CALL FOR SESSIONS

GET RESOURCEFUL - EMPOWER A GENERATION

Submit your session proposal under the technical and non-technical themes and sub-themes making up the below matrix. Proposals will be accepted until late fall 2016.

Session proposals must include:
Proponents | Session title | Short summary | Relationship to conference partners | Expected participation

This conference aims to provide participants with a program that will explore four vital themes: energy, minerals, water and the earth.

Grounded in geoscience, the conference will serve as a forum for industry stakeholders to discuss their research initiatives and activities as well as the key issues and trends shaping the future of energy, minerals and water resources including the science of the earth that underpins their sustainable discovery and extraction.

<table>
<thead>
<tr>
<th>Energy</th>
<th>Minerals</th>
<th>Water</th>
<th>The Earth</th>
<th>Resources and Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>Major minerals</td>
<td>Sub-surface water</td>
<td>Earth Evolution</td>
<td>Resources and indigenous people</td>
</tr>
<tr>
<td>Unconventional</td>
<td>Minor - critical minerals</td>
<td>Surface water</td>
<td>Earth Processes</td>
<td>Role of Geological Surveys</td>
</tr>
<tr>
<td>Sedimentary Basins</td>
<td>Technology and metals</td>
<td>Water - Minerals</td>
<td>Earth Systems</td>
<td>Resource frontiers - Arctic, Oceans</td>
</tr>
<tr>
<td>Geothermal - renewable</td>
<td>New sources</td>
<td>Water - Energy</td>
<td>GAC-MAC</td>
<td>Sustainability and climate</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>Knowledge and education</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Geoethics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Young leaders</td>
</tr>
</tbody>
</table>

Organizers

Supporters

Partners

AAG Association of Applied Geochemists
BCGS British Columbia Geological Survey
CGEN Canadian Geoscience Education Network
CGS Canadian Geotechnical Society
CSEG Canadian Society of Exploration Geophysicists
CSGP Canadian Society of Petroleum Geologists
GSC Geological Survey of Canada

Geoscientists Canada
IAH-CNCO International Association of Hydrogeologists - Canadian National Chapter
IAMG International Association for Mathematical Geology
IAPG International Association for Promoting GeoEthics
IUGS International Union of Geodesy and Geophysics
IUGS International Union of Geological Sciences

Submit your session proposal at: RFG2018.org
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On the Cover: The photo shows the disconformity between the whitish kaolinitic sandstone in the Morrison Formation (Jackpile) and the overlying orange sandstone in the Dakota Fm near the ghost town of Hagan, New Mexico. Photo taken by John Sorrell, CPG-11366.
The mission of the American Institute of Professional Geologists (AIPG) is to be an effective advocate for the profession of geology and to serve its members through activities and programs that support continuing professional development and promote high standards of ethical conduct.

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For AIPG news and activities go to www.aipg.org.
## AIPG 2016 Conference Program

### Saturday, September 10, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 am—12:00 noon</td>
<td>AIPG Executive Committee Meeting (open to all registrants)</td>
</tr>
<tr>
<td>12:00 noon—1:00 pm</td>
<td>AIPG Awards Luncheon (open to all registrants)</td>
</tr>
<tr>
<td>1:00 pm—4:30 pm</td>
<td>AIPG Advisory Board Meeting (open to all registrants)</td>
</tr>
<tr>
<td>4:30 pm—5:00 pm</td>
<td>AIPG 2016-2017 Joint Executive Committee Meeting &amp; Business Meeting (open to all registrants)</td>
</tr>
<tr>
<td>5:00 pm—6:00 pm</td>
<td>AIPG Foundation Meeting</td>
</tr>
<tr>
<td>5:00 pm—6:00 pm</td>
<td>NM Section Meeting</td>
</tr>
</tbody>
</table>

### Sunday, September 11, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 am—5:00 pm</td>
<td>Registration — Hotel (2nd floor)</td>
</tr>
<tr>
<td>7:30 am—5:30 pm</td>
<td>Field Trip — Valles Caldera and the Los Alamos Science Museum</td>
</tr>
<tr>
<td>8:00 am—5:00 pm</td>
<td>Field Trip — Sandia Crest</td>
</tr>
<tr>
<td>8:00 am—5:00 pm</td>
<td>Field Trip — Geology of the Galisteo Basin, New Mexico (cancelled)</td>
</tr>
<tr>
<td>10:00 am—4:00 pm</td>
<td>Exhibitor and Poster Set-up</td>
</tr>
<tr>
<td>5:30 pm—6:30 pm</td>
<td>Student Networking Event with Professionals (complimentary for all registrants)</td>
</tr>
<tr>
<td>6:30 pm—8:00 pm</td>
<td>Reception — Exhibit Area Open (complimentary for all registrants)</td>
</tr>
<tr>
<td>8:00 pm—10:00 pm</td>
<td>Rockslide Rendezvous! Come and share your musical talents or listen to live music and singing from your fellow geologists, enjoy the evening! (complimentary for all registrants)</td>
</tr>
</tbody>
</table>

### Monday, September 12, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 am—8:15 am</td>
<td>Section Delegate Meeting</td>
</tr>
<tr>
<td>7:30 am—5:00 pm</td>
<td>Registration — Hotel (2nd floor)</td>
</tr>
<tr>
<td>8:30 am—5:00 pm</td>
<td>Exhibits Open</td>
</tr>
<tr>
<td>8:00 am—5:00 pm</td>
<td>Field Trip — The High Road to Taos Pueblo</td>
</tr>
<tr>
<td>8:00 am—5:00 pm</td>
<td>Field Trip — Paleontology and Geology of Ghost Ranch</td>
</tr>
<tr>
<td>8:30 am—10:00 am</td>
<td>Plenary Session</td>
</tr>
<tr>
<td>10:30 am—5:00 pm</td>
<td>Technical Sessions</td>
</tr>
<tr>
<td>12:00 noon—1:30 pm</td>
<td>Luncheon with Keynote Speaker (complimentary for all registrants)</td>
</tr>
<tr>
<td>6:30 pm—8:30 pm</td>
<td>AIPG Awards and Dinner (all attendees welcome with additional fee)</td>
</tr>
</tbody>
</table>

### Tuesday, September 13, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 am—3:00 pm</td>
<td>Registration — Hotel (2nd floor)</td>
</tr>
<tr>
<td>8:00 am—5:00 pm</td>
<td>Field Trip — Exploring Basin Fill Stratigraphy and Paleodrainage Evolution of the Española Basin Half-Graben (cancelled)</td>
</tr>
<tr>
<td>8:00 am—2:00 pm</td>
<td>Field Trip — Pecos-Picuris Fault in Deer Creek Canyon</td>
</tr>
<tr>
<td>8:30 am—3:30 pm</td>
<td>Exhibits Open</td>
</tr>
<tr>
<td>8:30 am—5:00 pm</td>
<td>Technical Sessions</td>
</tr>
<tr>
<td>12:00 noon—1:30 pm</td>
<td>Luncheon with Keynote Speaker (complimentary for all registrants)</td>
</tr>
</tbody>
</table>

*All field trips begin and end at the Drury Plaza Hotel. Breakfast is complimentary for hotel guests. If not staying at the Drury, cost for the breakfast buffet is $6.99+ tax.
Wisconsin Section Students Attend Testing the Waters Field Trip

The ten (11) day “Testing the Waters” educational adventure held from May 15 to May 25, 2016 on the Rock River in Wisconsin is complete!

Preliminary results were varied. Some areas were cleaner than expected and others had unexpected lower water quality results.

WI AIPG provide them lodging, breakfast and AIPG baseball caps on May 17th, an honor guard of a WI AIPG paddler on May 22nd, monetary support and river geology educational resources for the student use in schools through-out the Rock River watershed basin!

The canoe and kayak paddlers used special equipment to take water quality samples along the Rock River from Mayville to Beloit, and stopped at communities along the way to share what they were learning and provided a forum for discussions about water quality and practical solutions.

Rather than conducting tests in one spot, paddlers installed special equipment on their kayaks to measure four parameters, every 10 seconds, all along the river throughout the 11 days of the trip.

The information was instantly uploaded to a mapping server via the paddlers’ cell phones, so anyone with Internet access could see the results.

Future website visitors are able to view data and even prepare maps to print or share in presentations or on social media.

The water quality tests included dissolved oxygen, temperature, conductivity and pH, each an important measure of water quality.

Traditional sampling was done as well by collecting water samples for phosphorus analysis at the start and end of each day and at the confluence of every major stream or river entering the Rock River. The paddlers also measured turbidity, or how clear the water was, several times each day.

Together all these measurements will give a better picture of the Rock River’s water quality and help communities plan on how and when water quality improvement projects should be implemented!

All the data, maps and photos collected can be viewed at: http://www.testingwaters.org/dashboard.htm

Final reports by the students will be posted in the next few months.

Georgia Southwestern State University Drilling Field Trip
ANNOUNCING NEW EXECUTIVE DIRECTOR

The American Institute of Professional Geologists, a service and educational organization serving the geosciences since 1963, has announced the selection of Aaron Johnson, PhD as its new executive director. Johnson will fill the vacancy created by the retirement of William Siok, CPG. The selection was made after a national search and selection process.

“We are very pleased to announce this appointment,” reported AIPG President Helen Hickman. “Dr. Johnson will bring new leadership and creativity to AIPG’s programs and a fresh perspective to AIPG’s continuing mission in support the geosciences and its practitioners.”

Dr. Johnson’s resume includes over 20 years of planning, administration, communications, fund-raising, and teaching experience in the academic sector. He was awarded a doctorate in Geological Sciences in 2003 from the University of Missouri-Columbia, and has been the recipient of numerous awards and honors for his outstanding contributions to teaching and research.

“My work with non-profit organizations has allowed me to develop a management philosophy grounded in the concept that people are the most important resource in an organization,” remarks Johnson. I believe it’s imperative to “strike a balance between dedication to the mission of the organization and outlining a bold vision for the future.” Dr. Johnson will officially assume the role beginning August 22.

AIPG NATIONAL OFFICERS ELECTION RESULTS

2017 President-Elect (2018) President
R. Douglas Bartlett,
CPG-08433
Scottsdale, Arizona

2017 Vice President
Matthew J. Rhoades,
CPG-07837
Socorro, New Mexico

2017-2018 Treasurer
James R. Burnell,
CPG-11609
Golden, Colorado

2017-2018 Editor
John L. Berry,
CPG-04032
Austin, Texas

AIPG Staff Changes!

The staff welcomes our New Executive Director Aaron W. Johnson. Check out the announcement above. Also, read Aaron’s first column on page 32. You can contact Aaron at awj@aipg.org.

After 8 years, Vickie Hill, Manager of Membership Services, has chosen to seek opportunity elsewhere. The staff was sorry to see Vickie leave. AIPG welcomes Dorothy Combs (dkc@aipg.org) as the new Membership Services Manager. Dorothy has been with AIPG for five years as an Administrative Assistant.

AIPG welcomes Irene Kadel-Harder (ikh@aipg.org) as the newest member to the AIPG staff. Irene will be working part-time as an Office Assistant. Irene has her Bachelor of Science degree in Geology and will be working on her Master’s degree. The staff is excited to have Irene join us.
Every two years, the AGI Workforce Program synthesizes and analyzes national data sets that track the changes in the labor workforce to look for changes in the geoscience workforce. To provide an accurate count of the geoscientists working in the United States, AGI’s definition of the geosciences is regularly compared to the labor definitions provided by the U.S. Bureau of Labor Statistics (BLS). For the Status of the Geoscience Workforce Report 2016, which will be publicly available soon, a revisit to the occupational listings revealed a difference in the definition for geoscientists working in colleges and universities compared to the listings of postsecondary teachers in atmospheric sciences, earth sciences, marine sciences, space sciences, environmental sciences, and geography. In previous years, the counts for these postsecondary teacher occupational categories were not included in the overall count of geoscientists in the U.S. workforce, but for the 2016 report, these occupations were included in the overall count.

The figure shows the changing number of employed geoscientists in the United States since 2006. While there appears to be steady growth from 2008 to 2014, the number of employed geoscientists do not include the occupational categories of geoscience postsecondary teachers as counted by the BLS. The table shows the total numbers of employed geoscientists as calculated by AGI. Actual growth between 2012 and 2014 was approximately 2,148 geoscientists if postsecondary teachers are omitted. Using the BLS employment projections data, AGI expects an increase in the number of geoscientists employed in the U.S. to increase by 10% over the next decade.

With each new edition of the Status of Geoscience Workforce report, AGI will continue to evaluate data synthesis and analysis procedures in order to provide the geoscience community with the most accurate insight into the changing dynamics of the geoscience workforce.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Employed Geoscientists (w/o Postsecondary Teachers)</th>
<th>No. of Employed Geoscientists (w/ Postsecondary Teachers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>266,100</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>262,627</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>296,963</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>299,111</td>
<td>324,411</td>
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<tr>
<td>2024 (projected)</td>
<td>355,862</td>
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</table>

- Carolyn E. Wilson
# Registration

<table>
<thead>
<tr>
<th>NAME (Last)</th>
<th>(First)</th>
<th>(Middle Initial)</th>
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<tbody>
<tr>
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<table>
<thead>
<tr>
<th>EMPLOYER</th>
<th>NAME ON BADGE</th>
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</thead>
<tbody>
<tr>
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<table>
<thead>
<tr>
<th>ADDRESS</th>
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<table>
<thead>
<tr>
<th>PHONE</th>
<th>E-MAIL ADDRESS</th>
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<tbody>
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<table>
<thead>
<tr>
<th>SPOUSE/GUEST NAME</th>
<th>NAME ON SPOUSE/GUEST BADGE</th>
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<tbody>
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<table>
<thead>
<tr>
<th>EMERGENCY CONTACT NAME</th>
<th>EMERGENCY CONTACT PHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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## FEES AND PAYMENT INFORMATION

### ANNUAL MEETING REGISTRATION

<table>
<thead>
<tr>
<th>Registration Type</th>
<th>Amount</th>
<th>After 8/10/2016</th>
<th>Amount</th>
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<tbody>
<tr>
<td>AIPG Member Full Registration</td>
<td>$425.00</td>
<td>$525.00</td>
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<tr>
<td>Non-Member Full Registration</td>
<td>$475.00</td>
<td>$575.00</td>
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<tr>
<td>Daily Registration</td>
<td>$250.00</td>
<td>$250.00</td>
<td>$</td>
</tr>
<tr>
<td>Spouse/Guest Full Registration (Admission to Welcome Reception, Breaks, Lunches, and Exhibits)</td>
<td>$225.00</td>
<td>$225.00</td>
<td>$</td>
</tr>
<tr>
<td>Spouse/Guest Welcome Reception Registration (Admission to Welcome Reception Only)</td>
<td>$35.00</td>
<td>$35.00</td>
<td>$</td>
</tr>
<tr>
<td>Student Full Registration</td>
<td>$95.00</td>
<td>$95.00</td>
<td>$</td>
</tr>
<tr>
<td>I Would Like to Support Student Registration</td>
<td>$95.00</td>
<td>$95.00</td>
<td>$</td>
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### FIELD TRIPS (Must be Registered for the Conference)

<table>
<thead>
<tr>
<th>Field Trip</th>
<th>Amount</th>
<th>After 8/10/2016</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geologic Highlights Between Denver and Santa Fe (Sat., 9/10/16, 7:00 am, Return Weds., 9/14/16 7:30 am)</td>
<td>$125 Student / $175 Professional</td>
<td>$125 Student / $175 Professional</td>
<td>$</td>
</tr>
<tr>
<td>Valles Caldera and the Los Alamos Science Museum (Sun., 9/11/16, 8:00 am – 5:00 pm)</td>
<td>$115.00</td>
<td>$135.00</td>
<td>$</td>
</tr>
<tr>
<td>Sandia Crest (Sun., 9/11/16, 8:00 am – 5:00 pm)</td>
<td>$115.00</td>
<td>$135.00</td>
<td>$</td>
</tr>
<tr>
<td>Geology of the Galisteo Basin, New Mexico (Sun., 9/11/16, 8:00 am – 5:00 pm)</td>
<td>$115.00</td>
<td>$135.00</td>
<td>$</td>
</tr>
<tr>
<td>The High Road to Taos Pueblo (Mon., 9/12/16, 8:00 am - 5:00 pm)</td>
<td>$99.00</td>
<td>$119.00</td>
<td>$</td>
</tr>
<tr>
<td>Paleontology and Geology of Ghost Ranch (Mon., 9/12/16, 8:00 am - 5:00 pm)</td>
<td>$115.00</td>
<td>$135.00</td>
<td>$</td>
</tr>
<tr>
<td>Exploring Basin-Fill Stratigraphy and Paleodrainage Evolution of the Española Basin Half-Graben (Tues., 9/13/16, 8:00 am - 5:00 pm)</td>
<td>$115.00</td>
<td>$135.00</td>
<td>$</td>
</tr>
<tr>
<td>Pecos-Picuris Fault in Deer Creek Canyon (Tues., 9/13/16, 8:00 am - 2:00 pm)</td>
<td>$115.00</td>
<td>$135.00</td>
<td>$</td>
</tr>
</tbody>
</table>
SOCIAL EVENTS/DONATION (Must be Registered for Conference) | Amount
--- | ---
Welcome Reception (Sun., 9/11/16, 6:30 pm – 8:00 pm) □ (please check if attending) | Included with Registration

AIPG Awards and Dinner (Mon., 9/12/16, 6:30 pm – 8:30 pm)

*Please select your dinner choice:
□ Herbed Roasted Beef Tenderloin with Roasted Garlic
□ Vegetarian Piquillo Pepper Relleno with Quinoa, Raisins, and Gruyere
□ Wood Grilled Salmon with Salsa Verde

$65.00 | 

Make a Donation to the Foundation of the AIPG

$ | 

TOTAL AMOUNT DUE $ 

☐ I am a first time AIPG National Conference attendee

Full AIPG Registration Includes: Welcome Reception, Technical Sessions, Student Poster Session/Competition, Exhibits, Registration Materials, Lunches, and Breaks on Monday, and Tuesday. Breakfast is complimentary for hotel guests. If not staying at the Drury, cost for the breakfast buffet is $6.99 + tax.

Hotel Information: Drury Plaza Hotel, 828 Paseo De Peralta, Santa Fe, New Mexico, 87501, (505) 424-2175. For reservations call (800) 325-0720 and be sure to use the group code ‘AIPG or 2219892’ to receive the reduced conference rate of $139 + tax per night, which will be honored until 8/8/16.

Cancellation Policy
You must send written notification of registration cancellation by mail, email, or fax to the AIPG office. Registration cancellations received by September 1, 2016 will receive a refund of their payments minus a $35 processing fee. No refunds can be issued for cancellations after September 1, 2016 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.

Acceptance of Terms
I understand that by registering for the 2016 AIPG Conference and Exhibition, I release and agree to indemnify the American Institute of Professional Geologists (AIPG), its agents, officers, volunteers and employees from any and all liability, claims, lawsuits, damages, losses, costs and expenses of any kind which arise out of or result from my attendance at the AIPG National Conference, whether or not foreseeable, including, without limitation, personal injuries to me or my guests. I also understand that submission of this registration form gives AIPG the authority to utilize any photograph or video taken, or uploaded to the conference app, of me and/or my products, for conference related publicity (e.g., website, TPG, videos, etc.).

METHOD OF PAYMENT

TOTAL AMOUNT DUE $__________

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 ________

Print name of cardholder:________________________________________

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

____________________________________

Send completed form to:
American Institute of Professional Geologists
12000 N. Washington Street, Suite 285, Thornton, CO 80241
cld@aipg.org, fax (303) 253-9220, phone (303) 412-6265 or
Register on-line at www.aipg.org via credit card, eCheck, or PayPal
Congratulations!  
2016 AIPG Student Scholarship Winners!

The AIPG Executive Committee is pleased to announce the awardees for the 2016 Student Scholarships. AIPG has awarded fourteen scholarships this year. The AIPG William J. Siok Graduate Scholarship went to Philipp Tesch, Texas A&M University. The undergraduate recipients are Julie Driebergen, Southern Illinois University; Melissa Luna, Central Connecticut State University; Kristina Butler, University of Alaska, Anchorage; Sean Czarnecki, Angelo State University, Texas; Katelyn Brower, Everett Community College, Washington; Emilie Bowman, University of Texas; Anna Stanczyk, University of Alaska, Anchorage; Aaron Ashley, University of West Georgia; Nam Pham, University of Tulsa, Oklahoma; Wesley Weisberg, Missouri State University; Anna Schuh, University of Arizona, sponsored by the AIPG Arizona Section; Brett Flessner, Michigan State University, sponsored by the AIPG Michigan Section, and Casey Saup, Ohio State University, sponsored by the AIPG Ohio Section. Part of the scholarship application is to submit an essay titled, ‘Why I want to be a Geologist.’ Below are the essays submitted by the scholarship winners.

The scholarships are made possible by the support of the Foundation of the American Institute of Professional Geologists and the AIPG members’ voluntary contributions.

Philipp Tesch, SA-6287

Ever since I was a child, I was fascinated with dinosaurs, rocks, planets, the universe, and digging holes. At age 7, I learned the Latin names of dinosaurs, my parents read astronomy books to me and I was busy getting my clothes dirty while digging through sand on the beach or the soil in my backyard. My interest in the natural world was broad and I decided to become an astronaut. The curiosity and fascination never ceased, but over the years it became clear that being an astronaut is not the regular 8-5 job that the 7 year old me imagined.

After graduating high school, I was at the point where I seriously started to outline where I wanted my career to go. Essentially, I looked up all university majors that were offered and asked myself the following three questions: 1. What are my interests? At this point languages and archeology in addition to natural sciences. 2. Where/what are my strengths? Natural sciences and languages. 3. What career path offers exciting job opportunities and could I see myself taking this path and still be happy with it in 30 years? This one clearly went to the natural sciences. Looking at the specific class descriptions and job examples, it became obvious very fast that geology was the way to go for me.

I was always fascinated by the idea of integrating and recombining multidisciplinary knowledge in a way no one did before, tackling issues from a new perspective to come up with a solution to scientific questions. Now, I am finally in a position to do exactly this. I am a fourth-year PhD student at Texas A&M University, working in the intersection of classic field-based carbonate sedimentology, well log interpretation and 3D seismic interpretation.
single person to walk the moon who was not an airforce pilot. It was geologist Harrison Schmitt with Apollo 17 in 1972 who walked the moon and did what every geologist would have loved to do. He threw his rock hammer on the moon.

Julie Driebergen, SA-7559

Why I Want to be a Geologist: A Love Story

I saw him from across the room. I remember the excitement of our first dates in natural history museums and petrified forests. I thought about my shrine to him on my shelf, glittering to vibrant to cryptic nuggets of a world long before I was even born. He’s much older than I am but I don’t care; I longed to find out what’s beyond his exterior. I stepped towards him, anticipation for the decision I was about to make. I outstretched my arms, about to embrace what would be my everything, my forever. I held him in my arms, my future. Then I handed the bookstore cashier my credit card and bought him, my first geology textbook.

I actually came to SIU seeking a degree in zoology with a geology minor, but when I took my first geology class (Earth Through Time), I fell in love. I don’t know how it didn’t occur to me how perfect of a match we were, geology and me. I spent alternative weekends between the Field Museum of Natural History in Chicago and the Brookfield Zoo. I would spend most of my time dragging my parents through the dinosaur exhibit, knowing how to pronounce the names of dinosaurs and other fossils that other non-nerdy little kids wouldn’t be able to attempt (there’s a special place in my heart for parasaurolophus and pachycephalosaurus). I can’t help but wonder if that recrystallized apatite longed for my presence on weekends that I was at the zoo or that they would become such a huge part of me.

My parents saw the first Jurassic Park while I was in the womb, engraving the roar of a T-rex into my soul before I even saw the remains of what may have produced that sound. My parents say they had never seen such a well-behaved child when they would take me to museum exhibits (wearing my souvenir in the gift shops was another story). I became obsessed with dinosaurs after seeing the fossils and watching the Land Before Time. I watched Jurassic Park when I was quite young; my parents asked me how I felt about the lawyer meeting his end, making sure they hadn’t ruined their child’s psyche by showing a PG-13 movie to a four year old. I apparently just shrugged and said that the dinosaur had to eat. I collect(ed) rocks and dinosaur figurines everywhere I went (and currently go). I was always a science kid, watching Bill Nye and the Discovery Channel. I also went through a volcano stage as a little kid; I was probably too young to have seen Dante’s Peak at the time but it was truly mesmerizing how the earth produced such powerful forces of nature. At some point my focus switched to extant animals. Geology becoming the one that got away. My dad always thought I would be an excellent paleontologist, but supported my dream of shoveling animal feces as a zookeeper. When I told him I was going to double major with geology, his reaction wasn’t a surprised one but rather an “it’s about time” one. Don’t get me wrong, I still adore animals, hence my double major.

In fact, my fascination with ancient creatures and my future life career of being a paleontologist is homage to the ancestors of the animals to which I would have been in servitude. Learning and figuring out from what an animal descended is fascinating, and the ones we awe over today wouldn’t be awe-able had mutations had not occurred and they had not evolved. Evolution is fascinating. How geological processes preserved the carcasses of animals is fascinating. The fact that a super volcano exists in my country that could send the earth into a very cold climate and devastate a good chunk of the continent is fascinating. Based on my interests, it makes sense that geology is mon amour. But our love story didn’t start until I was 19.

I knew paleontology was a possibility, there’s no doubt I would have taken an opportunity to work with fossils in high school, but animals were my main endeavor. I thought the geology minor would satisfy my craving for rocks. I was wrong. It came naturally to me. It left me wanting more. It was the class I looked forward to the most. After a single class, I declared my double major. Geology won my heart; reunited for good. I wanted to know more about Earth’s processes. I wanted to know what made up every rock I saw. Now I consider myself more of a geologist than a zooologist. I wear my flannel and rock hammer proudly. I decorated my jeep in Jurassic Park décor (despite all of the incorrectness of the movies, there’s nothing like seeing what you love come to life on the big screen and on your car). There’s no doubt I’m a geologist. There’s no doubt I’ll be one always.

However, I have an ulterior motive. I like to dress nice to class; I can look like a “girly-girl” at times. I’ve been told in my male dominated classes that I don’t look like a geologist (like I would wear a dress while scaling a rock face to look at the varying grain sizes and depositional environments?). I want those boys to answer to me, as their boss, and my future PhD in geology. Women are a minority (although the population is growing, I’m lucky if there’s even five of us in one of my classes). I’m going to break the stereotype, and use my love to make way for the future of the field. I want to be a geologist for all the girls in the past who were told they couldn’t be one. One day I want an even split of female and male geologists.

I’m not plotting to try to skew the gender ratio curve, though. I’ve always wanted to do something with my life that made me happy. I was going to be happy interacting with animals for up to $20,000 a year. My dream job has never been about the money. Sure geologists make more, but what I want to gain is more knowledge and contribute more knowledge about prehistoric life to the masses. I want to discover a creature no one has seen before. I want to nickname it “Julie” or maybe even after my cat, and have people gaze at it in wonder, never thinking about the person who discovered it but loving what I found. I want to casually listen in on the conversations people have about it, and smile knowing that I unearthed something that caused a connection between people sharing information. Maybe a little girl or boy will look at it and feel inspired to become a paleontologist herself or himself. Maybe Jurassic World 5 will consult me on the accuracy of its dinosaurs. Maybe I can convince them to just call it Mesozoic World since that would be more accurate. Maybe my fossil won’t be famous and I’ll spend my days content, dirty, and sweaty in a tent in a field helping an actually famous geologist discover something and having a giant pile of rocks to take home for my shrine (as
I want to become a geologist because I want to motivate society to protect our planet. In order to do so, my goal is to become an environmental consultant, so that I can learn about the techniques and theories that are used to analyze and manage the effects of air, land, and water contamination. By understanding these techniques, I hope to someday teach others to carry out simple acts to prevent further damage to the environment. As I have learned over the years, it is necessary to understand the geological features of an area in order to survive. By educating people on what the environment has to offer, I hope to elicit the value of the planet that we live on and encourage others to join me in taking a step towards a sustainable future.

Kristina Butler, SA-7010

“I make my vocation my vacation” - economic geologist Joe Kurtak. Joe gave a presentation called “My life as a geologist,” to our geology club a few weeks ago. He has dedicated his career to economic geology in Alaska. Having recently retired, he ended his talk by saying, “I could never be so lucky again.” Joe is just one of the countless geologists I have encountered who cannot rave enough about the rewards of choosing a career in geology. As he reminisced on the incredible places he has traveled for research, the people he has worked with, and the rocks he has studied, I felt so fortunate that I found geology. A career in geology means I get to spend my life doing something I am passionate about. It means that working hard now will allow me to travel for research, collaborate with brilliant scientists, and some day develop a research program that provides students with the same experience I have had. I think about Joe’s talk frequently as I prepare my graduate school applications and develop my career plan.

Geology was a natural choice for me: traveling, working outdoors, making discoveries, collaboration with brilliant minds, and the integration of many scientific disciplines – these have always been career criteria for me. My parents were English teachers and my family lived all over the world while I was growing up. My upbringing gave me a love for travel, meeting new people, and introduced me to many geologic wonders across the globe. The more I learn about geology the more questions I have, the more I want to travel to new places and spend time with rocks I haven’t encountered before. All geologists seem to share this trait, and I have been so humbled by the willingness of many professional geologists to take me under their wing (and often into the field!). Through my undergraduate studies, I have discovered that my research interest lies in sedimentology and stratigraphy. Specifically, I enjoy field-based projects and unraveling how landscapes have changed through time. I feel honored every day that I get to spend my time learning about geology and excited for all the knowledge that awaits me. I am confident that geology will be a challenging and fulfilling vocation. Years from now, when I retire from a lifelong career in geology, I know I will be able to say, “I could never be so lucky again.”

Melissa Luna, SA-6422

As a child, I have always wondered how the Earth came to be the dynamic planet that it is today. After countless visits to the Philippines, I was exposed to the effects of the Samar Earthquake as well as the aftermath of the Mount Pinatubo eruption, which gave rise to my love for geology. As I came to learn over the years, our society revolves around nature. We are constantly in demand for water, energy, and other resources that all depend on geology. By studying the true nature of our planet through both my academics and my travels, I have made it my goal to make a difference by inspiring others to join me in making our planet a more sustainable environment for generations to come.

As a student, I have been intrigued by how the local geology of an area affects the lifestyle of a region. Until today, people have been affected by the forces of nature, which are all dependent on where they live. By understanding the local bedrock, tectonic behavior, and even the nature of fluvial systems, one can take advantage of what nature has to offer and develop both a productive and sustainable lifestyle. Given what I have learned about the natural features around the world, I want to educate others so that they can take advantage of the geological tools that they have at hand. Until my junior year of college, I was solely exposed to studying geology and the society through textbooks. Fortunately, in the winter of 2015, I was blessed with the opportunity to travel to a country where I was able to see at first-hand how geology shapes society.

During the winter semester of 2015, I was given the opportunity to study abroad in Taiwan through the Center of Integrative Geosciences at the University of Connecticut. In this course, we studied how various geohazards affect major cities and villages within the country. As Taiwan is one of the most tectonically active countries in the world, we learned about how skyscrapers had to be stabilized in such a way to prevent severe damage from frequent earthquakes. Also, we learned the various practices that the Taiwanese government put forth to decrease the negative effects of pollution and increase the quality of the air given the vast amount of coal-fired factories that are operating in the region. By spending a month in a country where it is absolutely necessary to understand geology in order to survive, I have made it my goal raise awareness of the importance of protecting the environment to promote both safety and sustainability in our society.
Sean Czarnecki, SA-7532

We’re headed out there. We always have been. Out over the next horizon, out over the sea, out of the atmosphere and to the moon. Now the next out there is really out there, out of Earth’s orbit. I read an article today about a new fuel-less propulsion technology being developed that could make solar system exploration economically feasible. It’s happening. Within my lifetime, I’m confident some brave soul will step foot on Mars.

But I feel that in order for humanity to spread to other planetary bodies, we must have the best available knowledge of every aspect of the worlds we visit BEFORE we visit them. The local, regional, and indeed planetary geology of a planet is probably the most important area of knowledge for an astronaut stepping foot on another planet. NASA has plans to send humans to Mars in the next few decades and I want to be a part of the important research into the surface features of Mars so that these future astronauts know exactly what to expect when they step foot on Mars. But this knowledge is not valuable just for extraterrestrial exploration, but also to give geologists a perspective on Earth systems we have never had before. The morphologies and terrains studied on another planet such as Mars could give us new insights on the structures of the Earth itself.

Participating in this type of research would fulfill a lifelong dream of mine, to have a job studying astronomical objects. My favorite aspect of astronomy was always planets. The possibilities of extraterrestrial life, the extreme surface conditions on Venus, the great variety of Jupiter’s and Saturn’s moons; these were the things I always loved to learn about. I think that sending humans to these distant shores will only refocus people here on how precious our perfect planet is, and how important it is that we respect and protect our planet so that it doesn’t become a hostile environment like the one those first explorers will have to face, out there.

Katelyn Brower, SA-7588

Without reservation, I want to be a geologist. Ever since I can remember I’ve been interested in the natural sciences, and as a homeschool student I had the freedom and good fortune to delve into any subjects that captured my interest; much of my science time was spent outdoors in a hands-on environment, on wooded acreage that was, and still is, my backyard. My favorite place is, and has always been, outside investigating everything in the natural world. So, when I started community college in the running start program, after much soul searching and deliberation that seemed to lead to nowhere specific, I took an organic approach to discover a focus of study by beginning to take various earth science classes while filling my repertoire of fundamental requirements. Much to my surprise, in my second year, I took my first geology class as part of a learning community and everything became clear. I have since been on a firm course and engaged in my education. I am working hard and am an active learner, with a true desire to learn everything I possibly can.

My enthusiasm for geology motivates me to challenge myself and look for more ways to enhance my knowledge. Difficult courses I would have otherwise been frustrated with, I consider to be the foundation for successive classes and beyond to my ultimate goal, as it should be. I will have completed a comprehensive list of pre-requisites at Everett Community College, inclusive of calculus, chemistry, engineering physics and geology series courses upon graduation in preparation for my transfer to university in the fall, all while enhancing my GPA. I also completed a GIS course recently with Western Washington University through our local Everett University Center while continuing to attend the community college. My intent is to support my geology degree, and gain marketable skills to obtain a geology-related internship or position in a research project during summers, and overall hands on experience in the world of geological work so that I can be better prepared for my career.

Likewise, I actively surround myself with like-minded individuals in the geoscience community; casually, academically and professionally. My involvement in clubs and professional organizations allow me to collaborate, learn, network, and converse about geology, mineralogy and the like, making for an enriched experience. I love to glean knowledge from those experienced in the field; they have so much to share. As a steward of the earth and in my leadership role as president of the Math, Engineering, Science, Student’s Association (Messa club), I organized a volunteer event with our local Adopt-a-Stream Foundation, where we participated in a native planting along a creek bank. Aside from feeling good about a job well done, I was pleased to see the organization incorporate education into their program. Because of this, I recently reached out to several families in the homeschool community, for which I still have a connection with through my younger sibling, to encourage their participation in one of their events. My goal is to pay it forward; to share this learning experience and the importance of conservation and environmental consciousness with younger students, and ultimately share my enthusiasm for the natural sciences by including them through hands-on exposure. I am happy to say these families have responded positively and I am in coordination with the Adopt-a-Stream Foundation to organize an event this spring.

Geology is part of who I am, it fits my personality and lifestyle. I live in the Pilchuck Valley near the foothill of Mt. Pilchuck in the Cascade Mountain Range of the Pacific Northwest. The Mountain Loop Highway, by its historical name, leads me home; it also takes me directly into the heart of the Mt. Baker-Snoqualmie National Forest where I have spent many hours and years hiking. I originally hiked with my family as a child in this history rich environment, for which I have fond memories of. As much as I am content repeating those trails, in most recent years, my hiking experiences are more challenging, and have greater educational significance. I still hike with my family for enjoyment and recreation, as this is my solace, but now I am able to discover, interpret and share my knowledge of geology with them, while getting in a little rockhounding, too.

My career choice goes beyond interest; it is my passion and encompasses everything I enjoy in life. Every experience reaffirms my decision into the intriguing world of geology. I am
fascinated by the history of the earth and I find wonder in the things it has to teach us about the past, present and future. Geology is a subject I can get excited about every day, and it satisfies my curiosity, much like that of how I felt back in the day in my own backyard as a homeschooler.

It is with great anticipation that I advance my education to the university level. I am excited to begin a comprehensive geology program, where I will be learning side by side with others who share my passion for geology. Much of my educational experience thus far has placed me in a position of the unique, differentiating me from the sea of engineers that question, “You need physics to study rocks?” It would seem that my colleagues perceive geology, as a mathless, physicsless and scienceless field, for which I scoff at the insinuation. They soon discover I don’t just stand around gazing at rocks.

Honestly, I can’t wait to get into the field and apply what I learn in the classroom to real applications. I am steadfast and confident in my decision to be a geologist. I look forward to serving my beautiful home and community in the Pacific Northwest as an Environmental Geologist, protecting our natural resources.

Thank you AIPG, for supporting education and for the encouragement you are providing future geologists like me.

Emilie Bowman, SA-6120

I abhorred geology as a child. That is to be expected, however, if your geologist father makes you go mountain climbing for fun (when all I wanted to do was write). I grew up in Scotland, the birthplace of modern geology, so tall mountains and metamorphic rocks were not hard to come by, nor were father-led geological field trips. The rebellious child I was, I quickly learned to ignore conversations focused on turbidite formation or the progradation of the shoreline. When we moved to Houston, Texas, however, this was no longer a problem. There are few geological beauties around Houston; one must drive hundreds of miles for topography. But I didn’t care – I wanted to be a creative writer. On a drive to Kansas City, Missouri during my senior year of high school, my family and I took a detour to Mt. Magazine, the tallest point in Arkansas. On the top of the mountain, my father explained how synclines formed the mountain ridges and anticlines occupied the adjacent valleys. To my surprise, I found what my dad was saying intensely interesting. Thus, I decided to check geology on all of my college applications. I have absolutely no regrets.

Geology, in my opinion, is the most artistic science. The inside of most field notebooks I’ve seen look like Frederic Edwin Church landscapes. What attracts me, however, are the similarities between geology and creative writing. As a geologist, I am able to contribute to a story that is 4.56 billion years old. I realized that my calling as a geologist is to prevent disasters from stealing lives. I recognize that this work will likely come quickly unravel into natural disasters which devastate communities and lives. I aim to contribute to the reduction of these negative impacts by becoming an expert in landslide characterization and risk assessment.

This specific purpose blossomed following my decision to produce an undergraduate thesis. One of my first steps in conducting research on landslides was to read the Geotechnical Extreme Events Reconnaissance (GEER) Report regarding the 2014 Oso landslide1. The document is as equally fascinating as it is gut wrenching. One simply cannot believe that a neighborhood was allowed to exist at the foot of such a historically active scarp. The catastrophic slide was never an “if,” it was only a matter of “when.” As this reality resonated within me, I realized that my calling as a geologist is to prevent disasters from stealing lives. I recognize that this work will likely come with additional heartache and frustration, but I believe the difficulty of my life experiences has prepared me for that possibility. It is also this risk of anguish which provides motivation to produce accurate, thorough work in the realm of geohazards.

While landslides may be only one of many geohazards that pose a threat to modern civilization, I am of the opinion that they are underrepresented in our national assessment of natural threats. At present, the United States has no national or state guidelines of risk due to natural landslides despite the fact that such strategies are established in other developed countries including Australia and Japan. Also, if the United States still tarries in promoting mass wasting valuations, envisage the devastation that occurs in under-developed

Anna Stanczyk, SA-6099

When you hear someone describe their professional role as “helping others,” you likely picture a nurse, a humanitarian aid, or perhaps a psychologist. This phrase is not typically assigned to those in the field of earth sciences. Yet this short formulation embodies a significant piece of my motivation for becoming a geologist. In our current Anthropocene epoch of widespread human habitation, natural hazards quickly unravel into natural disasters which devastate communities and lives. I aim to contribute to the reduction of these negative impacts by becoming an expert in landslide characterization and risk assessment.

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Starting in college, I could only imagine science as separate fields. But when only one area is taught in each class, who wouldn’t? Biology grew on my curiosity exclusively in Biology class, physics attracted my mathematical side solely in Physics class, and chemistry bonded to my intrigue only in Chemistry class. The segregation left little room for intermingling. I’ve always enjoyed a bit of everything, which was frustrating when I had to pick one for a career. But, after three semesters, I finally discovered the answer in Geology 1121. What I found was a world of connections. Biology survived to help in relative dating and rock correlation through fossils and paleontology. Physics shed light on areas of hydrogeology, engineering, and structural geology. And chemistry? My reaction to its common application in geology was of joy. Geology is clearly not as separate as the others appeared to be. I’ve relished that interdisciplinary trait from the beginning, and I knew I wanted to do more with geology.

As I progressed through my courses, I enjoyed all of my classes, but especially those in geochemistry, petrology, structure, and engineering geology. I strove to get more experience in those areas, taking on teacher’s assistant (TA) positions in similar classes, where I helped the professors teach new students. In fact, I managed to take on two upper level TA positions last fall in Optical Mineralogy and in Field Methods. What had been a learning process now became a teaching one, one which I found surprisingly enjoyable. What had been interesting and new to learn became exciting to share. It still wasn’t enough, though; I needed to do more. So I took on two research projects. For the first, my advisor, Dr. Chowns, and I have been analyzing oolitic ironstones with a scanning electron microscope to better understand their clay-mineralogy. Their strange formation has provided quite the challenge to decipher for researchers, given that there’s no modern analogue. Many days have been spent with a furrowed brow, as I spoke with, well really mostly listened to, Dr. Chowns on the subject. For the second project, my other advisor, Dr. Berg, and I have started investigating a very curious suite of metagabbroic bodies in Central Georgia. I still feel the kink in my neck from that field day, as my head switched from petrologist to field geologist and back again as two excited and intrigued professors discussed the possibilities. Two vastly different projects, but both are surprisingly complex challenges, even for the professors. I can’t help but think of the satisfaction of determining the answers. But I need to learn more to be able to explore geology’s complexities, as even the experts have trouble. I know I need to continue into graduate school, and keep furrowing my brow in thought, as I take the steps to becoming a geologist.

Rocks. That’s what a geologist mainly looks at, right? That’s what the world seems to think. But it’s so much more than that. I feel that I can go anywhere with those rocks, into petrology, geochemistry, structure, engineering, and more. They hold secrets directly beneficial to society. The rocks hold resources we need, whether it’s silicon for computer chips, iron for steel, petroleum for cars, or even the radioactive material for our nuclear reactors. Physicists can’t take all the credit; someone needs to find their most important ingredient. Geologists can help fuel the world’s growth and development by studying the rocks. By studying geology, I can help partake in that, and power us to a better society. Geologists can also save the world. By learning Earth and her processes, geologists can better determine and predict potentially harmful problems. Studies into events like debris flows, earthquakes, water contamination, and others are studied in geology every day. Even coral reef declines are connected to geology, as paleontology ties past and present together from the rocks and present ecology. These studies give us a way to better repair environments we’ve hurt, and require a special connection only geology provides. By mixing biology, physics, and chemistry, and by looking at the rocks, whether it’s through structural, geochemical, or paleontological lenses, geologists can work towards a better future. This is why I want to be a geologist.
The most important turning point in my life to decide to be a geophysicist was when I got a four-year scholarship from PetroVietnam to study Geophysics at the University of Tulsa. PetroVietnam is the largest oil company in Vietnam; and they chose people from thousands of high school students to study in the United States in order to create an important working generation in the future. My father also works for PetroVietnam and he told me a lot about what it is like in the oil industry. My father’s boss is a geophysicist and he also told me who the geophysicists are. I started to have a big view about petroleum geophysicists but at this point, I cannot imagine that I would become a geophysicist in the future. PetroVietnam chose Geophysics as my major in the United States. This was the time when geophysics and I first met. I went to the University of Tulsa and took “Intro to Geoscience” class as my first major class. We heard a lot of professors in the Geoscience department talking about their interested fields such as Structural Geology, Earthquakes, Geochemistry, Environment, and Geophysics. I was interested in the presentations of two Geophysics professors, especially when they taught about the relationship between Geophysics, Math, and Physics. Because my base is a general-science student, I felt excited when hearing about wave equation, magnetic and gravity methods. This was when I decided to go into Geophysics. Even though I am just a sophomore, I took many Geology and Geophysics courses. I am taking Well-logging and Applied Geophysics now and these things are really intriguing to me. I also have a research project about using 3D seismic well log data to create a scientific output data of Teapot Dome in Wyoming.

I always believe that jobs choose people, and not people choose jobs and it is correct in my situation. My ambition in Petroleum Geophysics seems to start late but it is not a problem. There are many decisions in my life but until now, the decision of accepting PetroVietnam scholarship and study to become a Petroleum Geophysicist is the best decision. Becoming a good Petroleum Geophysicist will be a goal I will achieve in the future.

Wesley Weisberg, SA-6921

My father, who has always been fascinated by the amazing perplexities of our Earth, sparked my passion for geology at a young age. In my youth I had the heart of a geologist. I would gather rocks for my rock collection and attempt to unearth dinosaur bones at the local playground. At eighteen, my adventurous spirit led me to joined the United States Navy where I traveled all over the world as a Naval Aircrewman aboard the P-3 Orion aircraft. My mission was to conduct oceanographic acoustic analysis of submarines and aerial surveillance using advanced imaging systems. I thoroughly enjoyed my time in service and my job, but I felt my life was leading me in a different direction. I served the Navy for 8 years when I realized acoustic warfare was not my passion and that I wanted to pursue a career that I loved.

In the spring of 2012 I decided to leave the Navy, a decision that changed my life. At that time, I was still unsure of what career path I should choose.

“What do I want to do when I grow up?” I asked myself.

My skills as an acoustic analyst, I thought, could not transfer to a civilian job and I felt stuck. That’s when I decided to scan through every taxable career available in the Bureau of Labor Statistics Occupational Outlook Handbook and noted jobs that seemed appealing. After researching professions, I narrowed down my list to engineering, the sciences (particularly Earth sciences), and historian. In retrospect, I am grateful I did not choose engineering, physics II circuits answered that question, and finding work as a historian seem very narrow. It wasn’t until I explored positions offered in the geosciences that I grasped the many career opportunities and pathways available to aspiring geologists. It occurred to me that my training from the Navy could cross over too. As an acoustic specialist, I would collect my data in the field, analyze, and report my findings; exactly what a scientist does. Secondly, I was excited that this was a path I had always dreamed of following but for some reason thought unattainable. This gave me inspiration and hope that there was life after the military.

There were other motivations for my deciding to pursue a career outside of the military. First I want to say, the military is an excellent career but some service members can be close-minded about the prospect of moving on from the armed forces before the standard “twenty-years-service.” Particular individuals I worked with believed there was no life outside of the military. They tried to discourage people who wanted to move on to a different career outside the service. A few of my superiors, some of my peers, and even family members have said to me that I would most likely fail if I left the Navy. My mother-in-law even told me “geology is a dead science and that we already know everything we need to know about the Earth.” This kind of uninformed negativism sparked additional motivation within myself to achieve my dreams, prove them wrong, and share the amazing opportunities available within the geosciences.

Today, I am living my dream. I have worked hard to achieve my goals including; acceptance to a very competitive internship, developed relationships with individuals in industry through the GSA/ExxonMobil Bighorn Basin Field award, presented my research at various professional meetings, and took initiative at my university as president of our AAPG chapter. My successes have paved a bright future for my family and me in the geosciences and are a testament to my enjoyment for the field that I am in. The steadfast support from my wife and daughter has been my foundation, she is my rock and I could not do it with out her. I still cannot believe that someday I will be getting paid to do what I love. I am a firm believer if you do what you love you never work a day in your life.

Anna Schuh, SA-7590

Curiosity killed the Cat – but not the Geologist!

I want to become a geologist because I am curious. I am curious for the unknown and undiscovered. The travel bug bit me at a young age and I have been happily infected ever since. However, I do not just want to see the world, I want to understand it.
I am excited to learn about something that is far bigger than humans – bigger than humanity itself; something that has been going on for billions of years – a time range hardly fathomable. What fascinates me the most is the idea that geologic processes do not just pertain to our planet, but that other planets' geology can be inferred from mineralogical data, such as provided by the Mars Rover – Curiosity!

During my freshman year at the University of Arizona, I almost switched my major. I had chosen geology because I grew up with it – both my parents are geologists. But did I really know that this was what I wanted to do for the rest of my life? I met great individuals, hungry for knowledge and beaming with excitement. I did not share their enthusiasm. What I was missing was my niche.

I found it in mineralogy, specifically planetary mineralogy. After taking mineralogy – the same semester I was already in the process of switching my major to linguistics – I started working in the University of Arizona’s Mineralogy and Crystallography laboratory. This is where I was first exposed to the Nasa Mars Project. Fascinated and excited, I realized this was my true passion. My curiosity was awoken.

Curiosity can be found in many places and the possible scope of curiosity is endless. Curiosity not only leads us to travel to different countries, but truly from the smallest particles of our own body to the outermost edges of the cosmos. Curiosity is the force against inertia. With it, we dive into literature, travel through history, and experience art, math, and science. Awoken from disinterest and apathy, curiosity is what motivates us to follow our dreams and pursue our goals. It is not curiosity that will kill you, but its absence.

Brett Flessner, SA-7507

The Slow Moving Process that Is Geology

Ask me 10 years ago what geology was and ten year old me would have most likely described the clear smooth crystals my brothers and I once spent summer vacations to the beach collecting. We would search for hours, and compare our hauls at the end like miniature prospectors, fighting over the smoothest, or shiniest specimens. Little did I know at the time what I was dutifully collecting was Quartz, the most common mineral in the world. That knowledge would probably have diminished my enthusiasm at least a bit, with the realization that these gemstones (priceless jewels to me at the time) were just about as easy to find as any of the other stones laying on the beach. While I certainly was interested in the cool-looking minerals I collected at the time, my interest in geology didn’t really extend past filling a bottle or two with my favorite rocks, and forgetting about them once the summer concluded and the camping trip came to an end.

Ask me 5 years ago what geology was and I would have answered that geology was just one of those stupid classes in high school that we would never use again in ‘real-life.’ At that point in my life, my future plans were to have a positive impact on the world. I was going to be a doctor, a brain surgeon. I was going to be a big deal. For me, and just as it is for others, geology wasn’t even on the radar. Who wants to look at rocks all day anyway? I’d been to the Pictured Rocks in the Upper Peninsula of Michigan. “Sure they look nice,” I remember thinking, as we toured the Lakeshore by pontoon, “but they are just Rocks! They aren’t going anywhere, what’s the point?” I didn’t realize at that time, but the point of looking at rocks would become clear to me one day, no matter how long it took.

The summer after I graduated high school I (astoundingly) decided to study geology on a whim, more due to the fact that I had no idea what I wanted to be, than anything else. Had someone told younger me that I would be that nerd that admits to “liking rocks,” I would have laughed and denied. When I would be asked what my major was for my first few years at college I would preface with “It’s geology, but I don’t actually like rocks that much, I just wanted to be able to go outside sometimes.”

As I sat there, and spent my days looking at the infamous rocks, something grew on me. Not only did I amazingly come to like looking at the rocks, to the point where I now spend countless hours a week looking at assorted lavas from Ethiopia for various research projects, but I also began to realize that perhaps I COULD have an impact on the world in geology. At least locally, I saw that geologists do exist, and that the work they do not only lets us understand our world better (in terms of my professors), but also help to preserve our environment, and protect people.

Ask me today what geology is, and I would still not have a perfect answer. I was afforded the great opportunity to begin work at an environmental remediation firm in my area this past summer. This experience has truly revealed to me the impact geologists have in the world, and specifically my world. Up to this point in my fledgling career as a geologist I have already been involved in remediating the groundwater at multiple sites in areas very near my hometown. Without this fleet of professional geologists and their ability to analyze and take action in the environment we know and use, the environment itself would be in graver danger than it already is. If you asked me now, I would say being a geologist extends beyond the cool rocks we get to look at, and that it is the opportunity to better our communities in unseen ways, and is incalculably important, the field of geology, no matter how long it took me to come to that realization.

Casey Saup, SA-4945

Although I have always been a naturally curious person, I have sometimes been discouraged from pursuing a higher education due to my then-undiagnosed learning disability—attention deficit disorder. Fortunately, my father, who has the same learning disability, helped me greatly by providing me with the individual scholastic attention I needed and gave me constant encouragement when it came to my unique learning interests, despite the fact that the vast majority of my family never went to college. It was through this nurturing that I was able to discover a love of science and frequent trips to the Orton Hall Geology Museum at The Ohio State University fostered a great interest in geology.
This interest in geology quickly blossomed into a passion and an ever-expanding rock and mineral collection. As I grew older, I began to realize that geology was a viable career option for me, and when I enrolled at The Ohio State University, I declared my major in geological sciences. One of my favorite things about geological sciences that I discovered in my undergraduate career is that understanding geological systems allows for the incorporation of both history and science, and in order to fully comprehend geologic concepts you have to fit these two seemingly unrelated professions together to complete a puzzle. The various courses I took as an undergraduate at OSU also introduced me to the idea that geology is a hard science that can help solve real-world issues, but it doesn’t come with the constraints that a lot of other fields have; it allows you to travel and work in the great outdoors. Through encouragement from my undergraduate advisor, I sought out an undergraduate research project, which opened my eyes to the various career paths within the earth sciences.

My 3-year stint as an undergraduate researcher in a stable isotope biogeochemistry lab gave me an appreciation for two things; 1) that solving geological problems often involves other disciplines, and solving problems in other disciplines often requires geological concepts, and 2) the most amazing part of research is being able to teach and reach out to others with my own results and firsthand knowledge. The interdisciplinary possibilities in geology fascinate me and drew me in to the point where I wanted to pursue a Ph.D. in the young and growing field of geomicrobiology. With my degree, I hope to work on issues and solve problems that will allow me to help people—particularly as a geologist in academia or at a federal agency as a researcher studying either biogeochemical cycling or bioremediation. In addition to having long-term goals as a researcher, I also want to be able to teach others. One of the most fulfilling things I have been able to do in my time as both an undergraduate student and a graduate student has been teaching in both a university classroom setting and in a volunteer setting. I love being able to get other people excited about science and the world around them, and geology has something for everyone. Although I feel that I will be able to greatly contribute to the field of geological sciences, and I find it enormously enjoyable and fulfilling, the main reasons that I want to be a geologist are to be able to help and inspire curiosity in others.
May 7, 2016

I greatly enjoy Robert Font’s, CPG-03953, “Test Your Knowledge” piece in the TPG magazine. In the current issue, question #4 asks us to determine the value of a very nice-sized gold nugget. As a gold geologist, this was right up my alley. Not being familiar with the unit “slugs,” I set about calculating the value differently, and came out with a different answer. In the published calculations, the factor of 16 ounces per pound was used, however, those are avoirdupois ounces. Gold is sold in troy ounces, and there are only 14.5833 per pound. The following are my calculations:

First, I converted the volume of gold to cubic centimeters: 

\[(2.54 \text{ cm/inch})^3 = 16.387064 \text{ cm}^3/\text{inch}^3 \times 3 \text{ inch}^3 = 49.161192 \text{ cm}^3\]

Next, I multiplied by gold’s density (19.3 g/cm³) to get the grams of gold:

\[49.161192 \text{ cm}^3 \times 19.3 \text{ g/cm}^3 = 948.81 \text{ g Au}\]

Next, I converted the mass to troy ounces: 

\[948.81 \text{ g Au}/31.1034768 \text{ g/troy oz} = 30.50498 \text{ troy oz Au}\]

Then I multiplied by the price of gold per troy ounce to determine the value: 

\[30.50498 \text{ troy oz} \times \$1100/\text{troy oz} = \$33,555.48\]

A very nice nugget indeed!

Edward E. Gates
CPG-10902
Geologist

Laura Scheid to Lead Minneapolis Environment Office at WSP|Parsons Brinckerhoff

April 29, 2016, Minneapolis, MN — Laura Scheid, MEM-0834, will manage the Minneapolis environment office of WSP|Parsons Brinckerhoff, a global engineering and professional services firm, as the new general manager.

Ms. Scheid will direct the Minneapolis environment team, which provides services in such areas as environmental investigation, remediation, compliance and due-diligence.

Ms. Scheid has nearly 19 years of experience in geology, hydrogeology, environmental geology and geophysics. At WSP|Parsons Brinckerhoff, she has managed petroleum and chlorinated solvent investigations, developing cost effective, environmentally sound and risk-based remedial strategies, achieving regulatory closure and reducing client’s environmental liabilities and most recently served as a senior technical manager.

A certified professional geologist in Minnesota, Indiana, Kansas, Wisconsin and Wyoming, Ms. Scheid received an MS degree in geology from Wright State University and a BS in geology from the State University of New York College at Fredonia. She is a member of Minnesota Groundwater Association and the American Institute of Professional Geologists, serving on the Executive Committee for the local Minneapolis chapter.

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2015 has not been a good year for Rare Earth miners. The market has declined significantly and that has had a disastrous effect on some producers.

In the early part of this century, new applications were being recognized weekly for the rare earth minerals. More correctly considered the elements of the Lanthanide Series, the Rare Earth Elements (REE) include elements #59 through 71 – Lanthanum through Lutetium. (Scandium and Yttrium are commonly included as REE because of their similar properties.) The Lanthanides are used throughout modern technology – from the defense and electronics industries, medical and communications, and industrial fields. Their new-found applications in alternative energy (especially in permanent magnets in wind turbines) turned up the publicity.

People were becoming aware of the utility of the REE just as the Chinese government precipitated a speculative cascade. In 2009 China imposed export restrictions on REE. As a result of earlier geopolitical developments, China was producing 97% of the world supply at the time. Just then, a territorial dispute with Japan in the South China Sea caused exports to be further restricted. Prices rose to new levels. New mining properties were identified; the dust was blown off old properties; busloads of companies rushed to enter the Rare Earth business.

One of the most active companies was Molycorp of Denver. Once the world’s leading producer of REE, Molycorp leverages their experience and existing position to expand aggressively in the rare earth market. They began to upgrade and expand their Mountain Pass Mine in California and purchased several other companies around the world involved in the business. This aggressiveness proved to be poorly timed.

Across the world, the price increases led to a stampede of speculative buying, which led to higher prices … and so on and so on. Smuggling and illegal production in China helped add to supply. (It was estimated that as much as 40,000 tonnes of rare earths were smuggled in a year). A supply glut ensued.

On top of this, a ruling by the World Trade Organization early this year pushed China to eliminate their export tariffs. And there went the market. As an example, cerium had reached a price of $150/kg FOB China in 2011. In July of 2015 the price had dropped to $1.95/kg (FOB China). Some of the demand decay was caused by industries using substitutes or by recycling. Whatever the reasons, the price decline has had serious impact on producers.

Molycorp declared Chapter 11 bankruptcy on June 25 this year. The stock of big miners dropped 95% from the peak. The China Daily reported that most producers in China are now operating at a loss.

Some light can be seen at the other end. The supply glut is slowly being eaten up. Among the lanthanides, the heavier elements have no known substitutes, so prices for those elements have remained stronger and will rebound more quickly. As always in mining, the weaker producers will fall by the wayside. When demand rebounds, more options should exist for supply.

References

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Cecelia Jasamie, August 12, 2015. Most Chinese RE Miners Running at a Loss, Mining.com
Mark Jaffe, July 5, 2015. Rare Earths Just Not Rare Enough, Denver Post.
Abstract

This study is primarily based on information obtained during hydrogeological investigations of the strata under the Fresh Kills Landfill and the adjacent Brookfield Avenue Landfill in Staten Island, New York. The intent of this study was to create detailed descriptions of the sedimentology and stratigraphy of the Upper Cretaceous strata. Sediment cores were recovered to bedrock with the lithology and other sedimentologic features described for each soil core. The formations represent distributary channel sands, levees, crevasse splay sediments, marshes and upland swamps within floodplains, interdistributary bay deposits, the proximal marine environment and prodeltaic silts and clays. Pollen also was analyzed in order to correlate the strata within the study area. The majority of the pollen represented palynozones II, IIA, IIB and IIC, which is characteristic of the Lower Cretaceous Patapsco Formation. Pollen from palynozones III and IV was present only in a small number of samples found throughout the strata. These results suggest that the sediments under the study area are older than the Lloyd Sand and the Raritan Clay; however, the sedimentology and stratigraphic relationships of the beds and the information from the sediment cores, considered with the cross sections and the descriptions of the two formations have allowed the author to interpret that the Lloyd Sand and the Raritan Clay are present. This allows for the correlation of the formations under the study area with the Raritan Formation in eastern New Jersey, and Brooklyn, Queens, and Long Island, New York.

Methods Of Study

Soil cores from borings installed within the footprint and along the perimeter of each landfill (Figure 2) were examined by the author. Additionally for this study, the author also reviewed and used information from boring logs contained in the Wehran reports (1983a, 1983b and 1988), the IT Corp. hydrogeological investigation report (1993) and the Brookfield Avenue hydrogeological investigation report (Camp Dresser and McKee, 1998). Daniel C. Walsh also examined the D, B and BR series of logs.
Each sample was examined for lithologic class, grain size or grain size range, bedding, color or mottling, the presence of conchoidal fracturing, the presence of concretions, occurrence of fossils, silt and clay content, stiffness, field dilatancy, relative soil density, field plasticity and estimated hydraulic conductivity.

Global Geologic Setting
Deposition of the Raritan Formation took place during the first of two regional transgressions that occurred throughout New Jersey and along much of the east coast of the United States. The transgression began during the Late Cenomanian Stage and ended during the Early Turonian Stage. This event was part of a worldwide transgression that began during Albian time and ended during the Turonian (Olsson et al., 1988).

Local Geologic Setting
The Upper Cretaceous strata lie at the top of the northern limb of the Raritan Embayment where it meets the Long Island Platform and dips to the southeast (Zapecza, 1989). Sugarman (email communication, 2014) stated that the regional dip of the Atlantic Coastal Plain was no more than 0.50° southeast; however, a dip of 0.11 to 0.65° (1.9 to 11.4 meters/kilometer or 10 to 60 feet/mile) for the Atlantic Coastal Plain was determined by Zapecza (1989). Correlation of the beds below the study area indicate that the strata dip from 0.46 to 0.92°.

The Upper Cretaceous strata under the study area are contiguous with strata of the same age that are present throughout southern and eastern Staten Island. In the study area, the Upper Cretaceous strata consist of, in ascending order, the Lloyd Sand and the Raritan Clay of the Raritan Formation (table below). Upper Cretaceous sediments overlie weathered bedrock and residuum of a variety of pre-Cretaceous metamorphic and sedimentary rocks. The strata are overlain by Pleistocene glacial sediments, which are overlain by Recent marsh sediments and municipal solid waste. South of the study area, the Raritan Formation contacts the Upper Cretaceous Magothy Formation (Lytte and Epstein, 1987).

The northern limit of the Cretaceous sediments is defined by a buried glacial erosional feature which the author has named the “Toe of the Buried Escarpment.” The location of the escarpment is represented by the thin gray line in Figure 2 that starts above boring IT-001, continues to borings IT-308 and IT-801, and ends above boring D16. Despite glacial erosion, the Upper Cretaceous sediments thicken significantly to the south and are from 40 meters to more than 50 meters thick.

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<th>Series</th>
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plant fragments. Bedding is not visible in the sediment samples, and cementation is absent. Sediment samples demonstrate that the base of the Lloyd Sand is unconformable with the weathered bedrock and the bedrock. The fine sand layers at the top of the formation grade quickly into the Raritan Clay.

At the locations of borings XB-2 and IT-045D (Figure 2), 21m-thick distributary channel sands are present which grade upward from a very coarse conglomeratic sand to predominantly very fine to fine sand. The Lloyd Sand in the study area has been interpreted by the author as having been deposited as point bars in distributary channels and meander belts in a deltaic environment.

**Raritan Clay - Lower Unit**

The typical thickness of the lower unit of the Raritan Clay in the study area ranges from 0 to 13.8 m (Figures 3 and 4). The formation is predominantly light to olive gray with moderate red-brown motting. The motting varies from irregular ovals several millimeters in length to streaks slightly longer than one centimeter. In the Raritan, NJ area to the southwest, the red-brown motting is visible in the sidewalls of the clay pits and is only present where the clay is directly overlain by a thin ironstone layer. The clay is dense to very dense and becomes dry at depth. The sediment samples are very thinly bedded and plasticity for the unit is generally high.

As represented by the filled black circles in Figures 3 and 4, river channel sands are incised into the clay from locations IT-305 to D12 and from IT-044I to IT-005. The thickness of the distributary channel sands averages 13.5 m, but reaches 14.5 m thick at GW-29 (Figure 3). At locations IT-511 and IT-044I (Figure 2) the lower clay unit has been interpreted as residing in a slumped river channel. The slumped sediments may have originated as the result of sediment consolidation landslides, glacioisostatic deformation, or possibly due to an episode of seismic activity.

**Raritan Clay - Upper Unit**

Figure 3 depicts that the upper unit is complexly interbedded with the lower unit under the Fresh Kills Landfill, and is 0-14.1 m thick, varying in color from olive gray to olive black. Bedding is very thin and silt content is moderate to high, with very fine to fine sand present in pockets and as laminae. Mica is uncommon to common, plant fragments are absent to common, and iron sulfide nodules are occasionally present. The sediment samples are stiff and dense, plasticity is slight to moderate and dilatancy is slight to moderate when moist, though moisture content is generally low. Lignite laminae from less than one millimeter to a few millimeters thick and lignite interbeds are common at various locations. Sulfurous odors are apparent with freshly opened soil cores. Thin interbedded layers of sand with very fine to fine sand grains are present in the upper unit from IT-307 to GW-29 (Figure 3) and a thicker lenticular body of sand is present at the location of boring O-20.

The depositional environment for the entire Raritan Clay within the study area has been interpreted by the author as either the interdistributary bay or an upland restricted deltaic environment such as a floodplain containing swamps or marshes.

![Figure 3. Lloyd Sand and Raritan Clay](image-url)
Baskerville (1965) analyzed pollen in the Upper Cretaceous strata under the Fresh Kills Landfill. He identified pollen from palynozones IV to VII in samples of Upper Cretaceous sediments from under southwestern Staten Island. However, his study also identified Early Cretaceous pollen from zones II-B and II-C in the same sediments (table to right). The consultants collected sediment samples for pollen analysis during the Fresh Kills investigation to help define the interbedding between the sand and clay layers and, thereby, the hydraulic connections (IT Corp., 1993).

Ninety eight samples were collected from 38 borings, mostly from the IT series of borings. Palynozones II, IIA, IIB and IIC were assigned to 74 samples (IT Corp. 1993). Some of these results are depicted in Figures 3 and 4. These earlier palynozones were associated in New Jersey with the Lower Cretaceous Potomac Group (Brenner, 1963). Nine sediment samples contained pollen assemblages that represented palynozones III. Six sediment samples contained pollen assemblages that represented palynozone IV.

During previous studies, palynozone III pollen was found to be present in the Farrington Sand (NJ) and the Lloyd Sand (Long Island, NY) and palynozone IV pollen was found to be present in the Woodbridge Clay (NJ) and the Raritan Clay (Long Island), (Sirkin, 1974 and 1986). These formations were dated as the Cenomanian Stage of the Upper Cretaceous (Sirkin, 1974 and 1986). Additionally, six samples were determined by Sirkin to contain pollen assemblages representing palynozones V to VII. These palynozones typically occurred in the Upper Cretaceous Magothy Formation, which contacts the top of the Raritan Formation in New Jersey and Long Island (Wolfe and Pakiser, 1971; Christopher, 1979; Sirkin, 1986; Sugarman, 1996).

Sirkin and Brenner both were provided pollen samples from a select set of 12 other borings within the study area. Analyses

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### Table 2. Lower and Upper Cretaceous palynozones from Maryland to New York State (constructed from information in Brenner, 1963; Doyle, 1969; Wolfe and Pakiser, 1971; Wolfe et al., 1975; Christopher, 1977; Doyle and Robbins, 1977; Owens et al., 1977; Sirkin, 1974 and 1986; Jengo, 1995 and 2011).

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**Figure 4. Lloyd Sand and Raritan Clay**

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**Table 2. Lower and Upper Cretaceous palynozones from Maryland to New York State (constructed from information in Brenner, 1963; Doyle, 1969; Wolfe and Pakiser, 1971; Wolfe et al., 1975; Christopher, 1977; Doyle and Robbins, 1977; Owens et al., 1977; Sirkin, 1974 and 1986; Jengo, 1995 and 2011).**
made using these samples which contained larger quantities of pollen led to an agreement between them that pollen representing palynozone III (a continental to marine transitional period) and palynozone IV were present. Based on this, the Cretaceous strata under the study area were confirmed as Upper Cretaceous in age (IT Corp., 1993).

In addition, Sirkin found pollen representing palynozoones II, IIB, IIC, V and VII in sediment samples from borings installed to the north of the study area and in samples from borings IT-011 and D12 (IT Corp., 1993). However, the author examined these sediment samples and determined that the sediments all were Pleistocene glacial till and glacial sand. This finding suggests that sediment from the study area which had once comprised the Magothy Formation had been mixed with the glacial sediments.

Discussion

Sirkin (1986) determined that the Raritan Formation of New Jersey contained palynozone IV pollen based upon his identification of the Cenomanian Stage indicator Complexipollis-Atlantopolis assemblage. Additionally, Sirkin (1986) determined that the oldest pollen in the Raritan Formation under Long Island, New York belonged to palynozone IV. Other authors attributed the abundance and depth of occurrence of the Lower Cretaceous palynozone II, IIA, IIB and IIC pollen to downwarping of the Raritan Embayment. These authors also interpreted the presence of the palynozone II pollen as representing the updip onlap of the Patapsco Formation in the area of Staten Island (IT Corp., 1993). In contrast, this investigation does not evidence that the Albian Stage Patapsco Formation is present under the study area.

Considering the above, the Cretaceous sediments under the study area could be Cenomanian in age due to the presence of palynozone III and IV pollen. One also could interpret that the deposition of the Raritan Formation in the study area started earlier than on the Long Island Platform, making the formation time-transgressive.

Conclusion

IT Corp. et al., 1993, stated that the strata under the study represented the Lower Cretaceous Patapsco Formation based on the dominance of Lower Cretaceous pollen. The sedimentology and stratigraphy of the Patapsco Formation differs from that of the Cretaceous sediments under the study area. The Patapsco Formation is described as comprising interlensing sands, silts and clays. The clay is thick and massive with laminated silt-clay successions and thinly interbedded fine sand and silty clays. Fine to medium sands predominate. Coarse grained sediments with gravel and coarse sands are less common (Brenner, 1963; Glaser, 1969). However, Owens and Sohl (1969), Soren (1988), IT Corp (1993), Jengo (1995 and 2011) and Sugarman (1996), state that the Farrington Sand and the Lloyd Sand consist of fine to medium sand, with layers of coarse sand with gravel, and fines upward. They also state that the Woodbridge Clay and the Raritan Clay consist of a lower light gray unit with dense refractory clay at the bottom which is overlain by a dark gray unit consisting of very thinly bedded micaceous clay with thin layers of very fine sand. This author has determined from examining the sediment cores that the Lloyd Sand exists under the study area as a discrete thick layer of primarily very fine to very coarse sand with layers of gravelly sand. Also evident is that the Lloyd Sand is directly overlain by the Raritan Clay which contains a lower light gray, dense, refractory clay unit and an upper dark gray, micaceous, very thinly bedded clayey silt unit (Figures 3 and 4).

The information gained from the Fresh Kills Landfill and Brookfield Landfill hydrogeological investigations suggests that a division of the Upper Cretaceous sediments under the study area into the Lloyd Sand and the Raritan Clay is reasonable. These formational designations were made based upon the sedimentology of each unit, the stratigraphic interrelationships, and similar manners of deposition to the Farrington Sand and Woodbridge Clay of New Jersey. Considering all of the information that had been generated by the study, the author interprets the areas from eastern New Jersey to Staten Island and Long Island as consisting of one contiguous depositional region.

References


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Acknowledgments

The information in this paper was produced as a result of geological oversight performed by the author, Carlos Velases and Laura Whitaker (both formerly of the NYSDEC), and Daniel C. Walsh, Ph.D. (Director, Office of Environmental Remediation, New York City). The figures were drafted by Paul Varano. The author greatly appreciates the editing by Robert A. Stewart, Ph.D., CPG, John L. Berry, CPG, and Edward Baltzer, CPG, which strengthened and improved the paper. The author also thanks Peter Sugarman, Ph.D. and Scott Stanford, Ph.D. for reviewing the manuscript and providing important suggestions in interpreting the Upper Cretaceous stratigraphy.

Raphael Ketani earned a B.S. degree in Geology from the State University College at Fredonia, New York in 1976, and continued his geologic studies in graduate school at Eastern Kentucky University where he earned an M.S. degree in 1980. Mr. Ketani worked as a consulting oil and gas exploration geologist, monitoring drilling projects in the northern Rocky Mountain region and the Texas panhandle before moving back to New York City where he was hired by the NYS Department of Environmental Conservation. He presently supervises the cleanup of petroleum spill sites throughout the City. Mr. Ketani has 36 years of professional experience and is a Certified Professional Geologist through AIPG. Mr. Ketani also is a member of GSA, AAPG, NGWA, and the Society for Sedimentary Geology.

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

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Leading and Following

Jean M. Patota, CPG-11438

Leadership is a common topic and certainly is important for success in business and professional life as well as in our personal lives. Leadership has been defined in many ways, but we all can think of at least one individual who we admire for their passion and their ability to motivate others and get the job done. I’ve heard people referred to as a good leader after concluding a successful project or event but real leadership is not demonstrated occasionally during a narrow timeframe. Most of us would agree that truly effective leadership is demonstrated over a protracted period and those are the leaders who help navigate us through “good times and bad.”

I’m writing about leading (and following) because of some odd remarks overheard during recent conversations. I was told that the secret of a successful leader was to delegate – specifically, to simply enlist others by assigning a task or telling people what they should do. While strategically delegating to others is important and is not a leadership crime per se, it was further explained by the notion that it is unnecessary for a leader to understand the task or to ever have performed the task, but only to assign the work. Maybe that theory can work sometimes by those willing to cooperate out of loyalty to the organization, but my experience is that talented people don’t blindly dive into a challenge unless they trust (or have a little faith) that their leader understands what they are asking or has experienced the same themselves. It’s also critical that the leader or group has committed the resources necessary for success. The best leaders (who I’ve seen others follow consistently without hesitating) share various traits - they set the example by their own actions, communicate a thoughtful plan and vision, provide on-going support, empower others, share the credit for success and have earned respect by literally picking up a shovel alongside everyone else when needed to accomplish the group’s objectives.

During another conversation it became evident that a leader inferred the credit for a major accomplishment by other members. The leader displayed a habit of asking others how to accomplish routine administrative tasks and requesting to be provided with basic organizational information (but not where to find it). This self-styled “leader” lacked the experience, understanding, and historical context to effectively guide their organization and made no apologies - when questioned about specific objectives the leader’s response was essentially that “you’re supposed to know that...” or “it would be easier if you would just do it.” Well, of course it would be easy if someone else did your work and gave you the answers! Just tell me where to sign up for that kind of unearned loyalty.

It is not required nor is it possible for a leader to imagine every new idea or potential strategy. Those who are successful surround themselves with knowledgeable people, listen and engage in discussion, continue to re-assess and modify plans when prudent, and thoughtfully consider the benefits and risks to help arrive at workable solutions before leading the way.

Leading requires passion, energy, and is hard work. Natural leaders are relatively few or we would recognize a lot more names. Most of us then, are followers including me. There’s nothing inferior about following. It’s savvy to recognize a good leader and become a valuable contributor or supporter. Many of us are better at devising focused strategies or performing tasks than leading. We may be more confident in our own wheelhouse than managing the big picture which can be overwhelming (for us nerds, think Mr. Spock vs. Captain Kirk). But all leaders need good supporters and sincerely appreciate the diverse and talented people they can rely on for thoughtful advice or the skills to get the work done. Sometimes we should trust what others see in us and accept an assignment and other times it makes sense for us to identify the “highest use” of our abilities in the scheme of a specific project or goal.

There’s an art to being a good follower. It’s not mindlessly accepting direction with blinders on. It’s important to consider the organization’s “back.” Apologies for another TV reference, but the character of Radar O’Reilly in M*A*S*H is a perfect example. You don’t have to lead to be the MVP. Participation at any and all levels is welcome. You certainly have skills, knowledge, or maybe at least passion to share or apply – add a graphic to a newsletter, contribute a fundraising idea, recommend a local resource, contribute a photo, or sit at the registration table. Accept a task you might enjoy and your contribution will be appreciated.

I’ve attended virtual meetings during which participants do not utter a single word or offer any comment over multiple meetings. (It might be one’s nature to shun the limelight but I wonder how an organization’s position of authority is represented on some peoples’ resumes.) For whatever reasons, if you cannot lead you certainly can follow. Help promote your organization, ask a question, or voice an opinion (!). Simply “show up” mentally and/or literally.

Please consider how you show up at home, work, and in your organization – start following by reading your leader’s messages, responding in a timely manner when needed, paying your dues before the third reminder, and volunteering (even once). Leaders depend on followers. Successful leaders need us to follow in whatever ways we can contribute.
1. In the “unified Soil Classification System,” what does “MH” indicate?
   a) Clay of low plasticity.
   b) Mature, well-graded sand.
   c) Silt of high compressibility.

2. A type of “coal” with heating values of about 6,000 to 7,000 BTU per pound defines:
   a) Lignite.
   b) Bituminous coal.
   c) Anthracite.

3. Which of these minerals is classified as an “oxide” and constitutes an “ore of manganese?”
   a) Rhodocrosite.
   b) Pyrolusite.
   c) Sphalerite.

4. Which “Epoch” of the Jurassic “Period” is the oldest?
   a) Dogger.
   b) Lias.
   c) Malm.

5. In a structural geology model, we consider two stress vectors:
   \[ \hat{\mathbf{g}} = 3 \mathbf{i} + 2 \mathbf{j} + \mathbf{k} \quad (1) \]
   \[ \hat{\mathbf{y}} = 6 \mathbf{i} + 4 \mathbf{j} + 2 \mathbf{k} \quad (2) \]
   Which of the following is correct?
   a) \( \hat{\mathbf{g}} \) and \( \hat{\mathbf{y}} \) are parallel to each other.
   b) \( \hat{\mathbf{g}} \) and \( \hat{\mathbf{y}} \) are perpendicular to each other.
   c) Ha, ha; me do this? Dream on dude! Only in “Bizarro World!”

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Looking Forward

Helen V. Hickman, CPG-07535
hickmanhydro@att.net

I am optimistic about AIPG’s long term future. I think that we need to be creative and adventurous in looking for new ways to reach and interact with members across the country and beyond the borders, and look to supplement our income so we can do more for members in terms of services, activities, education and scholarships.

The Executive Committee and headquarters staff regularly reaches out to the section leadership across the country to find out how things are going and exchange ideas. In addition, I encourage all members to communicate with them and with each other. Scheduling a joint meeting or field trip is a great way to do something different to meet members from adjoining states, for example. If your section is struggling with new ideas to attract those “hard to motivate” members, please reach out directly to one of the more active sections, or to the Executive Committee, or directly to headquarters staff who can help, or put you in touch with someone who can.

As everyone should be aware by now, this year’s AIPG’s National Conference will be held in Santa Fe, New Mexico between September 10th and 13th, 2016 at the Drury Plaza Hotel, close to the center of Santa Fe. The title of the Conference is “New Mexico: Land of Geologic Confluences and Cultural Crossroads.” Set in a beautiful and geologically interesting area, there will be the usual excellent field trips and technical sessions. Events will include the Awards Luncheon and Awards Dinner, with lots of opportunities to network with members across the country and renew friendships. As a reminder, please send a representative from each of your sections to attend the business meetings. The Delegates meeting is held on Saturday September 10, 2016; details of the conference are on the AIPG website, www.aipg.org. A report on your activities should be submitted to Dorothy Combs before the meeting. Attendees have an opportunity to share ideas and discuss issues at the meeting. We are also scheduling a Delegates breakfast this year, so Delegates can explore ideas in more detail.

In addition to the typical technical format this year we are introducing a different type of presentation theme – asking for presentations related to Professional Growth and Improvement. We hope to have several presentations on subjects of interest to all geologists, including our student members. These topics will be related to Professional Business practices.

Student membership continues to rise in AIPG. We have added several new student chapters at universities across the country during the past year. Each chapter has a faculty and AIPG sponsor. We have had success providing opportunities for students to meet Professional Geologists for networking events in some student sections. The students are very interested in this type of event, as well as open to learning about what it takes to succeed as a professional geologist. These types of events have helped students obtaining internships and jobs upon graduation, and are equally helpful to our other members to pass on their skills and hire new staff. Sections please help your students to come to the conference in Santa Fe. There are opportunities for student volunteers to provide assistance on field trips.

I am happy to report that our Executive Director Search Committee has completed their work. Our new Executive Director, Dr. Aaron W. Johnson is on board and getting very busy. He will be sharing his thoughts for the future at one of the presentation slots during the Professional Growth and Improvement track in the Technical Sessions, so please attend to share your ideas, because he would like to hear from you.

The less positive part of having a new Executive Director is that we are saying goodbye to our current Executive Director, Bill Siok who has served AIPG for more than 15 years. He has devoted a lot of energy to the AIPG and last year when the previous Director did not work out, Bill came out of retirement to help the organization stay on track. We owe him a huge debt of gratitude for his dedicated service to AIPG and wish him the very best in his re-instated retirement!

I look forward to seeing everyone in Santa Fe!
Answers:

1. The answer is choice “c” or “MH” describes a “silt of high compressibility.”
   Clays of low plasticity are described as “CL.”
   Well-graded sands are classified as “SW.”

2. The answer is choice “a” or “lignite.”
   “Lignite” or brownish-black coal is the lowest rank of coal (above “peat”). “Lignite” is mainly used as fuel for electric power generation.
   “Subbituminous coal” and “bituminous coal” (depending on the ranks) have heating values ranging from about 8,000 to 14,000 BTU per pound. These are utilized as fuel in steam-electric power generation, for heat and power applications in manufacturing and in the development of “coke” fuel.
   “Anthracite” has heating values around 14,000 BTU per pound. “Anthracite” coal depicts the highest rank of coal. It is used in residential and commercial heating.
   Because of environmental concerns, sulfur content has become as important as the BTU values for coal. Low sulfur content is obviously most desirable.

3. The answer is choice “b” or “Pyrolusite” (MnO₂).
   “Rhodocrosite” is also an ore of manganese, but constitutes manganese carbonate (MnCO₃).
   “Sphalerite” is a sulfide and a main ore of zinc (ZnS).

4. The answer is choice “b” or “Lias.” “Malm” is the youngest of these three “epochs.”

5. The answer is choice “a” or “(ĝ and ŷ are parallel to each other).” The proof follows:
   We can test these using vector mathematics. We know that for two non-zero vectors, the “dot product” is zero when they are perpendicular to one another. Similarly, for two non-zero vectors, the “cross product” is zero when they are parallel to each other.
   Calculating the “dot product” first:
   \[
   \hat{g} = 3i + 2j + k \quad (1) \\
   \hat{y} = 6i + 4j + 2k \quad (2) \\
   \hat{g} \cdot \hat{y} = g_1y_1 + g_2y_2 + g_3y_3 \quad (3) \\
   \hat{g} \cdot \hat{y} = (3 \times 6) + (2 \times 4) + (1 \times 2) = 28 \quad (4)
   \]
   Since the value \( \hat{g} \cdot \hat{y} \neq 0 \) in (4), then the vectors are not perpendicular to each other!
   Calculating the “cross product” next:
   \[
   \hat{g} = 3i + 2j + k \quad (1) \\
   \hat{y} = 6i + 4j + 2k \quad (2) \\
   \hat{a} = \hat{g} \times \hat{y} \quad (5)
   \]
   Let \( \hat{A} \) be the magnitude of \( \hat{a} \). Then:
   \[
   \hat{A} = [(\hat{g} \cdot \hat{g}) \times (\hat{y} \cdot \hat{y}) - (\hat{g} \cdot \hat{y})^2]^{1/2} \quad (6) \\
   \hat{A} = [(3 \times 3) + (2 \times 2) + (1 \times 1)] \times [(6 \times 6) + (4 \times 4) + (2 \times 2)] - [(3 \times 6) + (2 \times 4) + (1 \times 2)]^2]^{1/2} \quad (7)
   \]
   Thus, the magnitude of \( \hat{g} \times \hat{y} = \hat{A} \) is:
   \[
   \hat{A} = (456 - 784)^{1/2} = 0 \quad (7)
   \]
   From the result calculated in (7), we see that \( \hat{g} \) and \( \hat{y} \) are parallel vectors!
   This math is easy stuff, isn’t it? Well, maybe not, but it is certainly a tool for us to use to solve geologically-related problems! C’est la vie, mes amis!

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Introduction and Vision

Aaron W. Johnson, MEM-2783
awj@aipg.org

I am excited and honored to join AIPG as the new executive director. I want to thank each of you for welcoming me to AIPG. I cannot overstate how much the National Headquarters staff has done to assist me as I transition into this new role. Wendy Davidson, Cathy Duran, Cristie Valero, Dorothy Combs, and Mona Scott do so much for AIPG, and much of what they do is unseen. I thank each of them for their help, support, and patience. I also want to extend a sincere thank you to the National Executive Committee for allowing me this opportunity. Following in Bill Siok’s footsteps will not be easy, but I am confident that we will be able continue to move AIPG forward.

I’d like to tell you a little bit about myself. I am a native of Miller, Missouri, on the far western edge of the southwest Missouri Ozarks two miles north of the Mother Road. I completed my undergraduate degree at THE Missouri State University, and finished my doctoral degree at the University of Missouri. My professional experiences include a number of positions, primarily in the academic realm. I have held academic positions at the University of Virginia’s College in Wise and at Northwest Missouri State University. During my academic career, I have administered degree programs, served as discipline coordinator and as interim department chair. My academic interests are focused on minerals and mineral exploration and the interaction between humans and the environment.

I have extensive experience working with geologists and geology students in the field, where my focus has been on field mapping and field-based structural geology. In addition to my academic interests, I spent two years working as an environmental field technician for a firm in Springfield, Missouri. Away from work, I have a passion for stock cars and classic automobiles and I spend as much time as I can with my family.

I am excited to outline a series of new ideas to help move AIPG forward. The staff at National Headquarters and I are already working on new programs to provide benefits to student members and our partners in industry. Some of our areas of focus will include experiential learning for AIPG student members, continuing education for all AIPG members, and strengthening the ties between National Headquarters and our state chapters. We hope to work with Universities and our partners in the public and private sector to match students seeking internships with organizations searching for students with specific interests.

I recognize that we succeed because of the support of our members, the hard work of our National Executive Committee and Standing Committees, and the members of our student chapters across the country. The work you do and support you give AIPG makes our success possible. I think we all understand that AIPG and geology as a profession face challenges, but I am confident that we can work together to address those issues and chart a path to a strong, vibrant future. I encourage your involvement and welcome your ideas and continued support. Please feel free to contact me with your comments, suggestions, ideas, or concerns. Thanks again for what you already have done.

Best Regards,

Aaron W. Johnson

Monomonie On The Bluffs

The City of Niagara, Wisconsin is located along the Menominee River, and the metavolcanics forming the bluffs along the river are the first thing you see as drive into town. The Niagara Area Historical Society sponsored an event from July 1-10, 2016, at the Niagara Area Historical Museum called “Bluffs on the Menominee” highlighting these impressive outcrops that have been so much a part of the town’s history. There were more than 50 submissions of paintings, photographs, drawings, colorings, writings, and crafts, plus music and food (homemade pasties)! . . . and a lecture by Paula the Geologist on the formation of the rocks in everyone’s backyard. After learning a bit about plate tectonics, the formation of pillow basalts, and a lively discussion on whether the Niagara Fault Zone might become active again, the crowd left suitability impressed know they lived in the roots of the once mighty Proterozoic age Penokean Mountains.

Paula Leier-Engelhardt CPG-08798 is WI AIPG’s Regulations & Legislation Committee Chair.
CPGs are QPs Except When the Property is in Canada

An Alaskan CPG contacted me about his need for and the cost of obtaining a geologic license in British Columbia. An AIPG CPG can report on properties located outside of Canada and receive Qualified Person recognition for purposes of Canadian National Instrument 43-101 for technical reports filed with a Canadian stock exchange. However, if the report is for a property located in Canada, the appropriate Canadian Provincial or Territorial license is required. For example, for properties located in British Columbia, a license from the Association of Professional Engineers and Geologists, British Columbia is required (APEGBC). I previously reported on the requirements for licensing in Quebec in columns 146 (Jul/Aug ‘13) and 147 (Sep/Oct ‘13). The Canadians license geologists by individual Province or Territory just like those US states that license geologists. It seems oxymoronic that a CPG is recognized as qualified for everywhere in the world except in Canada (ignoring US state licensing for the moment), but that’s the fact of life. In the US, the US Constitution leaves the power to license professions to the states.

The foregoing discussion leads to the discussion of reciprocity, the mutual recognition of each other’s licenses. Reciprocity may exist, sort of. It depends on which state/province/territory you’re licensed in and which one you’ve got a job in and the length of that job. Some states/provinces/territories have temporary practice provisions that provide a variety of reciprocity. You have to investigate each one. Column 147 discusses the way a CPG can get a temporary license in Quebec, but it isn’t cheap.

Geoscientists are not unique in facing this dilemma. A colleague who recently moved to Nevada from Colorado reported that his wife, a psychotherapist, couldn’t practice in Nevada because of the state licensing provisions for psychotherapists. Medical doctors have the same problem. Requiring lawyers to have a state license makes sense when they practice in state courts. But when they are practicing in Federal court, they need to be licensed with the US Supreme Court and obtain temporary permission to practice in a federal court in a state in which they are not licensed.

It would be nice to have a single credential that had universal, international recognition but that isn’t the way the world works. There is the argument that a professional should be aware of and comply with state laws and regulations applying to specific areas of practice, particularly in the environmental and engineering parts of the geoscience profession. The question remains, how much does the state license truly protect the public and how much is the state license guild protection from geoscientists in other states or from other professions who think they can all do geoscience.

Competent and Ethical Practice Versus Client Desires

A client retained a consulting firm whose principals are CPGs to prepare a NI 43-101 compliant technical report on the client’s property. One of the requirements of NI 43-101 is that all samples used as a basis for conclusions in the report must be verified using appropriate and acceptable quality assurance/quality control procedures. The client’s samples contained assays for gold and platinum. The consulting firm was initially unable to verify the samples and asked that more testing be done by a certified assay lab and that the additional samples submitted to this lab contain recognized standard and blank samples. Inexpensive Standard Reference Material (SRM) precious metal standard and blank samples are available from the Nevada Bureau of Mines and Geology and were purchased and analyzed using the client’s proprietary analytical process. The client’s assays for platinum reported platinum in the SRM blank and more platinum than is contained in the SRM platinum standard sample.

The consulting firm concluded that the sample data supplied by the client could not be relied upon for estimating mineral resources and therefore mineral reserves and so the consultant could not estimate tonnages or grades for a NI 43-101 compliant report. The client is unhappy because it believes that having retained the consulting firm to create mineral resource/mineral reserve models and to estimate related tonnages and grades the consulting firm is obligated to construct models and make tonnage and grade estimates. While the client may feel this way, the consulting firm is correct in concluding that without reliable sample analyses it cannot construct reliable deposit models or estimate tonnages and grades. Competent and ethical professional practice does not require a geoscientist or geoscientific firm to provide interpretations, conclusions, and estimates that do not have a geoscientifically valid basis simply because a client asks for them.

Are We in an Ethics Crisis?

Perry Rahn, CPG-3724, sent me the May/June issue of PE magazine, published by the National Society of Professional Engineers, that contains an article by Danielle Boykin, “Are we in an ethics crisis?” Boykin notes that several recent examples of engineers failing to call attention to engineering failures suggest an ethics crisis. The
cited examples are General Motors’ ignition switch failures, Volkswagen’s use of testing software to deceive emissions tests on diesel-engine cars, and the Takata Corp’s defective airbag inflators. Boykin suggests that these failures stem from corporate cultures that put profits ahead of the protection of the public’s health, safety, and welfare. Protecting the public’s health, safety, and welfare by reporting unsafe situations is the primary obligation in engineering ethics and in AIPG’s Code of Ethics. When an unsafe condition or fraudulent activity occurs, the professional engineer or geoscientist should bring the situation to the attention of corporate management or a client. If such notification fails to result in correction of the situation, then the professional engineer or geoscientist is required to withdraw from the project and potentially to report the situation to appropriate authorities. While such reporting may result in adverse consequences to the reporting, professional integrity demands that reporting occur when necessary to protect the public’s health, safety, and welfare. The preceding topic, “Competent and Ethical Practice Versus Client Desires,” is an example of such integrity.

Boykin quotes Allan McDonald,1 “A common thread in all of these recent [scandals] is that they really shouldn’t have happened because there were knowledgeable people well aware of the problem very early in the process, but they either didn’t step forward or didn’t get in contact with the right people... Then you saw a lot of energy being used to cover it up or point fingers elsewhere.” Just how to proceed when faced with this sort of ethical problem can be very difficult. Are you really aware of all the facts? To whom and how should your concerns be addressed? Discussing the situation in generic terms with someone whose knowledge and experience with similar situations you trust is often a good first step. These questions have been discussed in previous columns: “Whistle-blowing and tattletales” in column 82, Mar ’03; “Something bad has happened; who do you tell?” in columns 115, May/ Jun ’08 and 117, Sep/Oct ’08; “Oral but not written disclosure to a client about a potential problem” in columns 127, May/ Jun ’10 and 138, Mar/ Apr ’12; “Client confidentiality, reporting illegal activities and Colorado’s liability safe harbor” in column 105, Sep/Oct ’06; and “Confidentiality agreements versus public health and safety; conflict of interest” in column 124, Nov/ Dec ’09.

Should Scientific Papers Be Available for Free?

The issue of whether scientific papers should be freely available was first addressed in column 158 (Apr/ May/ Jun ’16). The January 2016 issue of the SEG Newsletter addressed the Society of Economic Geologists position on this issue in “Publishing with SEG: All About the Copyright Agreement.” Basically, the standard assignment of copyright agreement that authors sign with publishers gives the publisher exclusive control over when, how, and by whom the paper may be copied. When an author allows or facilitates unauthorized posting of published manuscripts on various websites, the author is in clear violation of copyright laws. SEG does provide an option for Open Access publishing when the author enters into an agreement for this with SEG and pays a fee that allows SEG to recover in advance some of the costs incurred in reviewing, editing, and publishing the paper. SEG is also implementing a “green” Open Access option pursuant to which a paper is published with the usual copyright restrictions but then the author is allowed to place a post-peer review version of the manuscript online after an embargo of 12 months after the publication date (the publication month of the journal, etc.) This “green” version is what the editor has approved for publication and for which the editor has given the author instructions for sending along to production but which has not been through copyediting, layout, final proofing, and publishing with the SEG logo. Under no circumstances can this manuscript be the final version published by SEG.

Like most scientific publishing organizations, SEG depends on its publication sales, via print and online through the SEG bookstore and GeoScienceWorld, to generate the income that keeps the costs low for Society services—including student programs, memberships, and publications. Commercial publishers also must recover their costs of production through sales. The costs of the publishing process are real and must be paid for somehow. Open access has a price.

Email Address Spoofing Attempts to Obtain Section Funds

A couple of AIPG Sections have recently been involved with attempts to misappropriate Section funds. The attempts went like this. The Section Treasurer received an email purportedly sent by the Section President requesting that an invoice for a stated amount be paid. In both known cases, the Treasurer noted something fishy about the email and called the President to check on the message. The President’s email had been spoofed and the request for payment didn’t come from the President. I gather such spoofing is relatively easy. While no harm was done, these instances do point out that such attempts can occur. Publication of Section officers’ names and email addresses on Section websites, newsletters, etc. provide the scammers with the basic information needed to spoof a message and attempt a scam. These incidents also serve as a reminder that such spoofed emails may be sent in other contexts. For example, someone seeking confidential information may create a spoofed email from a client requesting an additional copy of a report or other data. Pay attention and if there is any hint of something unusual, pick up the phone and check things out.

For those who need only an occasional search of the GeoRef database, it is easy to request a GeoRef custom search. A member of the GeoRef staff will conduct the search according to your specifications. The search results will be delivered by email.

To order a Custom Search, contact Jim Mehl at jmp@agieweb.org, (703) 379-2480 ext 236 or Monika Long at ml@agieweb.org.

The cost of a custom search is $225.00 plus $.45 per reference. Please mention AIPG when ordering your custom search.

1. McDonald is an ethics lecturer and author of Truth, lies, and O-rings: inside the space shuttle Challenger. McDonald refused to sign the launch authorization for the Challenger but was unable to stop the launch.
IN MEMORY

Jay G. Marks, CPG-00048, somewhat shy of his 100th birthday, passed away in the early morning hours on Monday, March 28, 2016, as he wished, in his own bed, with his immediate family nearby. He was preceded in death by his loving wife of 65 years, Consuelo Plaza Marks, mother Florence (Floy) Pixley, and father J. Glenn Marks.

Jay was born August 7, 1916, in Los Angeles, California. He took an early interest in fishing and hunting under the tutelage of his father and maternal grandfather, both prominent Southern California businessmen and avid outdoorsmen. Blessed with keen intelligence and athletic ability, he attended UCLA, then USC (one summer semester), and finally Stanford, where he ultimately earned a Ph.D. in paleontology.

Retirement hardly describes Jay’s latter years. He traveled with his wife, Consuelo, to the Middle East and Europe. An expert fly-fisherman, he went on expeditions to British Columbia and Alaska to catch steelhead and salmon. He continued to hone his wing-shooting skills on pheasant hunting trips. When his doctor advised him to give up competitive tennis at the age of 70 to avoid hip surgery, he took up golf, which he pursued with passion up through the last year of his life.

Jay G. Marks
CPG-00048
Charter/Emeritus Member
Member Since 1964
March 28, 2016
Englewood, Colorado

Charles Weiner
CPG-03218
Member Since 1976
April 6, 2016
Houston, Texas

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 pep 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.

Geologic Ethics & Professional Practices

articles, columns, and letters to the editor from The Professional Geologist from 1987 to the present, including Geologic Ethics and Practices 1987 - 1997
Edited by David M. Abbott, Jr.
Certified Professional Geologist (CPG)
Published by American Institute of Professional Geologists

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www.aipg.org

A Visit to the Red Planet

Michael J. Urban, MEM-1910

Mars intrigues us. Next to the Earth and moon, it is the most heavily studied and frequently visited (by spacecraft) object in the entire solar system. To say it piques our scientific curiosity is perhaps an understatement; it fascinates us, captivating our imagination with its possibilities. Not only is Mars home to the largest volcano in the solar system, but it also houses a reservoir of water (ice, vapor, and maybe liquid at times), and who knows, maybe one day we will discover that it harbors life too.

Exploration History

There have been some 20 successful missions to Mars since Mariner 4 left Earth in the year 1964[4]. Included among them are four surface travelers sent by the National Aeronautics and Space Administration (NASA): Pathfinder, the twin Spirit and Opportunity exploration rovers, and the Mars Science Laboratory Curiosity. The latest NASA visitor to Mars reached orbit in September of 2014: the Mars Atmospheric and Volatile Evolution (MAVEN) orbiter[2]. While Curiosity still roams the surface of the Red Planet in search of additional evidence of water, the MAVEN probe investigates Mars’ atmosphere and interactions with the solar wind[3]. NASA’s next tentatively planned mission will place a lander on Mars to study its interior; the Interior Explorations using Seismic, Geodesy and Heat Transport (InSight) mission is scheduled to lift off during the next launch window with Mars in May of 2018[4]. The orbital configuration of Mars and Earth align for optimal distance every 26 months, explaining why missions are initiated about every two years.

General Characteristics

Mars is the fourth planet from the sun, orbiting at a distance of approximately 225 million kilometers (compared to Earth’s 150 million km average distance). Mars is a terrestrial planet with a diameter about half the size of the Earth’s; its gravitational acceleration is a third of the Earth’s and twice that of Earth’s moon. The atmosphere of Mars is primarily composed of carbon dioxide gas (95%), with lesser amounts of nitrogen (2.7%) and argon (1.6%), and trace amounts of water vapor (210 ppm). The thin envelope of gases surrounding the planet produces a mere 6 millibars (mb) of atmospheric pressure on average (Earth’s average pressure is 1015 mb) – far too low for sustaining standing bodies of liquid water.

Despite being an alien world very different from Earth, Mars shares some interesting similarities: a 24-hour rotational period, an axial tilt of 25° (compared to Earth’s 23.5° tilt) causing seasonality, and polar ice caps of water and carbon dioxide. Mars also experiences surface winds, and at times, the entire planet’s surface can be shrouded by dust from powerful wind storms. In 1971, when Mariner 9 entered orbit around Mars, the first photographs sent back to Earth revealed nothing of the Martian surface due to a veil of dust – only the top of Olympus Mons (the largest volcano in the solar system, towering 25 km above the surface) protruded through the dust along the spacecraft’s orbital path[6]. Summer afternoons will routinely produce dust devils. These fascinating twisters resemble those found on Earth, but are many times larger, some observed with kilometer-wide bases and heights of 10 km[7].

Clouds are not uncommon on Mars, and diurnal heating patterns occasionally produce water-ice clouds surrounding volcanic mountains. Carbon dioxide snowfall has even been detected at the planet’s southern hemisphere[8]. Water is much more abundant on Mars than previously thought. Although only minute traces are found in the atmosphere, there is water-ice permafrost in some of the soil on Mars and the majority of the 4 km thick north polar cap is composed of water-ice[9]. During its past, extensive flooding events occurred on Mars[10], and just a few months ago, NASA announced finding evidence for liquid water flowing on Mars’ surface in ephemeral streams (likely fostered by the presence of dissolved salts and subsequent lowering of the melting point of water ice)[11].

Geologic Context

In May of this year, Mars made its closest approach to Earth (75 million km distant), shining bright red in the sky. Its vivid red color – causing it be aptly called the “red planet” – is due to the abundance of iron oxide at its surface. The crust of Mars is primarily basaltic, and therefore rich in iron-laden minerals like olivine and pyroxene. The mineral hematite, an iron oxide, is a weathering product of basalt, and fine grains of hematite dust cover much of the planet’s surface[12].
Other minerals discovered on Mars, like goethite and jarosite, imply alteration in the presence of water\textsuperscript{[13]}. Goethite is a hydrous form of iron oxide and jarosite is a hydrous potassium iron sulfate. Adding to the mounting evidence of a watery past for Mars are laminated mudstones on the floor of Gale Crater\textsuperscript{[14]}. Less surprising, crossbedding in sandstones is documented near Mount Sharp\textsuperscript{[15]} and the 4000 km long, 7 km deep, Valles Marineris, exhibits layers of rock much like the Grand Canyon on Earth. Both Gale Crater and Mount Sharp are areas examined by the Curiosity rover in its nearly 13 kilometer trek across the surface of Mars since landing in 2012.

From a broader perspective, Mars exhibits a crustal dichotomy, with the southern hemisphere having a higher elevation and older surface (i.e., more craters) than the northern hemisphere. Unlike Earth, Mars shows no sign of ever having experienced large scale plate tectonics. The presence of truly enormous shield volcanoes, like Olympus Mons, is evidence for a stationary crust, because the volcanoes continued to build in a single location (unlike the chain of Hawaiian Islands on Earth). Some of the youngest lava flows on Mars appear to be within Elysium Planitia, a large volcanic region, at Athabasca Valles.\textsuperscript{[16]} Whether Mars is volcanically active, dead, or dormant, remains to be determined.

Not all data about Mars has been collected remotely. In addition to the data collected at Mars, several meteorites have traveled from the planet and landed on Earth (probably blasted to escape velocities by impacts on Mars). Over 60,000 meteorites have been found on Earth, and just over 120 are from Mars.\textsuperscript{[17]} Basaltic meteorites provide direct evidence from Mars of volcanism as early as 180 million years ago.\textsuperscript{[18]}

**Summary**

Mars has been the subject of intense scientific investigation, driven largely by its proximity and similarity to Earth, but also because of the presence of water and potential for life. We continue to learn more about this enigmatic planet through the on-going activities of the Curiosity rover and the MAVEN orbiter. As humans ponder the possibility of settling on other planetary bodies in our solar system, Mars is clearly a candidate at the top of the list as NASA explores the potential for sending manned missions to the Red Planet.

**Featured resource**

This issue’s featured resource is the Mars Exploration web page at http://mars.nasa.gov/ suitable for children and adults, the website features direct links to the latest updates and images from Mars. A menu bar on the left side of the main page provides links to all of the current NASA missions active on Mars. Also at the main page is a link to Mars Quick Facts, which takes you to a colorful set of pictographs with general information about the planet as compared to the Earth. A series of dropdown menu bars at the top of the page enable you to search out and access various other links pertaining to programs, news, multimedia, and more.

**References**


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What Do You Mean Moisture is 110%!
Twenty Roadblocks to Communicating Engineering Geology

J. Barry Maynard, Mark T. Bowers, Paul E. Potter

Introduction
Like most disciplines, in the geological sciences there is an unfortunate tendency to write papers and reports as though the information will only be read by those initiated into the culture and practices of their own group. This is the source of the consternation expressed in our title, when we encounter an unfamiliar culture, in this case geotechnical engineering. These cultural boundaries give rise to countless examples of confusion in communicating, sometimes with tragic consequences.

A seminal work that analyzes issues of poor communication is the book by Robert Graves and Alan Hodge “The Reader Over Your Shoulder” first published in 1943 in the UK and in a 1971 US edition with many reprints. They urge writers to constantly keep in mind the members of their audience, imagining their complaining about confusing sentences or undefined jargon. In the same spirit we urge geologists to write with a wider audience in mind rather than other geologists. To facilitate this broader approach to writing, it is essential for geologists to realize and appreciate some of the subtle but important distinctions in the way geologists and other scientists and engineers use seemingly identical terms.

It may seem an annoyance to have to carefully explain what would seem to be understood by every geologist, but this body of assumed knowledge does not extend outside of geology and worse, many terms that look familiar are in fact used in surprisingly different, even opposite ways. This potential for a breakdown in communication is great. Mitchell, in his 2004 Seed Lecture (Mitchell, 2009), identified communication, in particular the failure to adequately define terms and conditions, as the number one reason for geotechnical failures.

The Engineer Over Your Shoulder
The most common hand-off of information is probably between geologists and civil engineers, for example in the investigation of a prospective site for the opening of a mine or the construction of a dam, a building, a landfill, or a roadway. These two specialties have different traditions and different training (Hatheway, 2005); hence their approaches to the problem are different. Ideally, these approaches should be complementary and reinforce one another but differences in communication often arise and may seriously interfere with the successful completion of a project.

In most instances geological study precedes detailed engineering investigation (e.g. Leggett, 1939, 1962, 1979). There is a handoff of information, sometimes occurring over a wide time gap, between the geologist and the engineer or the environmental scientist. It is therefore incumbent on the geologist to prepare information in formats and in terminology that are comprehensible to other disciplines.

In the words of Kiersch and James (1991, p. 555), “Many engineers...are confused by geologic reasoning and terminology, are prone to discredit geologic reports, and can regard them to be of little practical value. Likewise, geologists have failed to present their findings in language understandable to the intended readers, and to explain the significance of a geologic feature or setting.”

Serious mistakes are too commonly made. The catastrophic failures of the refuse piles at Aberfan in Wales (Penman, 2000) and the Stava tailings dams in Italy (Chandler and Tosatti, 1995) were a result of siting these facilities on top of known springs. The failure of the Malpasset Dam in France was related to insufficient understanding of planes of weakness in metamorphic rocks (James, 1988). The Portuguese Bend landslide complex in southern California that continues to destroy new houses and golf courses was mapped as landslide terrain by the US Geologic Survey as early as 1946 (Hill et al. 2007).

Twenty Ways to Miscommunicate Geology to Engineers
These communication failures stem from two sources: differences in vocabulary and differences in data formats, specifically spatial vs. digital data. We address the differences in vocabulary herein. Table 1 lists 20 of the most confusing English-language terms used by geologists and geotechnical engineers. Of these, it strikes us that eight are especially likely to cause misunderstanding (marked in bold) and therefore merit further discussion.

1. Grain Size Distribution or Grading
This is perhaps the most vexing vocabulary discrepancy because the boundaries between the size categories are slightly but significantly different, the method of representation of the data is opposite, and the qualifiers used to describe the distribution have opposing senses. Thorough discussions of grain size analysis in geology are still best found in the classic book by Krumbein and Pettijohn (1938). For engineering, Hunt (2005) is an invaluable resource.

The boundaries for grain size categories used by geologists come from the Wentworth classification, whereas engineers follow the ASTM classification (ASTM 2009). Consequently, when a geologist refers to “sand,” the material has a grain size between 0.0625 and 2.00 mm; in the ASTM scheme, the range is 0.075 to 4.76 mm. The difference can be significant. Voight et al. (1981) reported grain size in both systems for debris avalanche deposits of the 1980 eruption of Mount St. Helens and found that sand-sized grains averaged 42% using the Wentworth classification but 52% using the ASTM classification.

The method of representation of choice for both disciplines is a cumulative frequency curve, but it is customary to show percent (%) finer in one case and percent coarser in the other. Furthermore, because a sand with a wide range of grain sizes makes a better foundation, an engineer refers to it as “well graded,”
provided the fine fraction does not exceed 5%. Conversely, because the same sand shows reduced permeability compared to sand of the same median size with a narrow range of sizes, a geologist refers to it as “poorly sorted.” Even more confusing, geologists speak of a bed or bed sequence as being graded if it shows consistent vertical trends in grain size whereas in engineering gradation refers to the grain size distribution of a single sample.

Confusion can also arise in describing the finer sizes. Geologists tend to concentrate on mineralogy and to divide fine-grained materials into silt and clay on the basis of size, and to further subdivide clay-sized material into clay and non-clay minerals. Engineers rely more on physical behavior, namely plasticity, and divide silts and clays using the Atterberg limits into low-plasticity (ML and CL) and highly plastic (MH and CH) fines based on the material’s position on the plasticity chart. Kehew (2006) provides a helpful reference for geologists hoping to improve their grasp of geotechnical basics such as the Atterberg limits.

One might argue that the engineering approach to soils is their business and of no concern to geologists; however, consider the data shown in Fig. 1. The data represent a glaciated area in Greater Cincinnati that has experienced repeated landslide movement on some

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**Table 1. Pitfalls in Word Usage**

<table>
<thead>
<tr>
<th>Concept</th>
<th>Geology</th>
<th>Civil Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cementation</td>
<td>Binding together of particles of a soil or sediment by precipitated minerals</td>
<td>Injection of cementing agents into permeable or fissured soil or rock to reduce fluid flow or improve strength</td>
</tr>
<tr>
<td>2. Clay</td>
<td>Rock or mineral fragment &lt; 4 μm; in soil science, the limit is 2 μm, the size below which all particles are clay minerals</td>
<td>Plastic material consisting mainly of particles finer than 2 μm</td>
</tr>
<tr>
<td>3. Compaction</td>
<td>Volume reduction from overburden pressure</td>
<td>Densification by mechanical means</td>
</tr>
<tr>
<td>4. Consolidation</td>
<td>Lithification of a sediment by compaction or cementation</td>
<td>Gradual reduction of soil void ratio from dissipation of excess pore pressure (owing to an increase in effective stress) and in a squeezing of fluids from the soil pores</td>
</tr>
<tr>
<td>5. Dike</td>
<td>A tabular igneous rock cutting across the planar structures of the surrounding rocks</td>
<td>Artificial wall or embankment of earth or rock fill</td>
</tr>
<tr>
<td>6. Grade</td>
<td>In mining, metal content of an orebody</td>
<td>Degree of inclination of an engineering structure</td>
</tr>
<tr>
<td>7. Graded</td>
<td>Vertical trend in grain size in a bed or bedding sequence</td>
<td>Possessing a range of grain sizes</td>
</tr>
<tr>
<td>8. Grain-size units</td>
<td>UI = log2(mm)</td>
<td>US standard sieve mesh sizes; mm</td>
</tr>
<tr>
<td>9. Grain-size distribution</td>
<td>Sorting: the degree of similarity of grain sizes of a sediment</td>
<td>Gradation: the frequency distribution of sizes of a granular material</td>
</tr>
</tbody>
</table>
| 10. Grain-size distribution parameters | Inclusive graphic standard deviation: SD(Di/D60)^0.5 | Coefficient of uniformity: C_u = D_40/D_10,
Coefficient of gradation (or concavity): C_c = (D_60/D_10)^0.5 |
| 11. Grain-size distribution quality designators | Poorly sorted = wide range of grain sizes | Well-graded = wide range of coarser grain sizes |
| 12. Grain size distribution qualifiers | ≤ 0.05 Φ very well sorted, 0.051-0.09 Φ well sorted, 0.091-0.10 Φ moderately well sorted, 0.101-0.20 Φ poorly sorted, 0.201-0.40 Φ very poorly sorted, > 0.40 Φ extremely poorly sorted | Well-graded: ≤ 5% fines; C_p > 3 (sand) or 4 (gravel), 1 < C_2 < 3 Poorly graded: not meeting the C_p and/or C_c requirements
May be uniformly graded or gap graded |
| 13. Moisture content         | Weight water/total weight x 100 (also used by environmental engineers) | Weight water/dry weight x 100 (used by geotechnical engineers) |
| 14. Permeability units       | Geologists and engineers in the petroleum industry will use darcy as the unit of intrinsic permeability | Hydrogeologists and civil engineers will use cm²/sec for intrinsic permeability or cm/sec for hydraulic conductivity |
| 15. Pore space               | Porosity: Volume of pores/volume x 100. In hydrogeology, expressed as a decimal | Void ratio: Volume of voids/volume of solids (expressed as a decimal, not a percent) |
| 16. Rock                     | Naturally formed consolidated material formed of one or more minerals and having a degree of chemical consistency | Any natural material that requires drilling and blasting or similar methods of brute force for excavation |
| 17. Sand                     | A detrital particle between 1/16 mm (0.062 mm) and 2 mm. US soil scientists use 0.05 to 2 mm | A soil particle retained on U. S. standard sieve no. 200 (0.074 mm) and passing sieve no. 4 (4.76 mm) |
| 18. Silt                     | A detrital particle between 1/256 mm (0.004 mm) and 1/16 mm (0.062 mm). US soil scientists use 0.002 to 0.05 mm. | Nonplastic or slightly plastic material exhibiting little or no strength when air-dried consisting mainly of particles passing U. S. standard sieve no. 200 (0.075 mm) yet > 0.002 mm |
| 19. Soil                     | Unconsolidated earthy materials over bedrock supporting or capable of supporting plant life (includes only in situ material) | Unconsolidated aggregate of mineral grains and decayed organic matter down to solid rock, along with the liquid and gas that occupy the interparticle spaces (includes in situ and transported material).
The corresponding term in geologic usage is regolith |
| 20. Soil                     | Commonly refers to rocks of sedimentary origin. Soft-rock vs. hard-rock geology | Refers to a cohesive soil that can be molded by slight pressure. The opposite term is stiff (not commonly used in geology). Non-cohesive soils would be termed loose or dense |
What do you mean moisture is 110%!

Results of the failure of the geologist to convey the information, or failure of the engineer to consider that information.

2. Proportion of void space to solids
A critical property of a soil or rock is the ratio of the volume of void space to that of solids. Geologists work with porosity expressed in percent and signified by Φ in petroleum geology or as a decimal fraction represented by n in hydrogeology (note that phi in geotechnical engineering is used to represent the internal angle of friction). On the other hand, civil engineers work with void ratio (using e as the symbol) but may also use porosity in the decimal form. Porosity refers to the ratio of pore volume to the total volume of rock or soil, whereas void ratio refers to the ratio of the pore volume to the volume of solids alone. The terms are readily converted:

\[ n = ϕ/(1+ϕ); \Phi = n^*100\%
\]

\[ e = n/(1-n) \]

where n is expressed as a decimal fraction.

The potential for confusion is limited because the terms for the two systems of measurement are completely different.

3. Proportion of water to solids
The ratio of the mass of fluid to that of solids in a material, the moisture content when the fluid is water, has parallel differences between the two disciplines but the vocabulary terms are not different and confusion is common. Geologists use the ratio of fluid weight to total weight, whereas civil engineers use fluid weight to solids weight. In other words, geologists report moisture as a percentage of the weight of the sample as received; engineers report the percentage of the dry weight. A sure sign that a report is using the civil engineering definition is the appearance of values higher than 100%.

If we define for convenience m as the moisture content in the geology sense and w as water or moisture content in the engineering sense,

\[ w = m/(1-m) \text{ or } m = w/(1+w) \]

In both the geologic and engineering styles of measurement, the direction of these metrics is the same, the units are the same (dimensionless) and the variable used is superficially similar. However, critical differences are present. Each discipline needs to be sensitized to the likelihood of confusion and make it perfectly clear which convention is being used in every report, otherwise the reader will have difficulty knowing which system is being specified. Although it may seem redundant and be resisted by editors, it is our opinion that a good report or paper will include tables with both sets of variables.

Consider the infamous Aberfan flow slide. The liquid limit for the material in the waste tip proved to be 26.5% (Bishop, et al., 1969). The moisture content, when measured as percent of dry weight as is the case for comparison with the liquid limit, was 23-25%. This number was so close to the liquid limit it should have alerted the authorities to the imminent danger of liquefaction. However, if the moisture were expressed in the geologic sense as percent of total weight, the value would be only 19-20% and would convey a false sense of security. This emphasizes again that the terms and the units are the same, so unless the definition of the parameter is carefully stated, this value might be regarded as safe.

4. Permeability
Of the many properties of a rock or a soil, arguably the most important is permeability because it exerts the greatest influence on the movement of fluids and on pore pressures. It is notoriously difficult to evaluate permeability because it covers such a wide range and is so variable on a small scale. Litigation involving groundwater is likely to turn on widely different estimates of permeability by the experts on opposing sides.

Different schemes of measurement, different units, and subtly different symbols are used by petroleum engineers, geotechnical engineers, and hydrogeologists (Table 2). This practice is likely to cause each discipline to ignore or misinterpret data generated by the others. In most cases, there should be little danger of confusion if the units are carefully expressed, but there is a tendency to use K and “k” in the opposite sense in geotechnical and hydrogeologic notation.

Table 2. Measures of the Ability of Soil or Rock to Transmit Fluid

<table>
<thead>
<tr>
<th>Term</th>
<th>Units</th>
<th>Symbols</th>
<th>Synonyms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measures that depend on the properties of the liquid as well as the solid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic conductivity</td>
<td>L/T</td>
<td>K (hydrogeology)</td>
<td>Field coefficient of permeability (obsolete)</td>
</tr>
<tr>
<td>Permeability coefficient</td>
<td>L/T</td>
<td>k (Geotechnical Engineering)</td>
<td></td>
</tr>
<tr>
<td>Measures that depend only on the properties of the solid medium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permeability (petroleum geology and engineering)</td>
<td>darcy</td>
<td>k</td>
<td>1 darcy = 9.87x10^9 cm²</td>
</tr>
<tr>
<td>Intrinsic permeability (Hydrogeology and Engineering)</td>
<td>L²</td>
<td>K (Geotechnical Engineering) Kₜ (hydrogeology)</td>
<td>Specific permeability,</td>
</tr>
<tr>
<td>Effective permeability (permeability to one fluid phase – oil, water, or gas – when others are also present)</td>
<td>darcy</td>
<td>oil kₒ, water kₜw, gas kₜg</td>
<td></td>
</tr>
<tr>
<td>Relative permeability (effective permeability normalized to a reference single-phase permeability)</td>
<td>percent or decimal</td>
<td>oil kₒ = kₒ / k, water kₜw = kₜw / k, gas kₜg = kₜg / k</td>
<td></td>
</tr>
</tbody>
</table>

5. Definition of soil
The definition and classification of soils have a great potential for confusion as pointed out by Leggett (1953), who suggested that geologists adopt the engineering usage. Since this has not come to pass, clarity about differences in usage is needed. It is helpful to consider soil and soil classifications in terms of the purpose of the investigator. We identify five contrasting approaches to soils that...
have application in geology and geotechnical engineering.

Geomorphology: “What is the age of the surface that I am studying?” In this approach the material might be mapped as Sangaman, pre-Sangaman, etc. But engineers often find the geological fixation with age frustrating and are prone to dismiss reports in which this aspect is highlighted. The geologist needs to convey the physical consequences of greater age such as more leached soils or devitrification of volcanic ash (e.g. Mitchell, 2009).

Climatology: “Under what climate system did this material form?” In this context the soil science terminology of the U.S. Natural Resources Conservation Service (NRCS) (1999) is likely to be used by geologist, and the material might be appropriately designated as a caliche or a vertisol.

Mineral exploration: “What can the soil tell me about the composition of the underlying rocks?” In this application it is common to analyze B-horizon samples taken in a grid for Au, Ag, Pb, Zn, etc. as an indicator of underlying hidden mineralization. In this context, the distinction of transported vs. in situ material assumes critical importance.

Geotechnical Engineering: “What can I build on this material or what modifications are needed to make it suitable for building?” Here the system of classification is quite different and is likely to be confusing to the geologist.

Agronomy: “What can I grow in this soil?” In this case “soil” is the unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of plants. How different soil types are distributed has been a major focus of the U.S. NRCS, resulting in an exceptionally helpful series of maps and reports grouped by county. Many useful geological and geotechnical properties are tabulated and certain soil types can be correlated to slope instability or to drainage problems. Most professionals consult these tables early in a site investigation. The information provides a useful model of how information can be effectively communicated.

Just as with other properties it is critical to explain what convention is being used in reports and on maps. Geologists need to use qualifying descriptions by referring to “in situ” soils and should include specific definitions of size terms. It is not safe to assume that users will understand “silt” and “clay” because many users will not be geologists and will interpret these terms differently from the intention of the report.

Some additional papers that explore the issues of communication are Judd (1967) on construction projects; Kiersch and James (1991) on dams and embankments; Katzenbach and Bachmann (2004) on site investigation; and Hart (2011) on communication among geophysicists, geologists, and engineers. Turner (2008) has provided a wide-ranging review of the intersection of geology and civil engineering since antiquity.

Conclusions and Recommendations

It is tempting for the geologist to regard failures in construction or excavation as the failure of the civil engineer to consider geologic factors. We opine instead that it is the geologist who has failed to communicate the existence and importance of these factors. Because the flow of communication is almost always downstream from the geologist to the engineer, the bulk of the responsibility falls on geologists to clearly convey the significance of their results to engineers.

- Vocabulary, particularly the conflicting terms, needs careful definition to the extent that may seem excessive to most editors.
- Certain measurements such as clay content, moisture content and proportions of voids should be reported in both systems.
- Geological maps and reports should consider a wider audience and, like the Soil Survey Reports, include more information relevant to engineering such as Atterberg limits and slake durability.

Finally we urge the reader to study the paper by Voight et al. (1981) on the characteristics of the debris generated by the 1980 eruption of Mount St. Helens. They present data in both geological and geotechnical formats so that the information is readily understood without confusion by workers in both disciplines.

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It always amazes me to think of how geology is such an integral part of every day life. From the resources we rely upon to get us from place to place, or to the raw materials that power our communication devices, manipulation of our resources is what makes us stand out in our modern, developed world. The use of geologic materials in their simplest form has been around for centuries, as in the grinding up and recombination of clay and colorful stones for pigments in ancient paintings, for building purposes, or for the use of white lead in the 18th century to achieve that pale, highly sought after look of the wealthy. Applications of geology seem to crop up everywhere throughout history, and it is so interesting to imagine how ancient craftsmen were able to manipulate these raw materials without the aid of modern processing techniques.

I recently came back from a trip to Italy, and like many other European nations there is an abundance of history and that history can be visualized in the style and artwork found in many of the churches. In Italy, I was in complete awe every time we walked into an ancient church and saw beautifully carved pieces of stone, some of which originated from areas well outside of Italy. It is almost unbelievable to try and imagine how a giant slab of yellow marble made its way from somewhere in Africa to a church in Florence. The amount of manpower and engineering that would have gone into such a move is incredible, and furthermore, the craftsmanship it took to polish the surface and create intricate designs is a level of technique not seen much in today’s time. Ancient artists had a great appreciation for fine stone and many of the popular stones used for church decorations can be traced back to their source region. This can be viewed as a direct reflection of whom people in this area traded with, and what type of travel routes they used to obtain these materials, each geologic use is a glimpse into life during that time. Just walking through some of these ancient cities, it’s easy to see that geology was a part of everyday life; from the ruins of the Roman Forum you can see the stone streets that were constructed in layers of large to small stones so that the streets could be easily drained of water. In the Colosseum you can see the bare bones of this once grand structure whose walls were composed of layers of brick, cement, and travertine limestone. Today much of what remains of the Colosseum is the brick under layers, which reflect the scarce times when people needed building materials, so they would borrow from existing structures such as the Colosseum. Even walking into museums and viewing old paintings one can see what types of stones were used to create vibrant pigments such as lapis lazuli for that bright blue color, or thin sheets of gold added to a certain parts of a painting. It is a unique aspect of geology to see how people used nature to create a world rich in art and architecture.

Geology has and will always be an integral part of life. By studying some of these ancient structures and works of art, it is easy to see that people had a great understanding of their natural surroundings, and were able to manipulate them to fit their needs. It is amazing to see how many of these past geologic applications have withstood the test of time and thus have given us great insight into what life was like in the past. Geology is an important tool that helps to enrich our world, whether it be through art, science, or just simply through viewing spectacular mountain scenery, geology will continue to be at the forefront.

Continued from page 41


Authors: J. Barry Maynard, is Professor Emeritus at the University of Cincinnati, where he taught in the Geology Department from 1972 to 2015 and served as Department head from 1985 to 1990. His focus includes relationships of sandstone composition to tectonics; geochemistry of sedimentary ore deposits; and groundwater contamination. Barry’s interests include communicating landslide hazards to the public, and of the Society of Economic Geologists, and is a National Associate of the National Academy of Sciences.

Mark T. Bowers, PhD, PE is an Associate Professor of Civil Engineering and Assistant Dean for Undergraduate Studies in the College of Engineering at the University of Cincinnati where he has taught since 1985. He is the head of the Geotechnical Engineering Program and is a Registered Professional Engineer in the State of Ohio. Mark also has worked as a consulting engineer in Utah and a project engineer in Arizona.

Paul E. Potter, PhD attended the University of Chicago earning degrees in mathematics and geology. He worked for the Illinois Geological Survey and the University of Illinois before joining University of Cincinnati in 1971. After retiring in 1992, he worked in Brazil at several universities and currently is in Cincinnati as Professor Emeritus. He has authored or co-authored seven books on sedimentary geology and has received multiple awards.
The following is excerpts of our adventure during Washington and Lee’s Spring Term Geology Course: Regional Geology of the Colorado Plateau and Grand Canyon. We began our journey with one week on campus reading and discussing primary literature and becoming familiar with the stratigraphic column of the American Southwest. We also refreshed our introductory geology knowledge through memorizing the geologic time scale, honing rock and mineral identification skills, and reviewing basic sedimentary geology concepts. For the eight seniors in the course, who knew each other well after four years together in the department, this was a fantastic opportunity to get to know and embrace our younger peers. And after living and learning together for four weeks, we became a very close group.

The first six days of the trip were spent traveling from Salt Lake City, Utah to Las Vegas, Nevada, making frequent stops at road cuts and learning about geologic wonders along the way. Hiking up to Delicate Arch at Arches National Park, exploring the erosional remnants of the Ancestral Rocky Mountains at Fisher’s Tower, putting our relatively tiny hands inside giant dinosaur footprints of the Cedar Mountain Formation, and completing a geologic mapping assignment of an eroded anticline in the Purgatory Flats near St. George, Utah were highlights. However, it was no secret that everyone was counting down the days until we began our rafting journey down the Colorado River through the Grand Canyon.

After six days in Utah, we arrived in Las Vegas, Nevada, the base camp for our guide company, Grand Canyon Expeditions. The bright lights and bustle that bring millions to this city each year were just background noise for a group so eager to begin the next part of our adventure. And while early mornings were not exactly our group’s specialty, the excitement of finally laying eyes on the Grand Canyon after two weeks of learning about historical canyon explorations, such as the Powell Expedition of 1869, and reading Science review articles and excerpts from Edward Abbey, ensured that all 15 of us made our 4:30 A.M. call time, on time.

We arrived at Lee’s Ferry put-in, 14 miles downstream of the Glen Canyon Dam, where our belongings for the 8-day journey down the Colorado River were packed into 20-liter dry bags and ammo cans. In front of us, our rafts, the Hakatai and the Emily, floated against a backdrop of the Chinle and Moenkopi rock formations. Our remarkable river guides Emily, Den, Cleeta, and Laurie introduced us to river life and briefed us on the dry climate, bathroom etiquette, and the probability of encountering a rattlesnake. We pushed off early afternoon and began our 277-mile rafting journey through 1.7 billion years of the Grand Canyon rock record.

Beginning the first afternoon and continuing eight days, our time on the river was a mix of drenching rapid rides and discussions on the resistant cliff and less-resistant slope-forming rock formations of the canyon walls we floated through. Each student became an expert on specific formations and described to the class the characteristic lithology, depositional environments, and structures (sedimentary, structural, and metamorphic) associated with each. However, our discussions were not restricted to just the rocks. Our time was also spent learning about western water rights, industrial tourism, and what it means to protect our national parks.

Each night at our campsite after dinner, students gave 10-15 minute short-courses to refresh the class on their respective rock formations. It was exciting to incorporate into our lectures many other eager listeners from among the 15 non-student participants on the expedition. Teaching these ‘non-geologists’ not only helped us hone our knowledge and ability to communicate geologic concepts, but also fostered relationships between us students and the rest of the group.

With so many wonderful experiences, in addition to the amazing geology, we all came away with journals full of memorable stories. Some of the most exciting parts of our journey occurred during side-trips up the many slot canyons. We would dock the giant, 14-person rafts onto the shore and explore ancestral Puebloan villages for pottery remains or hike up to see the Paiute cliff dwellings, or our incredible stop at The Diving Board for 30-foot cliff jumping! All of these activities were unexpected, as many of us had not thought much about what we would be doing aside from conquering breathtaking rapids down the Colorado River.

The most memorable experience for many of us was when we reached the confluence of the Little Colorado River (LCR) and the blue-green Colorado River. The LCR was visibly different, a vivid turquoise in color due to the calcium carbonate content it acquired by flowing through calcium carbonate-rich Redwall and Muav limestone. Here, we readjusted our life vests to resemble diapers and body-surfed the LCR, maneuvering past travertine boulders and sliding down small drops in river level. As soon as we reached the end of the run, we hurried back up the shoreline to start again. Four or five times we ran the LCR, linking legs under armpits like bobsledders to make chains of 3-4 people floating together at once.

After a few “warm-up” days in Marble Canyon, which were actually quite cold and rainy, we hiked a short distance to the Great Unconformity at Blacktail Canyon. It was a marvelous spot in the Grand Canyon’s stratigraphy, the boundary between a well-understood
sequence of sediments and those of debated provenance, which marks the gap between the Proterozoic formations and those of the Mesozoic. Textbook-quality structural features, including boudinage and dykes, were found below the unconformity in the Vishnu Schist.

It was pleasant to sit in Blacktail Canyon while our guide’s guitar and lyrics echoed through the narrow slot canyon and feel the significance of a half billion years of missing rock record. At this point, the rim of the canyon and the Kaibab limestone rested over 1,000 meters above us. We all began to appreciate the spectacularly tall canyon walls, especially since the rocks exposed near river-level were far into the 1.7 billion-year Vishnu Schist and Zoroaster Granite Basement Complex!

We spent our final days on the river floating through Granite Gorge, the narrowest part of the canyon with the most technical and daunting rapids. In between the class 9 and 10 rapids, we enjoyed reflecting on the geology we had seen and discussing the forthcoming fate of the Colorado River and the Grand Canyon due to increasing demand for water in the western U.S. and tourism to the national park.

After what seemed like a few short days on the river, we were back to “rim life” in Lexington, Virginia where we soon deemed warm showers overrated compared to river baths and campsite nights accompanied by two guitars, a harmonica, and numerous vocalists.

We spent the last week of our adventure preparing final projects, which was a fantastic way to review and highlight different aspects of the trip. Groups of students were responsible for presenting on a different aspect of the Grand Canyon, from culture to stratigraphy to hydrology to volcanism. Our papers on these topics were bound into a class river guide, an educational compilation of pictures and excerpts from the trip.

Unfortunately, never again will we be awarded such a unique opportunity to learn geology. We are so very thankful to the Washington and Lee Geology Department and alumni who made this trip and course possible, including Dr. Lisa Greer and Nick Fox who led this amazing learning experience.
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Use of Surface Lithogeochemistry to Estimate Magnitude of Blind Uranium Mineralization in Northern Arizona Collapse Breccia Pipes

Lawrence D. Turner, CPG-11408  
Irving L. Turner

Abstract

DIR Exploration, Inc., has established a geochemical technology that permits pre-drilling estimation of the magnitude of uranium resources present in northern Arizona collapse breccia pipes by surface sampling the primary metal leakage surrounding these structures. The accuracy and reliability of the method is sufficient to serve as a rapid and very cost-effective substitute for much of the exploration drilling historically applied in the search for buried breccia pipe uranium ore bodies. To date, the surface sampling-based exploration method has been documented to work quite well at the 300 to 400 meter burial depths characteristic of Arizona breccia pipe uranium ore bodies.

Judging by the uranium-mineralized breccia pipe case study reported here, adaptation of the same geochemical approach to the exploration for other ore body types could rapidly and cost-effectively improve the rapidly declining economic mineral deposit discovery rate that is now plaguing the entire metals exploration and mining industry (Schodde 2014), and also reverse the markedly declining utility of exploration geochemistry as an ore body discovery tool (Schodde 2014). In both of these regards, DIR Exploration, Inc., has more recently adapted the same geochemical surface sampling-based method to exploration for Carlin-type gold deposits and for bonanza grade low-S precious metal vein deposits, and anticipates eventually doing the same for porphyry- and Mississippi Valley-type metal deposits.

The uranium exploration geochemical method described here was established by early 2010, at the end of a long search for a practical, inexpensive means of distinguishing between economically-mineralized, uranium-bearing collapse breccia pipes and similar looking barren geological structures located in northern Arizona west of the Navajo Reservation. As Figure 1 shows, the drill-hole-free prospect evaluation method described in this report is highly predictive of the amount of uranium ore in any given mineralized collapse breccia pipe.

Three main factors have been determined to govern the extent of uranium and metal sulfide mineralization in collapse breccia pipes during the breccia pipe mineralization process. These factors are: (1) timed existence of bacterial feedstock (oil); (2) upwelling, metal-rich brines; and (3) consequent generation of two proximal and coeval geochemical reduction barriers capable of precipitating metal sulfides and uraninite from upwell mineralizing fluids. See Figure 2.

Four independent geochemical parameters found in metal leakage values from bulk surface rock chip samples serve as numerical proxies for the breccia pipe mineralization-controlling factors just described. Multi-variable linear regression of these four parameters against published uranium reserves-plus-production figures from each test case produced a linear equation that predicts 97.95% of the variation in log value of the uranium resource present in the sampled cases. The statistical nature of the defined linear equation is such that its application to hitherto undrilled breccia pipe targets in northern Arizona is very strongly justified. Test application of the equation to twenty-three unmined breccia pipes with appreciable exploration drilling already completed verifies the results of the statistical tests of the linear equation.

A detailed explanation and discussion of the newly established exploration geochemical method, and the original northern Arizona surface geochemical data, can be found in the AIPG’s E-news in July. Watch for details on AIPG website, www.aipg.org.

Reference


Larry D. Turner, CPG-11408, is a second-generation mineral exploration geologist. He graduated from Eastern Washington State College in summer 1975 with a BS in geology, and thereafter began employment as a uranium project geologist and program manager for Minatome Corporation, working throughout the western US. Following completion of an exploration geochemistry-focused MS geology degree at Eastern in 1981, he briefly worked in petroleum exploration geochemistry for CITGO and then returned to mineral exploration as Energy Fuels Nuclear’s chief geochemist in northern Arizona breccia pipe uranium exploration. In 1987, he, his father (co-author Irving L. Turner), and his MS thesis advisor, Dr. Mohammed Ikramuddin, formed DIR Exploration, Inc., in order to manage a breccia pipe uranium exploration joint venture between DIR and the Japanese company, PNC Exploration (USA), Inc. This JV ended in 1993 with the continued and chronic uranium price level slump. DIR worked until 2006 as a mineral exploration contractor and as project generator. Over 1998-2000, Larry completed an MS in mineral economics at the Colorado School of Mines: some of the skills obtained in this graduate study led directly to the exploration innovation described in the current report. In 2006, DIR joined Takara.
Resources in a second northern Arizona uranium exploration JV. Work conducted during and immediately after this relatively short-lived JV (the region was effectively closed to uranium exploration in 2009) provided the data supporting the research and paper provided here. Larry D. Turner is currently conducting greenfields exploration for Au-Te deposits in central Colorado for DIR using a variation of the innovation described by the report.

Irving (Larry) Turner is a retired first-generation mineral exploration geologist who graduated from SIU-Carbondale (BS, geology/physics) and UT-Knoxville (MS, economic geology, 1960). He has two sons and two grandsons professionally involved in mineral exploration and mining, as well as a daughter and granddaughter who graduated from the Colorado School of Mines in other disciplines. After graduate school, I.L. Turner spent 10 years in underground and surface base metal exploration with St. Joe Lead, and then 4 years managing exploration programs for Vanguard Exploration in Washington State's Metaline mining district. Following Vanguard, Larry senior became a consultant for several years, managed exploration for NL Industries in Idaho's Bayhorse fluorspar mining district, and then joined Texagulf Minerals, Inc.. He retired from major mining company exploration work after working for a number of years as Leo Miller’s successor as Texagulf's VP of Exploration. In 1987, he, his son Larry, and Mohammed Ikramuddin, formed DIR Exploration, Inc., a company that has been active since that year in uranium and precious metals exploration.

Figure 1. Goodness-of-fit comparison of DIR-method surface sampling uranium resource estimates with actual mine production and/or measured reserves.
Figure 2. Vertical cross-section showing basic elements of a mineralizing collapse breccia pipe and the bulk surface rock chip sample geochemical parameters which permit statistical estimation of its contained uranium resource.
On the Topic of Martinique and Mt. Pelée

Robert Font, CPG 3953

This past March I fulfilled one of the remaining goals on my bucket list. I visited the city of St. Pierre in Martinique and had a great view of the infamous Mt. Pelée. My experience and observations regarding this fascinating area are condensed in the ensuing discussion.

Overview of Martinique:

During my visit, a delightful lady and local tour guide, Françoise, provided a concise and informative narrative of the island. In essence, Martinique is an insular region of France located in the “Lesser Antilles.” Its total area is 436 square miles. Fort-de-France is the nation’s capital. Other important cities include Marigot, La Trinité, Le Robert, Le Vaudin, Le Marin, Rivière Salée, Schoelcher and St. Pierre (Figure 1). The current total population is approximately 386,000.

Tropical forests are part of the island. The “Botanical Gardens of Balata” (Figure 2), which I visited near the capital city of Fort-de-France, are representative of the flora of Martinique. The northern end of the island catches most of the rainfall and is heavily forested.

The south is drier and characterized by savanna-like brush.

The island’s native fauna includes lizards and the dangerous “fer-de-lance” snake. The viper is portrayed in the “snake flag” of Martinique or “drapeau aux serpents.” In the 1800s mongooses were introduced to control the snake population. However, the mongoose has become problematic as it now preys on chickens and native birds. And, by the way, the snakes are still thriving.

The northern side of the island is mountainous with the highest point being Mt. Pelée at 4,853 feet above sea level. In contrast, the south has less relief. Attractive beaches are found in the southern section of the island.

General Geology Setting and Mt. Pelée:

The “Lesser Antilles” or “Caribbees” is the name given to the island arc south of the Virgin Islands. Most form a long, partly volcanic island arc between the “Greater Antilles” to the north-west and the continent of South America to the south. The islands form the eastern boundary of the Caribbean Sea with the Atlantic Ocean. The “Lesser Antilles,” “Greater Antilles,” and the “Bahamas” constitute what we know as the “West Indies.”

Pertinent to plate tectonics, the “Lesser Antilles” mark the outer edge of the “Caribbean Plate.” Many of the islands have formed as a result of subduction of oceanic crust from the “South American Plate” under the “Caribbean Plate.” The process continues and is responsible for volcanic and earthquake activity in the region.

The geologic history of the “Lesser Antilles” is complex. Basically, north of Dominica, the arc is divided into two island chains. The eastern chain is an older extinct arc largely covered by thick carbonate platforms. The western chain is a more recent arc and the site of active volcanism. South of Dominica the two arcs are superimposed, forming one chain of islands (Figure 3).

The island of Martinique is volcanic in origin. The oldest rocks consist of Upper Paleogene andesitic lava. Mt. Pelée is the island’s most dramatic feature. Rock samples from Mt. Pelée kept by the Smithsonian Institute include hypersthene andesite, dacite, volcanic ash, pumice and tephra. The strato-volcano erupted in 1792, 1851, and twice in 1902. The eruption of 8 May 1902, on “Ascension Day,” destroyed St. Pierre which is located only 4 miles south of the summit (Figures 4 and 5).
Tragically, 28,000 people died. Only two individuals survived in St. Pierre itself; Louis-Auguste Cyparis, a prisoner in a dungeon-like jail, and Léon-Compère Léandre, who lived at the edge of the city. Both were badly burned. Dr. John Dvorak in his text, “The Last Volcano,” narrates the account of a witness to the eruption. Captain Edward Freeman, commander of the steamship “Roddam,” was anchored in the bay when the eruption commenced. He witnessed the black cloud of the “nuée ardente” emerge from the volcano. Within two minutes it engulfed St. Pierre. By that time it was more than a mile wide and over one thousand feet high. The cloud of incandescent gas and ash approached the “Roddam” at hurricane speed. Captain Freeman watched his crew die in agony, as well as hundreds of people running desperately along the shoreline; their bodies on fire. The heavy iron chain that held his steamship to a buoy snapped and the vessel was set adrift. Suffering from terrible burns and in enormous pain Captain Freeman managed to steer the “Roddam” until it caught a current that allowed the ship to drift into St. Lucia. When Charles Dennehy, the British Colonial Surgeon of St. Lucia, asked Captain Freeman where he had come from, the Captain replied: “From the gates of hell” (Dvorak, 2015, p. XVI). At present, this beautiful island appears as another lovely spot in the overall Caribbean paradise. But as I viewed St. Pierre and the impressive Mt. Pelée towering so close to the city (Figure 6), I found myself offering a prayer so that what happened on 8 May, 1902, would not occur again!

References


Should I Become a CPG?
Have you been thinking about upgrading your membership to CPG? If the answer is yes, What are you waiting for? To find out if you have the qualifications go to Article 2.3.1 of the AIPG Bylaws. The AIPG Bylaws can be found on the AIPG website or the directory. The CPG application can be found on the website under ‘Membership’. Just follow the instructions. The basic paperwork includes the application, application fee, transcripts, geological experience verification and sponsors. If you have any questions, you may contact Dorothy Combs, Manager of Membership Services at dkc@aipg.org or call headquarters at 303-412-6205. www.aipg.org

Figure 4. The author points to Mt. Pelée from St. Pierre. Photo by Hilma Font.

Figure 5. A view of Mt. Pelée from the streets of St. Pierre. Photo by Robert Font.

Figure 6. Mt. Pelée stands ominously just 4 miles from St. Pierre. Photo by Robert Font.

AIPG Membership Totals

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New Applicants and Members can now be found on the AIPG website at http://aipg.org/newmembers

Section News can now be found on the AIPG website at http://aipg.org/sectionnews
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(Includes shipping)

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**Member Price:** $43.00
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The decisions of the Education Committee are final.

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To assist students with college education costs and to promote student participation in the American Institute of Professional Geologists (AIPG). Up to four scholarships will be awarded to declared undergraduate geological sciences majors who are at least sophomores.

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Applicants must submit: a letter of interest with name, mail and email addresses, and telephone number; proof of enrollment in an eligible geological sciences program, transcripts; an original one-page essay on why the applicant wants to become a geologist; and a letter of support from a faculty member familiar with the applicant’s academic work. The application packet should be submitted to:

**AIPG**
Attn: Education Committee Chr.
12000 N. Washington St., Suite 285
Thornton, CO 80241

**Awarded the month of MAY**

**Deadline**
February 15th

**AIPG National Scholarship Program**

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