation of natural habitat. As our population exponentially increases, the amount of land necessary to support homes, infrastructure, parks, and agriculture also increases. Land is a finite resource which will require careful consideration as it becomes more and more limited. One way to solve this is by utilizing underground construction. Roads and utilities can be rerouted underground to increase space on the surface for additional development, parks, bike paths, and green space that can increase the overall health, safety, and happiness of a population. Tunneling and underground construction requires intricate planning and high safety standards. This is a very complex process that involves many parties, and geology may be the most important aspect of underground construction. Approaching engineering from a geological perspective will help to identify complexities, provide a basis for appropriate project estimation, allow sound design of the infrastructure, and create a safe environment for the workers building the tunnels. Geological engineers play that vital role throughout the life of the projects.

As we continue to address complex geological problems we also need to consider the detrimental effects of climate change. Climate change precipitates a multitude of problems including increased intensity of storms, more severe and frequent droughts, increased amount and intensity of forest fires, larger swings in temperature, and water management issues, to name a few. Of particular interest to geological engineers is the increased intensity of storms and forest fires. These two alone have produced several recent catastrophic events that are extremely costly. They also pose an increased number and magnitude of threats as climate change accelerates into the future. Geological engineers have a specialized skill set in the prediction and mitigation of the geohazards that are typically a byproduct of these catastrophic events. For example, forest fires are proven to increase the likelihood of debris flows by decreasing the resisting forces in the soil slopes (i.e. destroying vegetation) and by altering the state of the soil grains (i.e. sintering of clay grains). This, along with the increased intensity of rainfall events, creates a perfect storm for debris flow hazards. Geological engineers at the USGS, universities, and in private industry are interested in assisting to mitigate these hazards as they threaten the safety of people, infrastructure and the environment.

Hurricanes also significantly contribute to geohazards, and they are occurring more often and with higher intensity due to climate change. Puerto Rico serves as a catastrophic example. During hurricane Maria in 2017, the USGS documented over 50,000 landslides directly related to rainfall from the hurricane. Landslides can be catastrophic and proved to be devastating in Puerto Rico by destroying several homes and damaging infrastructure. Hurricanies and heavy rainfall events can also cause flooding which can then lead to slope stability issues. Geological engineers help to better understand the secondary effects of these events and help to predict and mitigate potential issues.

As a geologist and geological engineer, I look forward to contributing to the solutions to these global issues. I feel as though they will have major impacts on our society and I believe that geological engineers can design safe, efficient, and healthy environments for people to live in.

Jordan Caylor, SA-9940
University of Texas at El Paso, TX Section

As we push forward into the 21st century many industries are evolving rapidly to keep pace with our changing world. The industries tied to geosciences are certainly no exception. By 2030 I believe the most important area of employment for geoscientists will be in natural resource exploration and optimization. I believe that the need for energy will be the underlying force that drives the majority of employment opportunities for geoscientists in 2030.

It is no secret that many people around the world desire a shift towards cleaner energies. Some geoscientists view this as harmful for their careers since we have historically been the explorers and discoverers of fossil fuels. I see this view of the job market as being based in fear and not reality. As our world population continues to grow our need for energy grows in proportion. To provide energy to our expanding population in 2030 we will have to utilize both renewables and fossil fuels.

It is highly probable that we will see our energy shift gradually in the direction of renewables such as wind, solar, and geothermal. However, this by no means takes geoscientists out of the equation. Thus, while solar and wind energy will provide larger parts of our energy needs in 2030, we will still require large amounts of our energy to come from fossil fuels. By 2030 our oil reserves will be becoming more sparse meaning that geoscientists will be tasked with finding oil in more remote and more geologically complex locations. In the renewable energy sector, I believe geothermal energy will see more growth than wind and solar. Geothermal energy is a win-win for both geoscientists and society since we will be employed to discover these resources, and people around the world will be happy to be getting clean energy from these plants. Furthermore, geothermal energy is much more reliable than wind and solar energy. Unlike wind and solar plants, geothermal plants gather their energy from sources that are constant over the brief geologic time that we exploit them. Renewable energy projects will also employ geoscientists due to the demand for rare earth materials to create these plants.

The key components of all renewable energy generators require rare earth elements and other exotic materials. While we continue to expand our energy horizons away from oil and gas, geoscientists will be in great demand in the mining sector to explore for these rare and vital materials. Thus, the mining sector of geosciences will likely see the largest growth in job opportunities for geoscientists.

While our world continues to evolve the employment opportunities for geoscientists will change, but I believe they will also grow in number. Just as in the past it is highly probable that the need for energy will be the underlying force that drives employment of geoscientists. The future makeup of our energy needs and resources may shift dramatically from that of today, but the need for geoscientists in the world will remain.
The Impact of an Incredible Mentor

Brandy Barnes, YP-0195

Over the past three years, I have had the opportunity to meet many outstanding geologists through my involvement in the American Institute of Professional Geologists. I never dreamed that starting an AIPG student chapter would light a fire of passion and determination for my profession and a support system that I like to call “my geology family.”

My motivation for writing this article is to express the importance of helping young professional geologists and students to create a network of mentors. Across industries, the geosciences have a wide generation gap, which can only be spanned by creating meaningful relationships between experienced and dedicated geologists and their future successors. From new mapping and fieldwork technologies to growing research on topics surrounding environmental impacts, the geological professions have undergone many changes in the last 20 years. The experienced professionals, many of whom are at or near retirement age, have invaluable expertise to impart to young professionals. It’s a shame when I consider that millennials may miss the opportunity to learn from these potential mentors before their retirement.

I am fortunate to have an abundance of mentors, through both AIPG and my employers. These mentorships have been my favorite aspect of growing as a geologist, and I consider them my “secret weapon”. When I need to know how the geosciences have changed, which path I should consider for my future, or how to reach goals in my professional career, I can turn any one of them and seek advice and encouragement. When I was looking for job, I was able to have my resume reviewed by professionals. When I had two job offers simultaneously, I found support and advice for navigating that privilege in a professional manner. When I needed information about licensing, I was given resources and shared experiences. Mentorship has been pivotal in my career.

I would like to share a story about a special man, a mentor, who impacted my life. In early 2017, I attended an AIPG Executive Committee Meeting in Orlando, Florida, where I lived at the time. I knew several members attending the meeting and had been active in the organization for a few years; naturally, I thought I would attend to see how AIPG was progressing. There was a gentleman whom I had not met at previous meetings. I introduced myself and asked a series of career-related questions that I often asked of experienced professionals. He was very kind and encouraging, and he appreciated that I took the time on a Saturday to attend the meeting. Six months later, at the AIPG Annual Meeting in Nashville, Tennessee, he was scheduled to attend as an AIPG Executive Board member. I decided to prioritize further connection with this gentleman. We greeted each other as old friends and spent much time discussing his professional experience, getting advice for my career endeavors, and laughing over a few beers, in the spirit of all great geologists.

From that meeting on, he became one of my most trusted mentors and friends. He invested an inordinate amount of time and energy into my success. Above all he possessed the unique ability to teach me self-assurance. He was never reserved about complimenting individuals who worked hard in their careers, gave back to their profession, or had the ability to show appreciation to other people. It was rewarding to know how proud he was of me, and to have someone always happy to help guide my career. His level of investment can leave an

I cherish every moment, lesson, and laugh with John. After his passing, I took a position in North Carolina and have been working on creating a more active AIPG section in this state, an effort he was involved with for many years. I realize that his impact on my life will continue in my professional career even though he is not physically present.
impact and can motivate people to do amazing things in their life.

This incredible man’s name was John Stewart of AIPG Carolinas. Unfortunately, John passed away in April 2018. During 2018, I had the honor of serving with him on the AIPG Executive Committee board; I am fortunate to have had memories of our meeting in February 2018, as do the other 2018 board members. His death was one that I took very hard and I began to understand that it was because I lost a person in my life that was a “cheerleader” for my success, and when you no longer have that person that gave you so much pride in yourself, the grieving process can be incredibly difficult.

I cherish every moment, lesson, and laugh with John. After his passing, I took a position in North Carolina and have been working on creating a more active AIPG section in this state, an effort he was involved with for many years. I realize that his impact on my life will continue in my professional career even though he is not physically present.

My hope is that by sharing my story, I can inspire more young geologists to seek out those mentors, because they can truly change the course of your life, often in ways that you can’t imagine. And those of you who mentor, or may become mentors, you are vital to the development of the less-experienced. You can encourage determination, self-confidence, and tools to be a better professional.

Young professionals, please remember to appreciate those around you, especially those who take the time to give you guidance. Too frequently, we wish we could thank those we have lost for everything they gave to us. An email, text, call, or chat over a beer (we are geologists) can mean a great deal to someone who cares about your future.

Thank you to all those people who have impacted my career so far and who give back to AIPG. You are the foundation of an organization that I am incredibly proud to be a part of. I offer my condolences to the family, friends, and colleagues of John Stewart; I know you miss his vibrant personality and infectious smile just as much as I do. We must follow his example and continue to invest in the future of the geological profession. That is the greatest way we can honor our friend, John Stewart.

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**Unexpected Encounters of the Grizzly Kind**

Paul Smith, CPG-6847

Paul Smith recently retired after working as a professional geologist for about 40 years all over the US, Latin America and Eastern Europe.

It was late summer in 1973, or perhaps 1974, and I and Rich Paulus, my friend and fellow student, were exploring exposures of thrust faults in Montana and Alberta. We had climbed up to the edge of the tree line and were about to break out into the open on a large open rocky slope, with me in the lead, when I pushed some brush aside and saw directly ahead, about a hundred yards or so away, a large (it looked enormous) grizzly bear. The bear saw us at the same time, raised its head and looked straight at me. I immediately froze in place, but Rich, coming along behind and not having seen the bear yet, ran into me from behind and mumbled something in surprise. I saw the bear’s ears flick when it heard Rich’s words. We had no weapons of any kind with us, except for our rock hammers, so we would have been totally helpless if it had decided to attack us. Fortunately it didn’t. It looked at us for a few moments, which seemed like an eternity, and then went back to what it had been doing before we interrupted it.

Unable to proceed any further we sat and watched it for a while, as one after the other it turned over the boulders that littered the slope and seemed to sniff around under each one before moving on to the next. I never knew what it had been doing until decades later, watching a TV documentary on grizzlies, when I saw a film of another grizzly doing the same thing. Grizzly bears, I learned, like to fatten up for winter by munching on fat- and sugar- rich moths that rest under rocks during the heat of the day on slopes above the tree line. A grizzly can consume thousands of these moths in a single day.

Anyway, to get back to the story, we decided to postpone our plans for the day, since the bear was heading off in the same direction that we had been planning to go. So we gave up looking for thrust faults for that day, hiked back down the mountain, and went looking for a few cold beers instead.
EXECUTIVE DIRECTOR'S MESSAGE

Professional Ethics and the Geosciences

Aaron W. Johnson, MEM-2783
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Like many college students, I worked several part-time jobs to pay my way through school. I worked as a lab technician in the chemistry lab on campus, as a bartender at the local pizza joint, I cut and delivered firewood in the winters, and I worked as a field remediation technician during the summers. Of course, I didn’t work all of these jobs at the same time, but at several points during my time in college, I worked more than one job and went to school. It was a challenging and rewarding experience, most of the time.

As undergraduates, we learned about physical processes, and fossils; we studied mineralogy and petrology, and geochemistry. At my school, we even learned how to write geological reports. There were several things we never learned. We didn’t learn what a Phase I or Phase II report was. We didn’t know anything about Leaking Underground Storage Tanks. We learned about how contaminant plumes might move, but we didn’t learn about the methods to address MTBE in groundwater. There was a gap between the conceptual geological knowledge we were provided and the applied skills that most students would need in the workplace. Most critically, we never learned about professional ethics for geoscientists.

The lack of understanding of professional ethics came into play for me during a heating oil tank removal in the mid-1990’s. The tanks and associated plumbing had been installed in the 1960’s, and our company was tasked with removal of the tanks and remediation of any associated contamination. The tank removal went well, and we identified a surprisingly small amount of leakage. After the last tank was loaded onto a flatbed, my field supervisor and I went to work removing the piping that had connected the tanks to the oil-fired furnaces inside the building.

The issue arose when we began to remove the plumbing. The piping was wrapped in insulation, and we worked quickly yet thoroughly to remove both. Everything was wet, and soon my field supervisor and I were covered in a muddy mess of thick red clay. As the day warmed, the clay started to dry. So did the insulation, and by late morning, I noticed that wisps of gray fibers floated around every time we moved the insulation. The age and timing of the application along with the characteristics of the insulation made me wonder if the insulation contained asbestos.

I informed my supervisor that I was concerned that the insulation might contain asbestos. The fibers from the insulation were in my clothes, and my hair, and I could feel them on my face. My supervisor responded that he didn’t think the insulation contained asbestos, so we went back to work. The more insulation we removed, the more uncomfortable I became. I finally told my supervisor that I felt unsafe. After some discussion, we went to stabilize some waste oil at a local maintenance yard, and then went back to the office.

At the office, I learned that the company had sent samples of the insulation out for testing but the results of the tests were not back. The project manager sent us out to remove the insulation anyway. The project manager’s reasoning was that the insulation would only be a problem when it was dry. I wasn’t sure what to do. I had received no training from the company or at college that would help me address this situation.

When I got home, I put my clothes in a garbage bag, tied it shut, and put it in the closet. The next Monday, I gave my notice. When asked, I told my supervisor that I just couldn’t work two jobs and go to summer school at the same time. In reality, I felt as if the company was more concerned with covering themselves, than with my safety. I was afraid to tell my supervisor, because I was afraid that would impact any reference I might need for a job in the future.

For years, I kept the bag of clothes. That bag came with me to Virginia, then Missouri, and Minnesota. Finally, after 20 years, I disposed of the bag. Looking back, I probably had a responsibility to report the actions of my field supervisor and project manager to Human Resources. At the time, I was a green student with no experience in the field, no training, and no understanding of professional ethics. I knew no other people in the industry outside of those working for the same company.

Today, AIPG supports more than 40 student chapters at colleges and universities throughout the United States. We work diligently to provide students with an understanding of professional ethics, and to help students build a network of professionals they can turn to for advice when they are faced with a new problem, or a unique situation. For the last three years, one day of our annual meeting has been dedicated to student opportunities. Student interest is high, with the number of students participating rising from about 12 in 2016 to 30 in 2018.

Your support of AIPG is fundamental to our efforts to help prepare the next generation of geologists as they enter the workforce. If you’re one of the AIPG members who support student chapters, thank you. If you’re one of the dozens of AIPG members who make presentations to students or student chapters, who serve as mentors to students and early career professionals, or who serve on the AIPG ethics committee, thank you.

I want to thank all of you for your continued support of AIPG. Your membership, your participation in AIPG initiatives, and the time and energy you expend on behalf of AIPG truly are appreciated.

I wish all of you a pleasant and productive summer.

Best Regards,

Aaron
Mentors and Mentees

Keri A. Nutter, CPG-11579
knutter@dowl.com

My mentors and peers are the keystone to everything that I have had opportunity to do over the last 15 years...

I have to admit that I really didn’t know what to write about for my President’s column this quarter. For the last edition it was pretty easy because I had a memorably and significant event of geological interest happen in my life that I could share with my colleagues. But this edition is different – it’s been an interesting kick-off to the season, with spring arriving much earlier than I can ever remember and construction season well-underway keeping my spring (and mind) busy!

And then, I realized that at the end of May I would be celebrating my 15th work anniversary with my company. The same company with which I got my first professional job fresh out of college and the same company that has facilitated my career in a field that I never thought I would find interest in or passion for. And that got me to thinking about all of the people in the past 15 years that have helped me along the way – the family, friends, and colleagues who provided support, guidance, and unconditional support and guidance in my journey so far.

My mentors and peers are the keystone to everything that I have had opportunity to do over the last 15 years; the projects I have had the privilege to work on, the locations for the work I have been able to visit, and the people I have met along the way. These mentors and peers have provided advice and been examples of the type of person/employee/professional that I want to be – challenging me to do better and elevate my expectations of myself. And the interesting thing is, I didn’t really go searching for these mentors, they just kind of appeared in my life. And I don’t say that to sound cavalier, because I realize that many of my peers have limited resources to find mentors that they can look up to, but I say it to convey my surprised realization that I didn’t even recognize they were mentors until I took a moment to reflect on my career so far.

For example, my first supervisor simply started out as my boss, telling me where I would go and how I should be doing things, but it was so guiding, and our time together was full of teaching moments. She not only taught me the technical side but made me realize that I had the potential to do things I would NEVER have dreamed of doing or trying. She also helped me to find strength and in turn I was able to provide support where she did not feel as strong (she doesn’t like social functions, but I love them!). She introduced me to clients and colleagues in our community with whom I still keep connected and shared with me the tricks of travel in rural Alaska that I can now share with my peers.

When I first joined AIPG, it was a vehicle to get my CPG so I could get a raise and achieve a higher level professional status in my community. What I didn’t realize was that it would also provide me with a very long list of mentors and peers and their wide variety of experiences and advice. The personal and professional growth I have gained from participating in AIPG, at the section and national level, is exponential and from people that I would not normally have had the opportunity to meet and connect with.

What I am trying to say is that you can find your mentor in unexpected places. There are formal programs to put you in touch with professionals that are in your field or of similar background and close proximity – these are fantastic to help in defined ways and fulfill mentoring where opportunity may be lacking. But also, do not discount the mentors that don’t share the same resume, geographic location, or interests. The mentors who don’t immediately seem like mentors are equally valuable to personal and professional growth. They provide you with unique perspectives you wouldn’t find in most of your inner or intermediate professional or social circles.

In this issue of TPG, Young Professional Brandy Barnes writes about the mentors in her education and career and shares a beautiful tribute to a very special mentor and colleague. Her story is a wonderful example of how to maximize your mentor-mentee relationship and capitalize on the professional and personal benefits and friendships.

As you read this, I have one thing to ask: Please thank your mentors and colleagues.

Thank them often and thank them sincerely. Many of these people likely may not even realize they are a mentor to you and to find out the impact they have had on someone can have a great positive affect for them personally and professionally. I have found that taking a few minutes to write a thank you note after a meeting or helpful conversation can really make someone’s day. For those more electronically inclined, an email can be as impactful and well worth the time.

So, to my mentors, who over the years have provided support, guidance, and friendship – Thank You!

AIPG has an option in the member directory to sign up to be a mentor or a mentee and the opportunity to be connected with a fellow AIPG member. Just go to http://aipg.org/page.php?ID=mentors to learn more and to sign up!
John Warren Gabelman, CPG-1613
Butte, Montana
May 18, 1921 - July 30, 2018

Member Since 1967

John Warren Gabelman, 97, of Butte, Montana passed away peacefully at his home Monday, July 30, 2018 after a short battle with a brain tumor.

John was born May 18, 1921 in Manila, Philippine Islands as the middle child of Charles Grover and Cyprienna Louisa (Turcott(e)) Gabelman. At that time, Charles was the CQM (quartermaster) with the Drafting and Engineering Division at Ft. Mills, Corregidor, PI. The family returned to the United States in 1925, settling in Denver, Colorado.

After graduating from East Denver High, John attended the Colorado School of Mines, Golden, Colorado where he received a Diploma in Geological Engineering (1943), a Master's Degree in Geological Engineering (1948), and a Doctorate of Science (Geology, 1949). John served in the US Navy (1944-1946) as an Aviation Electronics Technician's Mate 3rd Class USN-1 (SA).

While working on his degrees, John was a junior mining engineer in Gilman, Colorado. It was there that this brash, young geologist met his future wife, Olive Alexander Thompson; she was the new schoolmarm. They were married September 21, 1945 in Denver, Colorado. While making their home in the southwest, John and Olive began their family of 4 children, Peter, Paul, Barbara, and Joan.


John is survived by his daughters Barbara Kerr (John) and Joan Gabelman (Rob Gallentine), granddaughters Jennifer Scheil (Derek) and Samantha Greathouse (Eric), great-grand children Madeline, Alexander, Matthew, and Isaac (on his side). He is also survived by his nieces and nephews (Larry, Susan, Judy, Charles, Peter, John, Susan, David, Sandra, Branton), great-nieces and nephews (Olivia, Terri, Tracy, Kelby, John, Lin, Gary, Chris, Jill, Kaylan, Scott, Angela, Ginger, Kelli, Jennifer, Catherine, Leigh Anne), and many great-nieces and nephews.

John’s expansive mining career provided opportunities for professional and family travel worldwide. Between 1949 and 1952 he worked as a geologist for Colorado Fuel & Iron Corporation, Pueblo, Colorado. From 1952 to 1954 John was with the American Smelting & Refining Company, Salt Lake City, Utah. In 1954 John, Olive and Barbara moved to Grand Junction, CO where John was the District Geologist for the Atomic Energy Commission (AEC) until 1958. From 1958 until 1961, the family, which now included Joan, moved to Lima, Peru as John was the Geologic Advisor with the AEC. In 1961 John moved his family to Maryland, when he was reassigned as the new Chief Resource Appraiser for the AEC in Washington, DC (1961-1975). From 1970-1974 John also worked as a Consultant in the field as a member of the International Atomic Energy Working Group, Vienna, Austria. In his roles with the AEC, John explored uranium opportunities for the United States on many continents. In 1975 John and Olive moved to the San Francisco area when John began working for Utah International, Inc. as the Manager of Exploration Research. John retired from the corporate world in 1983, and began private geological consultation as president of John W. Gabelman & Association, Inc., Danville, California until 2002. At that time he moved to Butte, MT.

From the time he was a kid, John continually pursued his love of the outdoors, no matter where he lived. His passions were to find arrowheads, catch the ‘big’ fish from the perfect fishing hole (even if meant hiking for many hours through the mountains), downhill skiing on the freshest powder, uncover and analyze unique rocks (most recently Paul Bunyan's Wheelbarrow Dump), go for a walk in the mountains (hiking the Maude S or spending the night on the East Ridge), and find the best hunting spot (especially with son-in-law Rob).

John’s Butte Family offered him some of his greatest treasures of friendship. Meeting kindred spirit opened new doors of exploration, stories and fun! Reliving his ‘down-in-the-mine’ stories and cross-country skiing brought smiles to John’s face and in his heart. John loved his weekly lap swimming at Fairmont Hot Springs with the gang.

John was a true gentleman. He was quick to say ‘Thank You,’ and to open a door for a lady or walk her to her front door. He loved a good party with friends and neighbors. Those who knew John could count on an evening of stories, Robert Service recitations, and a ‘wee dram’ at evening’s end.

Right now John is definitely making some initial observations about the geology of heaven, which will surely be original and have all the Angel’s scratching their heads.

Funeral services will be Fri., Aug. 3, 2018 at 12:00, with visitation at 11:00 and a reception following the service; all at St. John’s Catholic Church, 1500 Majors St., Butte, MT. Interment will be Aug. 8 at Fairmount Cemetery, Denver, CO. In lieu of flowers donations can be made to Colorado School of Mines, Golden Colorado.

Adolf Honkala, CPG-0007
Westminster Canterbury, Richmond, Virginia
April 18, 1921 - September 20, 2018

Member Since 1964

Adolf was born April 18, 1921 in Salisbury, N.H. to Walter and Anna Honkala. He married Eileen Thorton in 1945. Adolf was a 1942 graduate of UNH. He served in the Army Air Force during WWII. He founded the Virginia Association of Professional Geologists in 1960. He was a long-time member of Tuckahoe Presbyterian Church, 7000 Park Ave., Richmond. He is survived by one sister-in-law, Barbara of Bethel, Maine; and several nieces and nephews. His parents, wife; and two brothers, Fred and Rudolph, precede him in death.

("Ad was a longtime mentor and friend to me since the 1980’s when I started work as a geologist. I had the good fortune to share many field projects with him and never stopped learning from him. He was genuine in everything and a timeless gentleman as well.

Rest in Peace. Ad. Yours was a job well done." - Bruce Faison

"I have known Ad for only about 30 yrs. I first meet and hired him as a consultant at Vulcan Materials about 30 years ago. Ad was a good friend and a mentor to me. He was an inspiration to all geologists who enjoy their job and the geologic profession. Ad continued to do geologic investigations, teach others, and learn himself. I just worked with Ad on a consulting job just 2-3 yrs. ago." - Jim Stroud
Research Fellowship on Professional Licensing in the Geosciences

The American Geosciences Institute seeks a Research Fellow for Fall 2019 to research, document, and communicate the value of professional licensure for geologists. The position will involve communicating with geoscientists across the United States to determine when and how the presence or absence of licensed geologists has impacted the public, covering issues including water quality and supply, resilience to natural hazards, ground stability, infrastructure quality, environmental liability, and public health.

The successful candidate will be highly self-motivated, familiar with the work of professional geologists, skilled in both quantitative and qualitative research methods, and comfortable conversing with a large, diverse community of geoscientists from across the country. Some experience with graphic- and web-design is a plus.

This is a full-time exempt position for 14 weeks and carries a fixed stipend of $7,875, plus an excellent benefits package. The start date is flexible and will be determined based on the needs of both AGI and the successful applicant. The position will be located at AGI Headquarters in Alexandria, Virginia.

Position Objective:
Research, document, and communicate the value of professional licensure for geologists

Essential Functions:
- Communicate with scientific societies, companies, and individuals across the United States to gather information, data, and stories about how the presence or absence of licensed geologists has impacted the general public, businesses, and private citizens
- Conduct surveys, analyze qualitative and quantitative data, write case studies and longer research-based reports
- Build a web-hosted collection of results to allow public access to the research and its derivative products
- Write and co-design several high-quality briefs on specific case studies or topical areas

Other Duties:
- Other duties as assigned

Work Environment & Physical Demands:
Work is largely in an office setting with long periods sitting/standing at a desk and computer. Work will require a large number of phone calls.

Required Education & Experience:
- Degree and/or professional experience in the geosciences
- Experience with quantitative and qualitative research methods
- Strong writing and interpersonal communication skills
- Ability to work collaboratively and respectfully with others
- Ability to research, synthesize, and communicate complex topics for a non-expert audience

Preferred Education & Experience:
- Some familiarity with Adobe Creative Suite (InDesign, Illustrator, Photoshop) and html/web editing.

Employee must be legally eligible to work in the United States.

AGI provides equal employment opportunities to all employees and applicants for employment without regard to race, color, religion, sex, national origin, age, marital status, genetic information, sexual orientation, gender identity and expression, disability, or protected Veteran status.

Please submit a letter of interest and resume to jobs@americangeosciences.org and include “Licensure Fellow” in the subject.
1. The chronostratigraphic unit that corresponds to the geochronologic unit we call “epoch” is:
   a) Series.
   b) System.
   c) Formation.
   d) Dude, this is starting to get confusing. Do I look like I am a stratigrapher to you or what?

2. Land sliding of a coherent mass along a concave, rotational slip surface best describes a:
   a) Slump
   b) Fall.
   c) Flow.
   d) Wow, I’m buried and mass wasted already.

3. Fractures seen in the vicinity of folds tend to faithfully depict the stress field that gave rise to the fold.
   a) True.
   b) False.
   c) Hey hombre, it feels like my brain is starting to fracture as I think about these questions!

4. Hydration is an example of chemical weathering as illustrated in the chemical reaction shown here:
   2NaAlSi₃O₈ + 2H₂O + CO₂ → Al₂Si₂O₅(OH)₄ + 4SiO₂ + Na₂CO₃.
   What are the key minerals constituents on both sides of the formula?
   a) Albite and gibbsite.
   b) Albite and kaolinite.
   c) Albite and anorthite.
   d) Dude, the only “hydration” that I care about is at happy hour time.

5. The choice below represents the deviator stress given the stress tensor:
   \[
   \begin{pmatrix}
   12 & 4 & 0 \\
   4 & 9 & -2 \\
   0 & -2 & 3 \\
   \end{pmatrix}
   \]
   a) \[
   \begin{pmatrix}
   8 & 2 & 9 \\
   3 & 5 & -3 \\
   -6 & 7 & 21 \\
   \end{pmatrix}
   \]
   b) \[
   \begin{pmatrix}
   8 & 0 & 0 \\
   0 & 26 & 13 \\
   9 & -7 & -33 \\
   \end{pmatrix}
   \]
   c) \[
   \begin{pmatrix}
   4 & 4 & 0 \\
   4 & 1 & -2 \\
   0 & -2 & -5 \\
   \end{pmatrix}
   \]
   d) Mama mia! You must be off your rockers if you think I’m going to figure this one out!
The future of the Texas Board of Professional Geologists is assured for five years. A bill to prolong its life passed both houses of the legislature, and went into law without the governor’s signature. The TBPG will undergo Sunset Review again in 2025, concurrently with the Texas Board of Engineers: the intent appears to be to merge the two boards, along with the Surveyors’ Board, unless there are strong reasons not to. We have many people to thank for this achievement, both for their time and for their financial contributions.

However, in Texas we have learned that we cannot relax: we MUST provide input to the new Board and therefore we must attend their meetings. We MUST stay in touch with our legislators, and continue to educate their staffs to the importance of good geological work in helping assure the safety and welfare of the public of Texas. We MUST be more visible and more valued by the public. We have five years before the Sunset process starts again.

The Texas Geoscience Council, which was set up to fight the threat to the Board, will need volunteers to do the ongoing work, and will need funds to support it. To those AIPG members who are licensed PGs in Texas: this is your livelihood, and state licensure goes a long way to ensure the high quality of Geologic work done before the public of Texas, as well as the ethical standards of practitioners. The assurance of quality adds to the standing of the profession and the satisfaction we can take in our work and our reputation. These points also apply to Professional Geologists in other states with licensing: it costs lots of time and money to preserve the privilege of being recognized as sufficiently critical to society to justify being supervised by a licensing board. The experience of Texas (and Arizona and Florida) should serve as a reminder to everyone that this privilege comes with responsibilities: society will not continue to recognize our value if we do not reach out and educate the public and their representatives about what we do and why it is important to them.

We have also learned that we will have to hire lobbyists to survive. I personally regard lobbying as a form of institutionalized corruption, but the fact remains that the firm we hired turned what looked like an unwinnable fight into a clear win, although temporary. Geologists in Florida and Arizona found the same thing: when the chips are down, you have to hire an insider.

Texas Geoscience Council is in the process of deciding on its governance structure, its goals and priorities, and its strategy. It welcomes suggestions and input from Texas PGs and from PGs from other states which have undergone a similar experience. Ideas from CPGs about what is important and how to achieve it are especially welcome: please contact the Editor of TPG with your ideas, and he will pass them on.

Finally, TGC wishes to express its heartfelt thanks for the support that it has received from AIPG National and from AIPG Texas in the effort to preserve licensing in Texas.

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GZA’s Mark Krumenacher Recognized By Illinois Association Of Aggregate Producers

Mark Krumenacher, a senior principal at GZA GeoEnvironmental, Inc. (GZA), received the Associate Member Leadership Award from the Illinois Associate of Aggregate Producers (IAAP) for his significant contributions to safety, sustainability, and education in the IAAP and the wider mining industry. “The whole mining industry continues to benefit from Mark’s technical presentations and papers,” said Shawn McKinney, IAAP’s assistant director, during the award event.

Joining the association in 2005, Krumenacher has authored white papers, provided technical presentations; led the formation of the association’s Sustainability Committee, on which he served as chairman for six years; oversaw the creation of the first Clean Construction and Demolition Debris (CCDD) regulations training seminar, leading to a partnership with the Illinois EPA creating seminars to educate the entire industry on the topic; and helped develop the Self-Assessment Guide to Sustainable Commerce as a guide for IAAP members to improve sustainability and environmental stewardship.

“All of GZA congratulates Mark on his continued contribution to safety, environmental protection, and sustainability,” said GZA CEO Patrick Sheehan. “Mark’s tireless work on these issues reflect his passion and commitment to the industry.”
Answers:

1. The answer is choice “a” or “series”. “System” is the chronostratigraphic (time-rock) unit that relates to the geochronologic (time) unit we call “period.” “Formation” is a lithostratigraphic (rock) unit, not a time unit. Lithostratigraphic units can cross time boundaries.

2. The answer is choice “a” or “slump.” “Falls” typically involve failure of solid bedrock along cliffs and steep slopes. “Flows” involve the down-slope movement of earth materials behaving as viscous fluids.

3. The answer is choice “b” or “false.” The statement is generally true for faults, but not for folds. For the latter, fractures do not necessarily reflect the regional stress field that gave rise to the fold. More commonly, they are genetically related to the folding process itself. David W. Stearns recognized and described four distinct sets (sets I through IV).

4. The answer is choice “b” where albite is sodium plagioclase feldspar \([\text{NaAlSi}_3\text{O}_8]\) and kaolinite is a clay mineral and a hydrous aluminum silicate \([\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4]\). Feldspars commonly weather into clay minerals.

The mineral gibbsite is aluminum hydroxide \([\text{Al(OH)}_3]\).

The mineral anorthite is calcium plagioclase feldspar \([\text{CaAl}_2\text{Si}_2\text{O}_8]\).

5. The answer is choice “c” and the proof now follows:

A stress tensor \(T\) can be rewritten as the sum \(T = S + D\). Now, \(S\) is the spherical or hydrostatic stress tensor (that part of the state of stress that causes hydrostatic conditions and only change in volume with no distortion), whereas \(D\) is the deviator stress (that part of the state of stress that deviates from hydrostatic and causes distortion). The principal diagonal of the spherical stress tensor has values equal to \(I_1/3\) where \(I_1\) is the sum of the principal diagonal of the original stress tensor. In our case, \(I_1 = 12 + 9 + 3 = 24\) and \(I_1/3 = 8\). Then the spherical tensor (\(S\)) is:

\[
S = \begin{pmatrix}
8 & 0 & 0 \\
0 & 8 & 0 \\
0 & 0 & 8
\end{pmatrix}
\]

It now follows that the deviator stress tensor (\(D\)) must be:

\[
D = \begin{pmatrix}
12 & -8 & 4 & 0 \\
4 & 9 & -8 & -2 \\
0 & -2 & 3 & -8 \\
0 & -2 & -5 & -8
\end{pmatrix}
= \begin{pmatrix}
4 & 4 & 0 \\
4 & 1 & -2 \\
0 & -2 & -5
\end{pmatrix}
\]

The above corresponds to our choice “c” and is the answer that we seek. Note that:

\[
S + D = T.
\]

Awesome, isn’t it? Well, maybe not “awesome” to some, but if you are into geomechanics, rock deformation and structural geology, this is really quite important.
Navigating “Me, too” in the geosciences

The title of this topic is the title of Robbie Gries’ 2018 GSA Presidential Address published in the February 2019 issue of GSA Today, p. 16-18, http://geosociety.org/gsatoday/archive/29/2/flip/mobile/index.html. Gries’ article is a thoughtful reflection on sexual harassment and discrimination in society in general and the geosciences in particular. Gries points out that “The largest contributor to sexual harassment is organizational environment. This puts the geosciences in jeopardy because geoscience inherently has many of these organizational hazards. These are:

1. Institutions where men outnumber women;
2. Where there is an absence of organizational sanctions—meaning complaints not taken seriously;
3. Where leadership provides a model for inappropriate behavior; and
4. Where there are large power differentials.”

Tolerance and habit support organizational harassment. I recall that early in my career the weekly meetings of one of the Denver area’s geological organizations began with a seemingly obligatory off-color joke ± a Texas Aggies joke. I recall writing a letter to the organization’s president asking that these jokes be stopped as they were inappropriate for women members of the organization, most of whom at the time were young professionals like me. The practice eventually stopped although I have no idea whether my letter had anything to do with it. But the point is, when you see or hear something, say something. This interrupts the tolerance and thoughtless habit.

A particularly interesting part of Gries’ article was her recounting of Jackson Katz’ class exercise of asking first the men and then the women in the class, “What steps do you take, on a daily basis, to prevent yourselves from being sexually harassed?” Men usually have no answers; it’s not a question that occurs to them. Women readily answer with a number of steps regularly taken to protect themselves.

A particularly interesting part of Gries’ article was her recounting of Jackson Katz’ class exercise of asking first the men and then the women in the class, “What steps do you take, on a daily basis, to prevent yourselves from being sexually harassed?” Men usually have no answers; it’s not a question that occurs to them. Women readily answer with a number of steps regularly taken to protect themselves.

Standard 4.4 of the AIPG Code of Ethics states, “A respectful and fruitful working environment is fundamental for maintaining a high level of professionalism. Therefore, discrimination or harassment, either sexual or of any other kind, is unacceptable because it offends the dignity of persons and seriously undermines the atmosphere of trust essential to the work of all geologists.”

Gries also recounts specific experiences during her career when sexual harassment occurred, along with similar accounts from other women geoscientists. While I’d like to think that things are better now than they were 40+ years ago, clearly sexual harassment and bias continues to be a problem. Ever...
behavior.” Again, when you see/hear something, say something. And write about it. Letters to the Editor and other submissions are needed to demonstrate that AIPG is not a reactionary group of misogynists, even though some of our members haven’t gotten the point yet.

The AGI Workforce Program webinar series recorded Preventing bullying and harassment in the field on April 19, 2019. This 55-minute webinar presents several scenarios of bullying and harassment (sexual and otherwise) that are a good follow-up to Gries’ address. The scenarios examined help broaden one’s awareness of potentially inappropriate behaviors and present some ways of avoiding such situations in the first place and/or dealing with them as they arise. The webinar can be viewed at https://youtu.be/au_iDfdtsJI. When viewing this webinar, do so with the full screen setting; the icon on the lower right of the screen because some slides use grey on white text or are otherwise harder to read.

Why smart people do stupid things

“Why smart people do stupid things” was the headline of a story in March 7, 2019 National Post article by David Robson. Robson asserts that history is full of brilliant people who believe stupid things or make stupid mistakes. He cites Sir Arthur Conan Doyle’s belief in mediums despite the best efforts of his friend, Harry Houdini, to dissuade him, or Steve Jobs’ refusal to undergo treatment for pancreatic cancer preferring health scams and fad diets. Robson points out that the latest psychological research shows that highest scores on IQ, SAT, or other measures of intelligence do not correlate with wise judgment.

Robson posits a process called “motivated reasoning” that occurs when we feel emotional about an issue and thus tend to apply our intelligence to one-sided, biased reasoning that serves our own beliefs and preconceptions so that “we always get the answer we want to see. That may involve only searching for evidence that backs up your point of view while also using elaborate reasoning to explain away any criticism or disagreements. And the more intelligent you are, the easier it is to build more creative arguments that support your beliefs.”

Robson points out that this process can produce the polarization around such politically charged issues as gun control or climate change.

“Honesty—avoiding the misuse of models” is the title of one of the lectures I’ve given in the past year during my appointment as the American Association of Petroleum Geologists Distinguished Lecturer for Ethics. One of the key points I tried to make was that we need to work hard to recognize and eliminate our unrecognized biases. A slide on this point quotes Richard Feynman’s admonition that “…you should report everything that you think might make [your conclusions] invalid—not only what you think is right about [them, and report] other causes that could possibly explain your results” (Feynman’s 1974 Cargo cult science lecture at Cal Tech; available on the web). Scientists frequently do not properly acknowledge the limits of what they really know and the uncertainties involved. Yet acknowledging these limits and uncertainties are what stating the “whole truth” and transparency are all about.

The Lorenz attractor

The summarizing sentence of my Honesty—avoiding the misuse of models talk is “All models are wrong; some are useful.” This is not a condemnation of models, rather it is a plea that we recognize a model’s limitations and inaccuracies. Edward Lorenz, a professor of meteorology at MIT, is known for his 1963 discovery of chaos theory, best known as the “butterfly effect.” Sensitivity to initial conditions is what causes nonperiodic behavior; the more a system has the capacity to vary, the less likely it is to produce a repeating sequence. Lorenz noticed this sensitivity when he changed the precision, the number of significant figures, in one of the parameters in a model he was running. This change in precision produced dramatically different results. This sensitivity makes weather very difficult to forecast far in advance. But chaos is not randomness. The “Lorenz attractor” illustrates the point that almost all chaotic phenomena can vary only within limits. The double oval shape (like a butterfly’s wings) of the Lorenz attractor gave rise to the butterfly analogy. Identification of a model’s limits of uncertainty and their disclosure should be part of the model’s description. Such disclosure helps determine the model’s usefulness. The fact that there are limits to weather forecasting and that different weather models produce different results does not mean that weather forecasts are useless. We still pay attention to them and their accuracy (within limits) is increasing.

Marcia Bjornnerud points out in her 2018 book, Timefulness: how thinking like a geologist can help save the world, that “Interpreting the Earth has always been deeply entangled with our self-perception as humans and our cherished stories about our relationship with the rest of creation. No wonder it is difficult to step back and see things in perspective.”

“When the conclusions of physics [Lord Kelvin’s objections to estimates of hundreds of millions of years of geologic time] seemed incompatible with
the increasingly detailed documentation of the Earth’s long history, some geologists declared that geology had to break with other sciences and pursue its own methods as a wholly independent field of inquiry. This aggravation at the impasse with physics is understandable, but it would unfortunately influence the way a generation of geologists were educated.” This led to the American and British rejection of Alfred Wegener’s 1915 arguments for moving continents. Wegener was not a geologist and he was a German. It took more than 50 years for plate tectonics to begin the explanation of continental movement.

Robson points out that there is a new scientific discipline—evidence-based wisdom—that aims to develop a means of avoiding motivated reasoning. One technique involves rigorously and honestly arguing against yourself. Probe the ways in which you may be wrong. Another is asking a colleague to evaluate your arguments for and against. The goal is to determine whether you are accepting or rejecting evidence because of your own biases or on the merits of the evidence. What is one of your passionate beliefs? How are you letting your passions bias your wisdom?

The continuing relevance of field camp

Peter Megaw, CPG-10227, contributed the following thoughts on my column on field camp in column 170 (Jan/Feb/ Mar ‘19). “He or She who sees the most rocks wins’ has long been a catchphrase among geologists that I hope will never go out of style. Although ‘office-based’ geology is increasingly common, an office-bound geologist is never going to get the visceral intellectual understanding of the rocks that comes from seeing and banging on them. Not having field experience is like trusting your calculator without understanding the math behind the buttons you punch. Perhaps a more apropos geological analogy might be lab-based geo-researchers who don’t have the field savvy to understand the ‘real-rock’ context of the samples they analyze. The geosphere is a marvelously complex system with many more degrees of freedom than we can readily comprehend…and we get the first real appreciation of that in field camp. The rocks keep us honest.

“Field camp is where we first learn to ‘listen to the rocks’ (tip of the hat to Spence Titley, CPG-1952) in a comprehensive manner. No examination of logs, chips, or core will give the same granular feel for the rocks. Field camp is also the first place we put together, as a conceptual whole, the manifold disciplines...structure, stratigraphy, igneous, mineralogy, geomorphology, and paleontology that comprise geology. To paraphrase Shirley Mensah, SA-7566, (from column 170)...this is where abstract classroom learning becomes real.

“Making that synthesis is vital to developing integrated geological thinking. Producing complete geologists without field camp is a signal challenge and there should be a special place in Hell for universities that discontinue field camp because of liability concerns. This timidity does a near-criminal disservice to the science and their students by producing semi-competent geologists ill-prepared for either academic or industry careers. In contrast, those schools that have maintained or grown field programs of all kinds deserve our active accolades and support, including recommending them to the brightest up-and-coming geoscience students we meet.

“Field camp is just the first step though...throughout our careers we need to continue exposing ourselves to new rocks as well as new interpretations of them. Spence Titley tells us to ‘listen to the rocks’ but James Gilluly also noted that ‘the rocks only answer the questions we ask them,’ so our evolution as geologists requires us to keep developing our field skills because the more rocks we see, the more and better questions we learn to ask.

“On a final note, one of the most remarkable things about geoscience compared to other sciences is our collegiality and openness...just ask anyone who works in a major convention facility which group has the best ambiance at their annual gatherings. I submit this fundamentally stems from being thrown together from dawn to dark in the field and what we learn from each other as we interact on both professional and personal levels. This creates a sense of community that makes geologists unique among scientists...another ‘secret’ to pass on to the next generation of aspiring geologists!”

Gender and mining education in the 1960s

Betty Gibbs is a mining engineer and geostatistician who has been a colleague and friend for many years. She is featured in a 5:38 minute YouTube video, “Gender and mining education in the 1960s,” an oral history prepared by the Bancroft Library of UC Berkeley, https://www.youtube.com/watch?v=FVzVGT7EMEE. Betty entered the underground mining industry in a time when very few women did. She began her undergraduate career in mining engineering at Virginia Tech in 1960. She moved to Colorado in 1964 and received her BS in mining engineering from the Colorado School of Mines in 1969. Her interview is historically interesting and not that long. Download and view it.

Suggestions for moving towards an internationally recognized CPD program

I’ve posted a webinar, “Suggestions for moving towards an internationally recognized CPD program,” on YouTube, https://www.youtube.com/watch?v=e7UjemTNiFA. This 31 minute presentation grew out of my frustration at the failure of professional organizations around the world to develop an internationally recognized continuing professional development (CPD) program. These organizations use similar, although not identical language, and each requires use of a unique reporting system, often requiring that CPD

Continued on p. 46
Comments on proposed rule: Modernization of Property Disclosures for Mining Registrants

Comments on the U.S. Security and Exchange Commission’s (SEC’s) proposal are available at https://www.sec.gov/comments/s7-10-16/s71016.htm

John Berry, CPG-04032, Editor

Mentors are a priceless resource. Consider becoming one today. Check the box on your dues renewal.

Geology of California

AIPG’s 2020 Annual Meeting will be in Sacramento, CA. If you have expertise on any aspect of the geology of California, especially that of the Great Valley, Lassen volcanic field, Motherlode, etc., I strongly urge you to submit a paper to TPG by May 1st, 2020, for the July-Aug-Sept 2020 issue. Papers will be Peer Reviewed and indexed. Go for it!

John Berry, CPG-04032, Editor

AIPG MEMBERHIP TOTALS

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WE ARE AIPG

Set the standard, raise the bar, pass it on...
How popular is Earth Science? How important is Earth Science education? How important is Earth Science itself? There are various ways to assess the place of Earth Science in our education and society. In 2013, the American Geoscience Institute collected data on high school science graduation requirements for all states in the USA. The survey found that while 22 states accepted an Earth and Space Science course for graduation, only two states required a year-long Earth/Environmental Science course whereas the number of states for required Life Science and Physical Science courses for graduation were 50 and 30, respectively. Overall, earth science education is underrated in our middle and high schools. As practicing geologists, we hope that earth science becomes an integral part of secondary (K12) education in the country. There are many reasons for this. According to a joint position statement by the National Earth Science Teachers Association (NESTA) and the National Association of Geoscience Teachers (NAGT), teaching Earth Science “offers experience in a diverse range of interrelated scientific disciplines; it is closely related to the student’s natural surroundings and offers students subject matter which has direct application to their lives and the world around them.”

The good news is that the public has an enormous interest in Earth Science. This is evident from the coverage of science news by the mass media. For example, the popular science magazine Discover publishes, in its January-February issue each year, the “100 Top Stories” of the previous year. I usually read these issues. Recently, I tabulated the Discover’s “100 top stories” for the past six years (2012-2018) under nine categories (Table 1): (1) Mathematics and Physical Sciences, (2) Space Science and Astronomy, (3) Earth, Environment and Energy, (4) Archeology and Paleontology, (5) Medicine and Life Sciences, (6) Neuroscience and Behavioral Sciences, (7) Technology as related to Culture and Entertainment, (8) Policy issues, and (9) Other. Of these, “Earth, Environment, and Energy” category as well as “Archeology and Paleontology”

Table 1. “100 Best Discoveries of Science” reported by the Discover magazine (January-February issues, 2013-2019)

<table>
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<tr>
<th>Disciplines</th>
<th>2012</th>
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<td>Technology &amp; Society</td>
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<td>Other</td>
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category belong to the Earth Science in a broad sense. Note that most of the discoveries related to “Archeology” were concerned with the evolution of humans (human paleontology or physical anthropology), and hence should be included in “Earth Science.” Thus, the Earth Science category topped the list for the years 2014, 2015, 2016, 2017 and 2018; it was second only to “Medicine and Life Sciences” for the years 2012, 2013 (see Figure 1). Although there is some subjectivity in choosing the “best” science discoveries for a given year, it is reasonable to assume that the editors of the Discover consider the importance of the discoveries as well as public (readers’) interest in them. All this is good news to Earth Scientists. The challenge is how to utilize this resource in our education (both formal and public), research projects, policy debates, and contributions to our culture as a whole. And let me end this brief article with a testimony from NASA. In November 2016, the space agency, given concerns that the Trump administration may reduce its budget, emphasized: “NASA’s work on Earth Science is making a difference in people’s lives all around the world. Earth Science helps save lives. It also helps grow companies and creates an awareness of environmental challenges that affect our lives today and tomorrow.”

“Overall, earth science education is underrated in our middle and high schools. As practicing geologists, we hope that earth science becomes an integral part of secondary (K12) education in the country.”

Figure 1 - “100 Best Discoveries of Science” reported by the Discover magazine (January - February issues, 2013 - 2019) and categorized by subject

The good news is that the public has an enormous interest in Earth Science. This is evident from the coverage of science news by the mass media.

activities be logged on the organization’s website. Because I report CPD to several organizations, the differences between programs and reporting systems can lead to a lot of wasted time. The presentation suggests how this situation can be changed for the better. The AIPG and MMSA CPD programs are in the process of being modified to conform to these suggestions. The Geological Society allows Chartered Fellows to upload their preferred CPD logs and supporting information on the GSL’s CPD program. The AusIMM is considering accepting other organization’s reporting logs.

If you, like me, report CPD to more than one organization, please watch my presentation and then urge your professional organizations to adopt the suggested changes.

Professional Ethics Fundamentals and Professional Practice Examples

In September 2013, I gave a talk, “Professional Ethics Fundamentals and Professional Practice Examples,” to the American Geoscience Institute’s Leadership Forum. This 40 minute presentation is available at David Abbott - Ethics Fundamentals and Professional Practice Examples. YouTube.com hosts an increasing number of video presentations that meet continuing professional development requirements regardless of your location.

The routine deletion/shredding of draft documents

I received a memo regarding a Queensland, Australia civil proceeding noting that, “This case confirms the reasonably settled position that a [Queensland civil procedure rule] requires disclosure of any report or statement of experts giving evidence, regardless if the document is draft or final.” This position arises out of common law and similar provisions are applicable in the US and Canada. This reinforces the point that one should routinely shred, or these days, delete and wipe with a file shredding program all drafts as soon as a subsequent draft or final document is prepared. If you routinely, at the time, shred or delete earlier draft documents, you should not get into trouble. This a practice I learned while employed by the US Securities and Exchange Commission.

2. File Shredder, fileshredder.org, is a free program for Windows that completely removes a file by using 1 of 5 increasingly stronger file shredding options.

AIPG Welcomes New Student Chapter from Georgia Southern University

Image source: Georgia Southern University

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 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.
Ethical choices and biases constantly surround us. Some are more obvious than others. How do we make certain, as members of AIPG, that we are being unbiased in our decisions and actions and follow our inner code of ethics as well as the AIPG Code of Ethics?

According to the Harvard Business Review, “Most of us believe that we are ethical and unbiased. We imagine we’re good decision makers, able to objectively size up a job candidate or a venture deal and reach a fair and rational conclusion that’s in our, and our organization’s, best interests. But more than two decades of research confirms that, in reality, most of us fall woefully short of our inflated self-perception” (Banaji, Bazerman, & Chugh, 2003). And from Cornell University, “Implicit bias includes attitudes and beliefs (positive or negative) about other people, ideas, issues, or institutions that occur outside of our conscious awareness and control, which affect our opinions and behavior. Everyone has implicit biases—even people who try to remain objective (e.g., judges and journalists)—that they have developed over a lifetime. However, people can work to combat and change these biases” (Cornell University Library, 2019).

A comment was made in the April 2019 Colorado Section Monthly Email that I feel provides a learning opportunity in ethics and bias: “Life is messy—may we agree? Being born is hard on our mothers. Growing to adulthood requires abundant food and transformed materials won at great cost to our fathers.” In my opinion, this comment displays an inherent bias in assuming that women become mothers and take care of their children while men become fathers and are the breadwinners of the family. While I agree that this fits the stereotype of a family from the previous century, this is far from reality for many families today.

Prudential Insurance Company conducted a survey of 3,000 Americans between the ages of 25 and 70 and found that 54 percent of women are the primary breadwinners in their family; 30 percent are married breadwinners who are generating more than half their household income (Prudential, 2018). In these changing times, it is now publicly acceptable for women to hold professional roles outside of the home, which was looked down upon in the past.

The comment in question displays an implicit bias that women are caregivers and men are breadwinners. The comment also violates the AIPG Code of Ethics Standard 4.4: “A respectful and fruitful working environment is fundamental for maintaining a high level of professionalism. Therefore, discrimination or harassment, either sexual or of any other kind, is unacceptable because it offends the dignity of persons and seriously undermines the atmosphere of trust essential to the work of all geologists. Such actions should be denounced immediately to authorities. It is unprofessional and unethical to condone any kind of discrimination or harassment or to disregard complaints of harassment from colleagues or staff. AIPG’s Anti-harassment policy provides more explicit examples of acceptable and unacceptable behavior” (AIPG, 2017).

Inherent discrimination lies behind the claim that women are caregivers and men are breadwinners. Expressing opinions such as this can have long-term negative impacts on both the person making the comment as well as those on the receiving end. The use of metaphors and generalizations should be carefully weighed, as they are often misinterpreted and taken out of context from the author’s intent. In my opinion, it is in the best interest of AIPG and our Colorado Section to do our best to avoid making broad-sweeping, unfounded personal statements such as this one.

References


Experiences and Challenges of Being a Non-Traditional Student

Heidi Harwick, SA-9084

Heidi Harwick completed her B.S. in Geology in 2018 and is currently a graduate student at the University of Texas at San Antonio. She also works at Educational Testing Service as a proposal production specialist in the business development group. Prior to moving to San Antonio in 2004, Heidi worked and lived in southern California and served in the U.S. Marine Corps.

Most of my classmates are traditional students, attending school full-time and focusing primarily on their studies before entering the workforce. I’m a non-traditional student, a little older than the average, working full-time and attending school part-time, and I wanted to share some of my experiences. There are fewer non-traditional students, though I’ve met other adults attending class while working, or starting their education later in life. There have been challenges and frustrations, but there have also been many good experiences, as well as plenty of helpful people along the way. Attending college has its ups and downs for everyone, so here are the things that I encountered and what I learned from them. I hope that my experiences and observations may be beneficial to other students (non-traditional or otherwise) pursuing their degree.

Working full-time during the day presents its own set of considerations when attending school. There is a limited number of classes that I can take per semester, so my pace is slower. On the other hand, my tuition and related costs are also limited, and having a job allows me to earn money to pay for school. Attending part-time means that it takes longer to graduate -- it took me ten years from my first undergraduate class until I completed my degree. I have just finished my first graduate semester, and have to keep in mind that I will not complete my master’s degree as quickly as will my peers. I’ve learned to think of attending school as a marathon versus a sprint, slow and steady with progress each semester. Going to school part-time also means that I spend a minimal amount of time on campus. I park, go to class, and then go to work or head home immediately afterward. This unfortunately means that it’s a little harder to connect and stay in touch with my fellow students. Many geology students know each other and attend the same classes all day, and so probably feel more of a sense of belonging than I do, so that while I see a lot of same people, I don’t necessarily get a chance to get to know them very well. Fellow undergraduate students and friends have graduated and moved on, and while I am of course happy for them and proud of their accomplishments, I have been left feeling a bit isolated. Another challenge of working during the day is that many meetings and lectures are during the day when I am at work. For my classes, I arranged an alternate schedule with my employer, but it is often difficult to go to those lectures and seminars that are held in the afternoon.

There have been several times that I’ve thought of the phrase “no man can serve two masters.” Attending school while working often feels like this, that you have a foot in two different worlds. You have to find and maintain a balance between work and school, between priorities at the office and at school, as well as taking care of things at home, commuting, and other responsibilities. Existing in both the school and work worlds also means that often the boundaries between them need to be flexible. For example, during final exams when school requires more time and energy, or when there are deadlines at work requiring overtime. Managing my schedule has certainly become a balancing act (one I’m becoming better at over time), and sometimes you just can’t do it all. There have been times where I’ve gotten overwhelmed and had to decide on one thing to do first, then prioritize the others, and postpone other things, or even let something unimportant left undone. My job can sometimes be demanding, often with multiple overlapping deadlines and periods of stress, so I’m not always able to focus on school and geology studies as much as I’d like.

An issue I’ve run into as a non-traditional student is that most schol-
Being a part-time student isn’t all bad, however. By taking fewer courses, I can focus on just those one or two classes per semester. I’ve often talked with my classmates who are balancing a full load of courses, labs, and assignments per semester. While my time management is focused on a balance between school and work, I think there may be an advantage to focusing my studies on fewer courses per semester and using that energy to learn only a couple of subjects at once. During midterms and finals I am also glad to have only a couple of exams to study for, rather than trying to review information for several classes at once. Another benefit is that working full-time provides me with a salary, and I am fortunate to have an employer with tuition assistance that helps to pay tuition and fees each semester.

People are an important part of attending school — a good teacher and helpful classmates can make all the difference. Scholarships require you to be a full-time student, meaning 12 credit hours for undergraduates (or 9 for graduate students). I typically take 4 to 7 credit hours (2 or 3 classes), which is manageable with my work schedule, but falls short of this requirement. As all students know, college can be rather expensive, so anytime you can apply for a scholarship it is certainly helpful. When I attended field camp, I took a leave of absence from work and was able to apply for (and fortunately was awarded) a couple of scholarships that helped to offset the cost. I also hope to take advantage of grants and graduate scholarships as often as I can going forward.

As I continue my academic journey and attend graduate school, my love of geology is what continues to drive me. I love looking out of the window on a plane, or taking a road trip and stopping to see somewhere wonderful and interesting. Appreciating what it took to build an extinct volcano, or the layers in a road cut, or a beautiful incised valley, makes nature even more fantastic. The hard work and challenges can be overcome and are all worthwhile. I know it is possible to keep attending school while working full-time, and I am excited to continue my graduate coursework in geology.

Palo Duro Canyon, Canyon, Texas. (Picture taken during road trip to Colorado Springs for AIPG national conference September, 2018.)
Why You Should Speak More Than One Language

Shirley Mensah, SA-7566

“Comment vas-tu? Teny3y)) t33? Muhutis3n? Annyeonghaseyo?” I simply just said; “How are you”, in four different languages. The first salutation is from the French language, the second and third salutations are words from the two native languages, Ga and Twi, which I speak in my country, Ghana. The last is from the Korean language, Hangul. One might ask how and why I know all these languages. I readily share my story about languages with you below.

As a child growing up in Africa, my world revolved around the many languages spoken all around me. Ghana is a multilingual nation that has over 80 tribal languages being spoken. Thus, I developed a love for learning new languages within and outside my culture.

One day in college, I decided to do some research on foreign languages and perceptions about it. I found that the majority of people in island nations do not see any need for learning and speaking other languages. English is mostly seen as the universal language of the world. An article1 by Clayton Lewis on “Monolingual Myopia”, noted that there is a reversion to a belief in “English language exceptionalism”. That is, since English is the accepted lingua franca of international business, there is no need for the majority of people in the world to learn other languages.

I, on the other hand, strongly believe that language competency is increasingly becoming a valuable asset in this fast-paced integrating world. Hence, in this article I will discuss the importance of, and some benefits of, learning and speaking more than one language in this modern age.

The first benefit concerns the anatomy of the human brain. A multilingual brain looks and works differently from a monolingual brain. An article on a Swedish study2 on language and brains in 2012 states that, “language learning makes the brain grow”. In this study, a group of people had their brains tested before and after learning a foreign language. It was found that the brains of the people under study had actually increased in size, compared to their brain size before learning the new language. This increase in the brain size is due to the continuous exercise the brain does as it processes words in the various languages known to the individual. To explain this exercise the brain does, I will use a scenario in daily speech. For example, if an individual who is fluent in many languages wants to say the English word “canvas”, before the person verbalizes the full word; the brain picks up on the first few letters of the word and throws suggestions to the individual, as if playing a guessing game. So your brain undergoes this exercise in suggesting words that fit the start of the real word you wish to say, “canvas”.

These word suggestions your brain throws at you may be, canopy, carnivore, cannot, etc. The coolest part about this is, the brain not only suggests English words to the individual, but also suggests words from all the other languages known to the individual. All this happens in milliseconds with every word we speak in our daily communication. Even as I am typing this article, my brain is continuously making suggestions in my mind for the next word I am typing out. And these suggestions come in all the five languages I know. This rigorous lifelong brain exercise leads to a number of cognitive benefits. The first cognitive benefit is the development of higher density of the grey matter in the brain. According to an article by Susan Perry on “The Bilingual Brain”3, brain scans of polyglots (people who speak many languages) were found to have greater grey-matter density. The density was pronounced in people who were very proficient in a second language and those who learned a second language before the age of five.

Grey matter is responsible for storing brain neurons and synapses. It processes all information; hence this higher density leads to greater efficiency in information processing. Bilingual or multilingual brains therefore, generally have better ability to focus attention on a task while filtering out the unnecessary stuff. They are also able to multitask easily, and have an increased ability in good decision making.

The second cognitive benefit is the potential for the delay in age-related decline; a delay in the onset of age-related conditions such as dementia and Alzheimer’s disease for up to four years. It is really helpful to know that just by learning to speak many languages we make our brains stronger and help to push back conditions such as these in our old age.

The second benefit of multilingualism is its importance in the career world. An article by Bernadette Morris on “Why study a foreign language”, states that, “To be competitive on a global scale, the business world of tomorrow needs individuals who can work in a culturally diverse environment and who have strong skills in foreign languages”. The world is becoming more integrated than it used to be in the past. As the days go by, companies frequently set up headquarters in different countries. Being multilingual gives a better chance of coping with communicating with people from diverse backgrounds. As geologists, possessing this skill gives the opportunity to work overseas, and more opportunities to work with colleagues who have a different native tongue. A mere five or six languages will enable you to talk to almost everyone on earth: English, Spanish, French, Chinese, and Russian. This would definitely also help promote diversity in the sciences.

There is a famous quote by Ludwig Wittgenstein which states that, “The limit of my language means the limit of my world”. I definitely want to be a part of the group where language barriers do not limit people from sharing in the cultures of others. How about you, my reader? Are you going to be the individual on the left in the cartoon on the previous page; (Figure 1)? It is never too late to learn a new language.

I hope you choose today to embrace the concept of learning new languages.


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**Interview**

**Interviewee:**

**Linda Hensel, MI Section**

Linda Hensel is an active member of the AIPG Michigan Section. Linda graduated from Michigan Technological University (MTU) with a B.S. in Geological Engineering in 1980. She did some graduate work at MTU and Western Michigan University but never completed her thesis for a M.S. in Geology. She has been a Certified Professional Geologist (CPG) through the AIPG since 1997. Currently, she serves as the Field Trip Subcommittee Chair for the MI Section and has previously served as a Section Officer. Linda volunteered to be interviewed so that the AIPG’s Young Professionals can learn from her real-world experiences.

**Erica Stevenson (ES):** What was the most difficult part about attending college for you?

**Linda Hensel (LH):** I think the most difficult thing for me to adjust to while attending college was being in a new environment. I can understand why most freshmen are required to live in a dormitory and I made my first friends there. Other difficulties included needing more money and being away from family. I also learned during graduate school that teaching was not for me and that I needed to be in the private sector.

**ES: Are you still in contact with any of your college classmates?**

**LH:** Not really, since many moved away from Michigan and got married and whatnot.

**ES: What was the trending job at the time of your graduation? Did you land a job in that field?**

**LH:** The trending jobs in the geological sciences at the time of my graduation were in petroleum exploration and development. I enjoyed my work in the petroleum business and I worked in various locations in the [U.S.] Southwest, Northeast, and Michigan in my initial 6 years with a down-hole geophysics company. I now work in the environmental sector and have done so since the early 90s.

**ES: So, you worked in other states as a Young Professional. Did you live in these states? Which ones did you enjoy living in the most?**

**LH:** I’ve lived in 15 different states including Texas and Oklahoma when I worked in the petroleum field. I had a lot of nice people to help me while I was there. Leaving a home environment was still hard despite having a Type A, outgoing personality. I enjoyed the places I worked and lived and was able to visit while I lived in the Southwest. Some of my favorite places in the U.S. are in that area of the country.

**ES: What was one of your biggest struggles as a young professional? A young professional meaning a person out of college but not yet certified as a professional geologist.**

**LH:** One of my biggest struggles as a young professional while working in the petroleum business was acclimating to the culture and attitudes of some locals in Oklahoma and Texas. I met a greater number of very genuine and wonderful people that made my adjustment to the Southwest easier with time because they accepted me for myself and I reciprocated.

**ES: Do you feel that being a member of the AIPG has been beneficial for you? How so?**

**LH:** I definitely feel that being a member of AIPG has been beneficial to me both personally as well as professionally. I met new people and made new friends at the quarterly meetings and as well as really enjoyed the interaction with speakers, many college students and various young professionals. Organizations are good to be a part of because they offer you the chance to share stories and ideas as well as reinforce the importance of science.

Continued on p. 60
HAPPY HALLOWEEN,  
*It’s Time for a New Career*

William C. Howald, CPG-11041

On October 31, 2005, I awoke to my regular routine—coffee, news then check the Blackberry. At that time, I had a Blackberry, cell phone, digital camera and a MP3 player. I recall telling my assistant that someone should figure out how to bundle all this stuff into one device—if only I had known!  

Halloween is a state holiday in Nevada because that's the day Nevada became a state—October 31, 1864. It was a holiday in Nevada but not for the rest of the world. My Blackberry was vibrating wildly with red lights flashing as the news that Barrick Gold was making an unsolicited bid (hostile takeover) for Placer Dome in a deal worth US$9.2 billion—the day of doom had arrived! Placer Dome initially recommended that shareholders reject the offer. Since the company was in play, that caused a slew of potential “White Knights” to step forward and kick the tires. I spent the next several months shuttling geologists and dignitaries around to the mines, projects and offices in the Americas while managers in other parts of the world did the same. After several months, Barrick and Placer negotiated a friendly merger with an improved deal worth US$10.4 billion. I like to think that our efforts of adding significant gold ounces to the Bald Mountain resource contributed to the increased offer and friendlier terms. 

Much like the news of today, mergers tend to make a lot of people redundant and that is exactly what happened at Placer. From senior management down to office personnel people were given severance, early retirement or were let go, and that is what happened to me, my staff and my regional offices. So what's next? Poor me!? I don't think so! 

Once the takeover was finalized at the end of January 2006, I stayed on until March with my last official act to close the Reno office. From February until March, I kept in contact with a number of my friends and associates in the junior mining sector. A number of groups had completed deals with Placer Dome and myself in Nevada, Mexico, Peru and Chile, and they were interested to know what my future plans would be.

**Fearing Lions, Tigers and Junior Miners**

These creatures are not scary. They are nimble, quick and surgical. That’s why junior mining companies have come into being.

Historically, large mining companies had extensive generative exploration departments that worked exclusively for the mining company at finding new ore deposits around the world. The exploration budget for any company is a discretionary budget that is limited by the company’s cash flow, capital projects, and exploration priorities. Over the last 25 years, the number of large mining companies has decreased while the remaining companies have reduced their generative exploration staffing requirements and focused funds and manpower toward near-

mine exploration programs. Free-market forces allow smaller discovery-based companies to pick up the slack and fill the niche for new mine discovery. Playing the rule of large numbers, the larger mining companies are willing to fund, participate in, and purchase new discoveries from, the junior mining sector—roughly 2,000 companies are on the TSE (Toronto Stock Exchange). The high-risk dollars required for mineral exploration are raised on the Toronto, Sydney, London, and New York stock exchanges. However, most North American publicly-traded junior mining companies are domiciled in Canada. The reason behind this is twofold. Firstly, Canada is a commodity-based economy. In 2018, Canada’s gross domestic product was running at $2.223 trillion. According to Statistics Canada, the mining, quarrying, oil and gas extraction sector was almost 8% of Canadian GDP—approximately $151.6 billion. Because of the large role mining plays in the Canadian economy, Canadians understand the sector and the value it creates for their society. Therefore, my second point, commodity-based companies are welcomed, and establishing a new junior mining company is relatively easy.
Mineral exploration is high risk but can provide a high reward and return to investor groups. The value curve can be divided into three discrete activities which can affect a company’s share price. The main activities are: discover, build and mine. The biggest share price appreciation occurs when a junior mining company makes a new bona-fide mineral discovery. Ironically, the value curve peaks and then begins to decline when the company announces a positive feasibility with a new mine to be built. The value decreases because investors know the company will need to raise capital and/or acquire debt to build the mine (Fig. 1). The value curve begins to appreciate again but at a lower rate once the mine is operational, generating cash flow and thus having lower risk. The investor demographics change significantly as the project is de-risked and becomes a mine.

Figure 1 - Value curve

I decided to get involved with two groups, and we formed two private companies with the intention of going public on the Toronto Stock Exchange. Company A had the mandate of exploration in Chile and Argentina, and Company B had the mandate of operating in Nevada. I also formed a private engineering company that would work on projects and assist other clients. Since AIPG is a USA publication, I’ll focus on starting a Company B. For the record, Company A was sold in 2009, and Company B was sold in 2018.

That September, I bought a great new product called an iPhone and ditched my Blackberry! When asked why I bought an iPhone, I replied because I can. Starting your own business can be liberating!

Envisioning the Future

All companies start with a vision, dream or idea. Richard Branson, of Virgin fame, said, “If people aren’t laughing at your dreams, you’re not dreaming big enough”. It takes as much effort to start a small company as it does a big company so think BIG. My current company is looking for the next 50-million ounce gold deposit (at US$1,200 per ounce gold price, that’s a lot of value). As a wise exploration manager once told me, “You won’t find what you are not looking for!”

To start, you need to know the three most important attributes of any mining or exploration company – people, place and project, in that order. The order is important because if you have the right people, you will find the right place and the right projects. In any organization, people are the key. Back in my days with Placer Dome, the HR department commissioned a study on what positions create the most value in a mining company. I’m happy to report that the study showed geologists and mine managers have the biggest impact in creating value for a company; however, you still need the other professions to achieve your goals. After all, you still need lawyers, accountants, directors and consultants - pick wisely.

For Company B, we used a well-known Nevada legal group and incorporated a wholly owned US subsidiary to hold our projects in Nevada. Claims in the US can only be held by US citizens or entities. The first project, which became our qualifying project for the Initial Public Offering (IPO), was acquired from an Oregon based group who acquired it from Newmont. The principal of the group claimed he was the owner of the apple orchard that Steve Jobs would visit. As many of you already know, the mining industry is full of interesting and sometimes eccentric people – that is one of the aspects that make it so interesting.

A major factor in the success of your own new business is the strength of your commitment. You may have the title of President, Chief Executive Officer or Chairman of the Board, but you still may need to go to the field to collect soil and rock samples, map, sit on a drill rig, complete your own reports and expense report, and stay in budget. You are basically an army of one who has to do the janitorial duties when required.

I have never worked as hard as I have at a junior mining company. There is no fall back if you go over budget and run out of money. I’ve been there, and it’s not fun. One time I had $10,000 in the bank and still hadn’t paid all the drill invoices not to mention payroll at the end of the month. It was a scramble, but with my team, we were able to raise money, pay the bills and release some good drill results which then allowed us to raise more money for a second round of drilling. I was fortunate to work with vendors and drilling contractors who allowed me to make payments on my outstanding invoices. Relationships are key, and I paid them every penny.

There is only you and your ability to speak to investors and raise capital when needed or warranted. You, and only you, set the tone of the company as well as the company’s drive and its ultimate success or failure. There is no going over to the water cooler and bitching about the boss because he/she is you!

My current company is looking for the next 50-million ounce gold deposit (at US$1,200 per ounce gold price, that’s a lot of value). As a wise exploration manager once told me, “You won’t find what you are not looking for!”

I’ve witnessed several groups coming out from a larger corporation and starting a new junior. There is an adjustment period where you either understand you are responsible for everything and move or become paralyzed because you are responsible for everything. I like to use the advice of Teddy Roosevelt, who said, “In any moment of decision, the best thing you can do is the right thing, the next best thing is the wrong thing, and the worst thing you can do is nothing”. You’ll find as your company moves through its programs that many decisions are required to keep it on track, on budget and moving toward its objectives. As we liked to say at Company B, “I don’t need it perfect, I need it Tuesday”.
Making the Sausage

Starting the companies was relatively easy. My partner had access to a securities lawyer and an accountant, and we incorporated the companies in British Columbia. Next, the company needed to be capitalized. The initial funding was offered to friends and family along with the principals. A second seed round was offered to several resource-focused funds. Initially, Company B raised CDN$1 million.

The cost of working toward a Canadian IPO is roughly CDN$400,000 for legal fees, various listing and exchange fees, audited financials and a National Instrument 43-101 Technical Report (“NI43-101”).

What is a NI43-101?

“NI43-101 is a national instrument for the Standards of Disclosure for Mineral Projects within Canada. The Instrument is a codified set of rules and guidelines for reporting and displaying information related to mineral properties owned by, or explored by, companies which report these results on stock exchanges within Canada.”

The NI43-101 was created following the Bre-X scandal to protect investors from unsubstantiated mineral project disclosures.

In March 1993 and October 1995, Bre-X Minerals Ltd., a Calgary based, Toronto Stock Exchange listed company announced that significant amounts of gold had been discovered at its Busang property in Kalimantan, Indonesia. The company’s stock price went from mere pennies to CDN$286.50 on a split-adjusted basis as claims of gold reserves of 200 million ounces were reported. In May 1996, the company’s market capitalization was over CDN$6 Billion. I remember Placer Dome offering to complete a “Merger of Equals” in January 1997, but later that year, Bre-X Minerals’ stock collapsed after salting of the samples was uncovered, and the gold values were found to be a fraud - there was no gold. It was an epic scandal and changed the industry for the good. The 2017 movie “GOLD” starring Matthew McConaughey dramatized the scandal; however, a truer account is available in print and titled, “Bre-X: Gold Today, Gone Tomorrow”, published by The Northern Miner.

The NI43-101 requires that the information be vouched for by a “qualified person.”

“The Qualified Person, in the spirit of the National Instrument, is required to be a reputable professional who is knowledgeable of the mineral property concerned, and who has sufficient experience and qualifications to make the statements which are made within the report. Often the Qualified Person need not be the author of the report, but in attributing the report as being compliant with the National Instrument, they are vouching for it. This is a matter of professional integrity and carries legal risk; as misleading statements can result in legal sanctions in Canadian and other jurisdictions.

A qualified person is defined in the National Instrument as:

- an engineer or geoscientist with at least five years of experience in mineral exploration, mine development or operation or mineral project assessment, or any combination of these;
- one who has experience relevant to the subject matter of the mineral project and the technical report; and
- is in good standing with a professional association and, in the case of a foreign association, is of recognized stature within that Organization.

The requirement for a Qualified Person in the NI 43-101 is different from that required by the The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code), and the South African Mineral Reporting Codes (SAMREC and SAMVAL Codes), wherein the person must have 5 years’ experience relevant to the deposit type or style of mineralization but is otherwise similar in terms of who may or may not sign off on such a document.

The Qualified Person must declare whether a qualified person has verified the data disclosed, including sampling, analytical and test data underlying the information or opinions contained in the written disclosure; a description of how the data was verified and any limitations on the verification process; and an explanation of any failure to verify the data.”

As a Certified Professional Geologist within AIPG, you are a qualified person for the purposes of NI43-101; however, if you are an officer, director or related party of a company, you need an independent, third-party qualified person to write the first technical report for your qualifying property.

Before you do your IPO, your company needs audited financials, a title opinion from your US legal counsel, and a NI43-101 technical report from your qualified person. All of this information is sent to your securities lawyer to complete the prospectus. Now the fun starts.

Heading Out on the Road Show

At Placer Dome, I would meet my boss and colleagues at least three times per year at some location within one of our regions, and we would hash out priorities, budgets and personnel. Projects that were not meeting their objectives were cut, and the funds re-directed to projects that were advancing. It was cut throat and demanded good information and a clear purpose to get the money. The process of finding a brokerage firm, setting the IPO price and going on a road show is similar. Getting money from people you don’t know is hard work. The story has to be crisp, clean and new. Investors want to know what the vision is, who the people are (people are important), where it will happen, and finally, what is the project. Investors bet on the jockey, not the horse.

So with presentation in hand, you learn your story very well as you will likely repeat it every hour on the hour between 7 and 10 times a day during your road show. By the end of the day, you will be tired of listening to yourself but you must remain upbeat and fresh. The last meeting of the day is the hardest presentation to give. Everyone watches the clock because beer-thirty is next. However, on one road show when raising funds to purchase a Nevada mine, my last meeting of the day turned out to be the most successful, although it had a very rough start. I walked out of the meeting with my lead order – CDN$10 million ($10 million down, only $30 million to go).

One important learning from this process is that when investors say call me next week, they are not interested in investing in your company. I found that the people who were interested committed the same day.

Spreading the News

New companies are judged initially by their management. Investors expect you to execute on your vision and be transparent about your findings. Most investors know that your venture is high risk and if successful, high reward. You need
to keep them abreast of your progress and results. This is done through disclosure of plans, budgets, activities and most importantly results. Do the results prove or disprove your idea?

Because most investors are not geologists, mining engineers, metallurgists or technical experts, you will need to craft your news releases so that the casual observer can understand the result and its implications for the stock — this is not an easy task. Distilling highly complex technical data so that your grandmother can understand what you are talking about is an art. It’s good to have someone in your circle whom you can trust with confidential information and who can carefully review your information as a layman. It’s important that your news release is clear, simple and well written. It’s also the investor’s window into the company, and poorly written material says a lot about your intentions, ability and attention to detail.

Continuous disclosure is how Canadian junior companies keep their investors up to date. Disclosure must be reviewed and approved by a qualified person. Unlike the NI43-101, this person can be someone who has the credentials of a qualified person but can be associated with the company. For Company B, I was the qualified person for the news releases. I often asked my securities lawyer to review the news before distributing. Lawyers are meant to worry so you must make sure they do not change the intent of your news. They only need to confirm that the release conforms with NI43-101 disclosure standards.

Once you have a budget and plan, a helpful activity is to sit down with your team and outline when activities will be complete and, on this basis, map out the timing of news releases for the next 12 to 18 months. This helps with program timelines and gives management a sense of where information might occur so they can get ahead of the issue in the event that it is positive or negative. If you promised the market a milestone in Q2 and you see that that isn’t going to happen, you need to let them know that the event is delayed, and most importantly, why it is delayed.

Keeping in tune with the pulse of the market is hard work and requires a lot of email, face and telephone time. You may consider hiring a professional investor relations firm or an investor relations manager. This will be your company’s face to the investing public and someone who will remind you of what was promised and when. This person needs to be the quintessential people person with extreme patience — you can’t please all the people all the time, and you will hear about it constantly.

**Behaving Like an Owner**

This is probably the most important point of this article. There is nothing like executing on your plan and giving the market the results you initially envisioned. Execution, execution and execution will give investors comfort and drive your market capitalization higher as you de-risk your project. As I said before, sometimes things don’t go as planned. When that happens, you must get out and let your investors know what happened and how you are going to fix it. They may be upset at the result, but will appreciate the transparency, and some will give you the benefit of the doubt and remain a shareholder. Candor is important.

Starting your own company or business is intellectually, personally and professionally rewarding. You will never work as hard professionally as you will with your own business. You’ll finally understand those catch phrases like “Act Like an Owner”. You must focus on getting the right technical and administrative people, doing the right things, selecting the best projects, and executing on your corporate strategy. If you succeed at these core functions, your company will be rewarded in the capital markets, and you will have extreme fun and the gratification that you made it happen.

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**Editor’s note:** William (Bill) Howald, CPG-11041, is a serial entrepreneur who has started and sold several public companies over the past 12 years. Prior to creating junior mining companies, he was General Manager of Exploration, United States and Latin America, for Placer Dome Inc. During his tenure at Placer Dome, Mr. Howald was an integral part of the teams that delivered over 100M oz of gold resources to the Placer portfolio. A number of these resources are now mines. Mr. Howald was born on the “Richest Hill on Earth” (Butte, MT) and has over 34 years in the international exploration and mining industry gained primarily in the Western US, Mexico, and Central and South America.
Abstract
Created by Congress in September 2018 and welcomed by President Donald Trump with a proclamation on October 26, 2018, Camp Nelson in Jessamine County, Kentucky, is a national monument. A tour of its battlements located in the Inner Bluegrass, shows prominent karst terrain and rich limestone soils suited to raising horses. Camp Nelson was a training center for African Americans, and among other parts of its history, two cavalry organizations were formed there: the Fifth and Sixth United States Colored Cavalry (USCC).

The purpose of this paper is to acquaint the reader with the application of geology at the military installation and theatre levels during the American Civil War, and to highlight the importance of Camp Nelson in the campaigns that closed the War.

Introduction
In Kentucky, in the spring of 1864, Sherman and Grant planned the campaign now called “The March to the Sea” (Brisbin, 1868). Camp Nelson’s breastworks (Figures 1, right and 2, page 57), in excess of 1.5 miles in length, were formed in an east-west layout between the Palisades of the Kentucky River to the west and Hickman Creek, an ancestral fluvial path near the Kentucky River Fault zone.

African Americans were the primary builders of Camp Nelson.
Starting in 1863, Camp Nelson focused on supply, but the vision for the camp changed. Former slaves started enlisting there in October 1863 (see Fig. 3) and the Federal mission continued to evolve through the end of the war. On April 18, 1864, active enrolment began of black Kentucky troops. Only Louisiana enrolled more black troops than Kentucky (Prichard, 2014). Black manpower became acculturated into the armed forces of the United States at Camp Nelson.

From Camp Nelson, the Commander of the military district of Kentucky, Gen. Stephen Burbridge, using the black troops he had recruited and trained, would cross the Appalachians and strike at the most vital part of the Confederate supply system, at Saltville, VA (See Figure 4), thus hastening the end of the war.

Relation of Camp Location to Geology
The Camp commands the high ground overlooking the Kentucky River, which here flows in a steeply-walled canyon (Figs. 5 and 6), giving the region the apt name of “The Palisades” and enabling the creation of easily-defended positions. In the vicinity of the camp, the Kentucky River has excavated two terraces which are mantled by sand, silt, clay and gravel, thus providing plentiful construction material (Fig.7-bottom). Cobbles of quartzite, quartz geodes, and pebbles record the ancestral course of the Kentucky River.

The dramatic 60-degree change in the river’s course, from SW to NW, is in part caused by the Kentucky River Fault.
**GEOLOGIC NOTES ON FORT PLACEMENT**

**Enlisted September 17, 1864:**
**Adam Devoe.** Wife: Ellen Devoe.  
Three Children. Appointed to Company H, 5th USCC, Sargent Devoe was formerly a slave of Governor Thomas Bramlett, a Union Democrat. (Prichard, 2014).

**Figure 2** - Plan view of the earthworks at Camp Nelson, dated September 1864, as the 5th and 6th USCC prepared to embark on the Saltville Campaign.

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**Adam Devoe.** Wife: Ellen Devoe.  
Three Children. Appointed to Company H, 5th USCC, Sargent Devoe was formerly a slave of Governor Thomas Bramlett, a Union Democrat. (Prichard, 2014).

**Figure 3** - Record of one African American recruit of Camp Nelson.

**Figure 4** - Union campaigns against Saltville, VA late in the Civil War.

**Figure 5** - A natural fortification, Camp Nelson is indicated by the black star south of Lexington. Its elevation is induced by the fault’s position astride the domal Cincinnati Arch. Modified from Jillson, 1945.

**Figure 6** - Jillion’s discovery of abandoned high level deposition (Jillson 1948) with modification to show proximity to Camp Nelson walls.

system (Figs. 6 and 7). The faults have thrown resistant beds on their northwest (downstream) sides upwards (Fig.7, cross-section A-A’), not only diverting the river northward but forcing it to cut a canyon into what is now an elevated karstic plateau carved into the resistant limestone. Jillson, in his thorough Monograph, “The Kentucky River” notes the formidable accomplishments of the Kentucky River in battle with the landscape.

The river has seen eight base level changes which altered its course (See Figure 5) responding most recently to a Pleistocene uplift of about 1000 feet. Recent entrenchment closely follows the past course. The principle structural feature in opposition to the erosional force of the river is the Cincinnati Arch, a domal feature, which reaches its apex in the vicinity of Camp Nelson. (Jillson, 1945).

Jillson shows that two structural controls; the crest of the Cincinnati Arch and the Kentucky River Fault System, diverted the path of the river into its present course, leaving Pliocene high level fluvial deposits (See Figure 6, Jillson, 1948). The Camp Nelson Limestone (the oldest rocks that outcrop in Kentucky) and the intersection of the fault sys-
GEOLOGIC NOTES ON FORT PLACEMENT

tem (Jillson, 1945, 1948) form one of the most scenic cases of stream modified stratigraphic and structural barriers in Kentucky. The Camp Nelson Limestone is dolomitic and is erosional resistant compared to the rocks southeast of the fault zone. The faults define a graben with about 315 feet of displacement. A marked difference in topography sets this area apart for military considerations as well. Elevation created by these forces form two walls of a generously spacious bastion: a north wall contributed by the fault zone at a strike of nearly N 45° E in the up-river and the latest incisions of the Kentucky River, west of Camp Nelson, strike nearly N 15° W to make a western barrier (Fig. 6 blue lines).

Union power in the landscape would have been confirmed by the development of Camp Nelson at a key bridge defense point in the Bluegrass: it guards one of only two bridges over the Kentucky River. In Unionist Kentucky, forts, made of various materials and designs, defended cities, bridges, rail heads, tunnels and trestles. A railhead existed in Nicholasville, only ten miles north of Camp Nelson (Fig. 8). This offered relief should the Camp become invested (besieged) by the enemy; it also served as a regional Union point of embarkation.

The landscape shown in Figure 8 is a legacy of the 1800s, when a mature horse industry existed in the Lexington region. Intense weathering of the Lexington limestone which underlies the plateau and contains small quantities of apatite leads to a phosphate-rich and therefore highly fertile soil, providing ideal pasture for horses. Rarely, the phosphate is sufficiently concentrated to make the soil itself a mineable agricultural commodity. In 1850’s, analysis of phosphate soil content in Jessamine County found less than 0.2 % in the vicinity of the cantonment area but North of Nicholasville, a result of half of a percent was assayed (Owen, 1857).

From Camp Nelson, approximately 10 miles south of Nicholasville and only one day’s ride from Lexington, capital of the Blue Grass region (and home of Henry Clay as well as of the rebel John Hunt Morgan), troops could easily access the rich Inner Bluegrass terrain to their north (Fig. 8). Part of Camp Nelson’s purpose was also to discourage the frequent Confederate raids on the Inner Bluegrass, where rebels often sought fresh mounts. Moreover, this geographic situation allowed Camp Nelson to train and develop cavalry which could fully exploit the equestrian resource in favor of the Union.

Strategic Value of Camp Nelson:

As we have seen, geology gives the camp considerable strategic value;

1) its position in the Inner Bluegrass denies products from the enemy (products like grain and horses),
2) it defends a bridged crossing, one of only two over this river, and thus
3) blocks a vital road,
4) It has reasonable access to rail.

Tactically speaking, Camp Nelson occupies the high ground, giving its defenders the advantage of clear visibility and downward-directed fire on their attackers. Camp Nelson had very adequate access to water in case of siege as well as wood, soil and stone for construction of blockhouses, stockades and breastworks. The terrain would have been clear-cut for a mile or more from the

Figure 7 - Surface Geology of Camp Nelson and Cross Section of Kentucky River Fault Zone and the Lexington Peneplain (Wolcott, 1969). Star = site of Camp Nelson (Wolcott, 1969).

Figure 8 - Inner Bluegrass with “gentleman farm” land use (modified from, Oakes, 1977).
unlooked for and, in an age predating cavalry to show up at places and times sure Confederate raiders overland or be intact. Covered bridge. It survived the civil war. Hickman Bridge was a double-width crossed the Kentucky River at that time, 10) Of the two turnpike bridges that tifications (to enfilade the Hickman works of the type shown on the map in Figure 2.

Camp Nelson also had satellite fortifications (to enfilade the Hickman bridge; one example is shown in Figure 10). Of the two turnpike bridges that crossed the Kentucky River at that time, Hickman Bridge was a double-width covered bridge. It survived the civil war intact.

If necessary, the cavalry could pressure Confederate raiders overland or be delivered by rail. It is the characteristic of cavalry to show up at places and times unlooked for and, in an age predating barbed wire, speeding and stealthy cavalry sought out enemy position and strength information. Cavalry duties included finding informants and guides. Cavalry were “shock troops” or the elite soldiers on the field. They were expected to pioneer the trails for the army to follow and to engage the enemy as a rear guard if necessity called for retreat. They were a challenger for enemy cavalry.

Decidedly, a fortification at Camp Nelson was needed. An engineer specified the type of structure that would best achieve the vision of the commander. The last decisions, once under fire, lay with the “earthwork superintendent,” applying field expedient measures to shore up the defenses (Nichol, 1986).

An artist, engineer or other officer using cartographic skills likely prepared maps showing the location to be defended or the topography that influenced the placement and design of the fort along with the range of the major artillery on any bastions or hilltops (Dunnigan, 2012). Obstacles or rifle pits would be constructed to deny the enemy favorable locations nearby. It was rebel General Morgan’s habit to pack along the small mountain howitzer, therefore the planner in Kentucky had to think about the possible appearance of artillery.

Why Target Saltville?

Salt made war possible. Among other uses, salt was necessary for preservation of food, leather manufacture, and for human and animal consumption. Salt’s essential nature has been recognized since prehistory (Whisonant, 2015).

The Confederate army mined iron, lead and salt in Southwestern Virginia. Major Union actions against Saltville and nearby Wythe County are reported in two thorough Virginia Mines and Mineral publications by Whisonant (Whisonant, 1996). The strategic value of Saltville was that it served to preserve the pork needed to feed the southern soldiers and its rail line connected Knoxville on the west side of the Appalachians to Virginia.

The Union’s appraisal of Saltville’s target value were likely as follows; 1) Meat preservation, 2) lead production, 3) salt, 4) communication by rail, 5) iron works, and 6) diversion of slave labor to free. The selection of Saltville in October as a target seems logical. In addition, Burbridge observed the theatre situation had changed. June 12, 1864, Burbridge defeated Morgan at Cynthiana, KY; September 4, 1864, Union General Gillam struck Greenville TN, and killed General Morgan, whose Kentucky rebels were protecting the approach to Southwestern Virginia. With Morgan gone, less vigilance perhaps was required back home (Prichard, 2014) and the Federals would have good fortune.

The Timeline

Kentucky abandoned its “neutrality” position in August of 1861 and was promptly invaded. In September, Confederate General Felix Zollicoffer raided the Kentucky salt works at Clay County, hauling away 600 bushels of the substance. Out of military necessity, Union forces destroyed the salt operations in late October 1862. Clay County, Kentucky rated among the top five salt manufactories open to the South (Whisonant, 1996). The Kentucky salt works changed possession four times in the course of the war in contrast to the salt operation in Southwestern Virginia, which remained untouched by the Union until after Gettysburg.

The Southwestern Virginia salt works was associated with folded sabkha deposits of the Mississippian MacCrady Formation. (See cross section Figure 11) At its peak in 1864, the salt project included 38 furnaces, 2,600 kettles and perhaps as many as 300 buildings. The huge salt output during the war years commonly exceeded the railroad’s ability to transport it, and reached an estimated two-thirds of all the salt required by the Confederacy.

Burbridge submitted plans for his campaign on Saltville to Washington and at acceptance, his attack involved several white regiments as well as the 5th and part of the 6th USCC. The path conformed to the valley of the Big Sandy River reaching into Virginia, extending 300 miles with the final 40 miles in Virginia. A horse soldier is expected to travel 35 miles per day and Commanders must keep the column tight and in contact in mountains. Eight men lost their lives to falls during the arduous passage. (Whisonant, 1996).

On October 2, 1864, Burbridge’s units struck Saltville. The rebel militia dug into the high ground and delayed
ES: Is there any general advice that you would like to impart on today’s young professionals?

LH: My best advice to young professionals is to take advantage of the wisdom of the seasoned professionals they work with when they first are employed at any company. Do not be afraid to ask any questions, be yourself with your colleagues and be engaging. Find yourself a good mentor that you can align with and who has your best interests at heart. I’ll also say that it is important for you to assert yourself, especially if you are a woman. It can be more difficult for women to do this because men tend to get the final word despite not necessarily being the person most capable to decide. This is where you need to assert yourself.

Burbridge at Clinch Mountain. The delay and effective re-enforcement, resulted in a Union loss at Saltville. Burbridge retreated using the same path over the Cumberland Plateau following the Levisa Fork of the Big Sandy River. Meanwhile, a massacre of wounded and captured USCC occurred at Saltville. (Whisonant, 1994).

November 15, 1864, Sherman set out from Atlanta to complete the “March to the Sea.” Union General George Thomas smashed Hood at Nashville, December 15 and 16, 1864. Grant then ordered Burbridge to concentrate forces for a second comprehensive Southwestern Virginia attack with General Stoneman in command. (Prichard, 2014).

On December 10, Stoneman moved northeast from Knoxville with about 5,500 mounted troopers and four cannons. His objectives were to destroy not only the salt works but to knock out the crucial lead operations in southern Wythe County and to devastate the Virginia and Tennessee railroad. Burbridge’s 5th and 6th USCC were a
component. Union forces broke through on 17 December destroying rail, mines, iron and lead ore processing assets, and military stores. Junk was thrown down the well shafts. By Christmas the job was finished. In spite of the material mismatch between North and South, industrial capacity of the South grew through the war, until the very end (i.e. new iron operations developed in Alabama and copper in Tennessee). (Katcher, 1992).

By March 1865, at the eleventh hour, the rebels at Saltville were mining again. Stoneman’s men returned in April and laid waste to the facilities two days before Lee’s surrender at Appomattox. After hostilities ceased, a Confederate ordnance officer characterized the Wythe County mines saying: “Our lead was obtained chiefly, and in the last years of the war entirely, from the lead mines at Wytheville Virginia. The mines were worked night and day, and the lead converted into bullets as fast as received.” (Whisonant, 2015)

Significant numbers of Kentuckians fought at Saltville 1 and 2. Col. J Russell Butler’s 1st Kentucky Cavalry, always remembered Saltville as the first time they faced black troops in battle. (Prichard, 2014)

Conclusions
This study examines how geology impacts both installation and theatre level strategic thinking. Very often, places of geologic prominence like mountain passes, and reserves of oil, water, and minerals are associated with conflict. This has been true for millennia, and remains true today.

References
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