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Coyote Flat Landslide

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Article requirements may be found at: https://aipg.org/page/TPGArticleSubmittal. Articles must be in MS Word format; any graphics (figures, tables, photos, etc.) must have a minimum 300 dpi resolution and you must have permission to publish it if the graphic is not your own.

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On the Cover: Photo Challenge Winner: Show Me the Mentoring: Albert Lamarre’s wife Janet is comparing her foot to the footprint of a dinosaur at Dinosaur Ridge near Morrison, Colorado by Albert Lamarre, CPG-6798.
The mission of the American Institute of Professional Geologists (AIPG) is to be an effective advocate for the profession of geology and to serve its members through activities and programs that support continuing professional development and promote high standards of ethical conduct.

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

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The Coyote Warp, or Coyote Flat Landslide, is a physiographic feature located on the east side of the Sierra Nevada, between Bishop and Big Pine, California. Its origin has been described as an artifact of structural warping. An alternative explanation is a mega-landslide.

Abstract

The Coyote Warp, or Coyote Flat Landslide, is a physiographic feature located on the east side of the Sierra Nevada, between Bishop and Big Pine, California. Its origin has been described as an artifact of structural warping. An alternative explanation is a mega-landslide.

Introduction

What follows is an alternative to Bateman’s (1965, p. 174) explanation of the geology and geomorphology he observed in the eastern Sierra Nevada, between Bishop and Big Pine. He proposed that the old (Eocene?) erosion surface had, by some mysterious and unexplained tectonic process, been warped down to the north, northeast, and east.

Matthes (1930 and 1960) recognized four stages of erosion in the central Sierra Nevada, the oldest being a nearly completely destroyed surface of presumably Eocene age. Although the age of the surface is clearly a subject for spirited debate, based on regional considerations, it seems an Eocene age makes the most sense at this preliminary level of review.

Bateman (1965, p. 174) includes the Tungsten Hills, west of Bishop, as a part of his Coyote Warp, as well as a similar-sized area south of Big Pine Creek. For simplicity, these two flanking areas are herein acknowledged as likely appendages to the main, obvious, landslide mass, but attention to them will be left for another essay.

Phillips (2017-a) offered a listric fault solution to explain the Coyote Warp. In this interpretation, the Sierra block would slide westward away from the White Mountains fault, leaving a series of fault blocks to fall into what is now Owens Valley.

Discussion

Coyote Warp

The Coyote Warp is described in great geological and geomorphic detail in Professional Paper 470 (1965, p. 174-181). The warp was characterized as having little in common with the adjacent Sierra escarpment. Instead, it was suggested that it represented a dissected old erosion surface (perhaps of Eocene age, Wahrhaftig and Birman, 1965, p. 305) that has been cut by faults and dissected by erosion of numerous steep-sided canyons and arroyos.

Additionally, several normal faults, some with valley side down and some with Sierra side down were described. Horsts and grabens abound between these discontinuous, curvilinear fault sets; all of which seemed to have baffled Dr. Bateman — he of course was an economic geologist and was apparently not familiar with engineering geology, at least not the same way as we are today.

Coyote Flat Landslide

Imagine an approximately 14½ mile wide, by approximately 17-mile-long, short-run-out block-glide-landslide or rotational slump — or some combination thereof (Figure 1). It has also been suggested that this feature may be a sackung (or sagging) by Kim Bishop, (personal communication, 2018; Radbrunch-Hall and others, 1976).

The Owens Valley graben provided an amply deep (approximately 7,000') and wide hole into which the slide could move (Pakiser and others, 1964; Hollett and others, 1991; Danskin, 1998).

Earthquakes along the Sierra frontal fault system would have released enough energy to get the earth moving, even if only a little bit at a time (Hough and Hutton, 2008).
At both ends of the mega-landslide, two small landslides were mapped by Bishop (2010), one near the northern toe (Figure 2), and the other near the southern toe (Figure 3).

Northerly views of hummocky and broken topography (Figure 4), and sag-ponds (Figure 5) can be seen along the southern side of the landslide along Big Pine Canyon Road.

Approximate Coyote Flat landslide boundaries proposed herein are (Figure 6):

1. Bishop Creek bounds the Coyote Warp landslide on its northwest-ern side.
2. Big Pine Creek/North Fork Big Pine Creek bound the slide on the southern side.
3. The southwest side of the Coyote Flat landslide is bounded by a nearly linear line of northwest trending stream valleys and small lakes along the east side of the Sierra crest.
4. The northeastern side, the toe area, is buried by Owens Valley alluvium (Figure 7).
5. The basal slip surface just might be a series of buried, water-saturated, roof pendants, with a lower coefficient of friction than broken granitic rock.

**Geomorphic Features**

**Room to Move**

The Coyote Warp landmass extends far out into the Owens Valley, away from the crest of the Sierra Nevada Mountains. The Owens Valley graben is bounded by down-to-the-basin faults on both sides, leaving a large hole to fill with landslide debris, fluvial and lacustrine sediments.

**Faults**

A series of short, discontinuous, near-vertical, northwest trending, down-to-the-east faults have been mapped (Bateman, 1965, Pl. 4) from the western edge of Coyote Flat, well out into the middle and near the eastern edge of the Flat. At the eastern edge of the Flat, a down-to-the-west fault forms the eastern edge of the Coyote Flat graben (Figure 7).

From Coyote Flat, east to the Owens Valley, a series of short, discontinuous, near-vertical, north-south trending faults dip back west, characteristic of the distal end of the mass slumping back toward the center of the slide mass (Figure 7).
Many of the short faults, especially in the vicinity of Coyote Flat, cut very young Quaternary glacial till and alluvium, suggesting that slide movement may not be finished. Initial movement is, however, at least pre-last glacial.

**Topography**

Coyote Flat topography is immature, irregular, and hummocky (Figure 8).

**Benches**

Besides the main Coyote Flat bench, there are a number of smaller named benches within the overall slide mass.

Warren Bench is an approximately three miles long and half-a-mile-wide bench located near the toe of the Coyote Flat landslide. It is located in Sections 11, 14, 23, and 26, of T9S, R33E, SBBM, about three miles west of Big Pine.

**Groundwater**

The presence of closed depressions or sags (Figure 9) and springs and swampy ground (Figure 10) are also suggestive of geologically recent landsliding. A number of named and unnamed springs discharge where the slide mass meets Owens Valley fill, as well as within the slide mass itself.

**Driving Forces**

There have been numerous glacial periods and interglacial periods during the past approximately 2.6 million years (Alfred Wegener Institute, 2020). The age of landsliding has not been established, but it must have been after the Sierras rose, or as they were rising, and as the Owens Valley graben was forming. If during this period of tectonic unrest, glaciers piled great thicknesses of ice on what is now Coyote Flat, then it seems reasonable to suggest that perhaps thick glacial ice might have, more than once, provided driving forces to initiate and perpetuate landslide movement down into Owens Valley.

**Summary and Conclusions**

The Coyote Warp land mass located on the east side of the Sierra Nevada Mountains, in the vicinity of Bishop and Big Pine, California, has been attributed to structural warping (Bateman, 1965, p. 174). A review of Bateman’s description of the Coyote Warp land mass and adjacent areas (1965, p. 174-183), as well as other pertinent literature (see references), leads to an alternative conclusion that the physical and geologic features observed may well be artifacts of a geologically recent mega-landslide, the Coyote Flat Landslide. Additional field work, including geophysical investigations, will further our understanding of the Coyote Flat Landslide.

**References**

Axelrod, D. I., and Ting, W. S., 1961, Early Pleistocene floras from the Chagoopa Surface, southern Sierra Nevada Mountains, in the vicinity of Bishop and Big Pine, California, has been attributed to structural warping (Bateman, 1965, p. 174). A review of Bateman’s description of the Coyote Warp land mass and adjacent areas (1965, p. 174-183), as well as other pertinent literature (see references), leads to an alternative conclusion that the physical and geologic features observed may well be artifacts of a geologically recent mega-landslide, the Coyote Flat Landslide. Additional field work, including geophysical investigations, will further our understanding of the Coyote Flat Landslide.

COYOTE FLAT LANDSLIDE

Figure 7 - Structure Section A-A'. See text for discussion of evidence for landsliding as opposed to structural warping (Bateman, 1965).

Figure 8 - Coyote Flat. View to northeast. The corral is in middle distance. Gray terrane at the base of the hills is glacial drift. (© 10-22-2020 W. J. Elliott 085)


United States Geological Survey, 1912, Mt. Goddard, California, 30' topographic map, scale 1:25,000, contour interval 100'.

United States Geological Survey, 1913, Bishop, California, 30' topographic map, scale 1:125,000, contour interval 100'.

United States Geological Survey, 1947, Mariposa, topographic map, NJ 11-7, United States, scale 1:25,000 (1" = ~4 miles), contour interval 500'.

United States Geological Survey, 1948, Mt. Goddard, California, 15' topographic map, scale 1:62,500, contour interval 80'.

United States Geological Survey, 1949-a, Bishop, California, 15' topographic map, scale 1:62,500, contour interval 80'.

United States Geological Survey, 1949-b, Mt. Tom, California, 15' topographic map, scale 1:62,500, contour interval 80'.

United States Geological Survey, 1950, Big Pine, California, 15' topographic map, scale 1:62,500, contour interval 80'.


**EDITOR’S CORNER**

This edition of TPG begins the second half of 2021, and includes the essays of the AIPG student scholarship award recipients; please be sure to check them out to find what is motivating the current generation of students to want to become professional geologists. This edition also includes a piece on California geology – the Coyote Warp Landslide – an Alternative Interpretation. An international flavor is added with an article on Haiti’s Rock and Soil Engineering Challenges and Potential Solutions.

As the year is progressing, I’ll take the opportunity to remind members of a couple of things. First, for those eligible to do so, please vote for your choice of candidates for National Officers. The election closes on June 30; be sure to review the statements and background of each candidate, and vote for the individuals you feel will be best for AIPG. Second, the Annual Meeting this year will be held in Sacramento, California. Please consider attending the meeting, particularly if you have never been to an Annual Meeting. The field trips are always a good time, and you will have many opportunities to network with friends and colleagues from around the country. I know, some members say that it costs too much to attend the meeting, or it is too far away, or they don’t have the time to take from their busy schedule to attend. Then consider rolling the Annual Meeting into a personal or family vacation. There are many things to see and do near each of the Annual Meeting locations, and by combining the meeting with a vacation, you are better able to do both at the same time. Many first time attendees of Annual Meetings have enjoyed themselves so much that they return the next year – and make lifelong friends with members from all over. I encourage YOU to attend; and if you do, look me up at the meeting. I look forward to meeting you!

This past year former editor John Berry and I have encouraged the submission of articles on California geology for publication in TPG. Since the 2022 Annual Meeting will be held in Marquette, Michigan, I encourage everyone to submit an article on Michigan geology for publication in the upcoming four TPG editions that lead up to that meeting. I’d like the first articles by August 1, 2021 to allow time for review and editing.

As I write this, we are beginning to emerge from the shadow of the Covid-19 pandemic. Restrictions are being lifted in many jurisdictions, and people are starting to relax and enjoy getting back to a semblance of normalcy. Please be mindful of the restrictions that are still in place and respect the choices of others if they are more conservative in mask wearing or similar behaviors that we’ve had to endure the last year and more.

But with the lifting of restrictions, we are able to travel more, and in particular, visit various outdoor points of interest, parks, and similar locations. While it may seem obvious that while visiting these locations, we all need to behave ourselves, it seems that there are always those who cannot or will not do so. I’ll share an example from a trip that Sara and I took last year to Michigan’s Upper Peninsula. After a week or so of sightseeing (and rock hunting!), we were on our way home and stopped at Laughing Whitefish Falls State Park. The park has nice trails to the falls, and wooden steps and a platform with a very nice viewing area of the bottom of the falls. The platform is a dead-end of the trail, and the perimeter has heavy railings and wire fencing above it to discourage anyone from climbing into the gorge and onto the falls. Unfortunately, when we arrived at the platform, there were numerous individuals (some with small children) that had climbed over the fence and were all over the falls. People had also constructed little cairns of rock in many places on the rock face. Needless to say, this behavior reduced the enjoyment of others that were trying to enjoy the falls and take photographs of the location. It can also result in a closure of the park, resulting in no one being able to enjoy it – this happened at a portion of the Sleeping Bear Sand Dunes National Lakeshore for several months last year.

While this kind of behavior is unacceptable to many of us, what should we do? If I were much younger, I would have considered jumping the fence myself and removing the cairns so that we and subsequent visitors would have a more unspoiled view of the falls. But this doesn’t eliminate the problem; someone else would probably just rebuild them, and others would continue to play in the falls. There are safety issues in connection with this choice as well – the hazard of going over the fence, climbing water-slick and algae-covered rock, and potential confrontations with belligerent individuals that believe that the rules don’t apply to them and they can do what they like. I gave serious consideration with talking with a park ranger about it, but there were none to be found when we were on the way out.

I’d be interested in other’s views of the situation, and if you have experienced similar issues, what did you do about it? Are there ethical issues in connection with the situation? What do you think?

Adam W. Heft, CPG-10265

**Are Rules Just Meant to be Broken?**

This past year former editor John Berry and I have encouraged the submission of articles on California geology for publication in TPG. Since the 2022 Annual Meeting will be held in Marquette, Michigan, I encourage everyone to submit an article on Michigan geology for publication in the upcoming four TPG editions that lead up to that meeting. I’d like the first articles by August 1, 2021 to allow time for review and editing.

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Adam W. Heft, CPG-10265
Dear Editor:

Geology has always been a passion of mine since I was young. I developed an even stronger passion later for teaching. I consider myself fortunate to be able to merge both of my passions into my career as an Earth Science teacher in a high school in northeast Indiana. I received the National Association of Geoscience Teachers award Outstanding Earth Science Teacher Award in 2020. Through that award, I received The Professional Geologist publication and there are three recent articles (“Emphasizing Geoscience as the Epitome of STEM” (V58.1), “Thinking About Geology” (V58.2), and “The Pressing Need for Advanced Placement Geology Course in High School Classrooms” (V58.2)) that resonate with my soul. The unfortunate common trend throughout the United States is the closure of geology departments and programs in colleges and universities. There have been countless articles and conference sessions discussing how to address this problem. Most suggestions have been focused on improving the programs by providing more internship opportunities, more hands-on instruction, and better field camps as a way to entice future students and retain current students. While I appreciate their perspective, they are completely overlooking the most obvious issue: Earth & Space Science (ESS) has nearly been completely eradicated from high school curriculum, and therefore few students have recent exposure to geoscience before entering post-secondary training. As a secondary Earth Science teacher in northeast Indiana, I can vouch for the need to view Earth Science as an equally important and essential course as biology, chemistry, and physics. The articles by Hailey Pantaleo, Mark Schaaf, and Matthew Rhoades highlight some of these concerns as well. I make the argument that the issue regarding Earth Science education is more about recruiting students and exposing them to geosciences early on than it is about academia programming.

State boards of education design curriculum initiatives around current needs, which are often 5 to 10 years too late to address the issue. For example, STEM became a major initiative around 2005 to address an engineering shortage in manufacturing. Then around 2010, there was another huge initiative to address the nursing shortage by pushing and focusing heavily on biomedical sciences. Project Lead the Way (PLTW) is a national program many schools have adopted to meet the initiatives pushed by the Department of Education in many states. PLTW has amazing and intensive learning activities that excite students in engineering and biomedical sciences. One of the biomedical courses from PLTW starts with a crime scene setup in the classroom and students work through biomedical principles throughout the course to solve the crime scene. In one of the engineering courses, students work for several weeks to design and code an automated marble sorter that differentiates the marbles based on their color. It’s easy to see why schools and students are thrilled to incorporate programs like PLTW into their curricula.

So where does this leave ESS education? To make room in the curriculum for these initiatives, Earth Science has been relegated back to middle school. Many states don’t even offer Earth Science as a high school course. In states where Earth Science is offered as a high school course, most schools reserve the class for students who “don’t do science”. Schools also actively steer academic students away from Earth Sciences classes and push them into courses such as chemistry and physics instead. This means that the students taking Earth Science in high school, if offered as a course, are students who struggle in the school setting and are unlikely to pursue careers in geoscience. In Hailey Pantaleo’s article, she shared that her only exposure to geoscience was environmental science, which is considered a life science (biology education certification). Matthew Rhoades discussed a push to bring in AP Geology as a possible solution, but this seems unlikely to succeed because many schools are dropping AP courses in favor of dual-credit courses. A study in 2014 tried to assess student and teacher perceptions of Earth Science education in Oklahoma. Despite Oklahoma’s vast oil and natural gas reserves, the study struggled to find Earth Science teachers as participants. Of the 39 teachers who responded, only ONE had a degree in Earth Science and that teacher wasn’t even teaching Earth Science. From the same group, 64% of the teachers said they did not enjoy teaching Earth Science and 13% of the teachers thought that Earth Science is very important. The issue of interest in geoscience as a legitimate science within schools begins with changing K-12 schools’ perceptions.

So what can be done NOW to engage K-12 students in geoscience?

1) Actively reach out to K-12 educators to speak with students.

One of my favorite resources to bring real-world science in my classroom is Skype A Scientist. Scientists register themselves to be virtual guest speakers and are partnered with K-12 educators all over the world. This is a great way to talk about programs and current research.

2) Develop partnership with local K-12 schools.

K-12 schools are in desperate need of partnerships with local universities, especially in geoscience. As stated earlier, it’s all about recruitment and engagement. Students in K-12 enjoy having guest speakers who can make the learning experience engaging and meaningful. Bring undergraduate students to assist in hands-on activities that get kids excited about geoscience. This could be as simple as having students complete water and soil sampling activities. Presenters could bring in exhibit items that may promote curiosity and inquiry. It doesn’t have to be elaborate, but it does have to be meaningful and repetitive.

3) Offer summer camps.

Similar to the partnership listed above, this is a simple way to bring students of any age group to the college campus or local parks to learn about geosciences. Transportation and cost may be an issue but there are many grants available to promote K-12 STEM education programs.

4) Promote high schools to attend professional geoscience conferences.

Attending conferences has several benefits: (1) it serves as professional development for the teacher, (2) students are exposed to higher level research, (3) teachers and students begin building their professional networks, and (4) K-12 educators can deepen their understanding.

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of geoscience concepts through attending and are able to incorporate these new concepts into their curriculum. Students learn that research is so much more than googling. They get to see how fun research can be and the positive relationships you build as a researcher with the community. Students also learn how scientists can make positive changes in their communities. Networking is a critical, yet under appreciated, aspect of becoming a professional. Students love to build meaningful relationships and attending conferences could potentially help students build mentorship partnerships with university representatives or professionals in the field.

I brought 12 high school students (grades 10 - 12) to the Geological Society of America’s annual conference a few years ago. I was absolutely amazed how well these students interacted with professionals and presenters at the conference. We attended two days and the conversations with students after each session was mind-blowing. Not all of these students were interested in geoscience, but they were interested in science as a career and attending the conference opened their world to what research looks like and the types of problems geoscientists investigate. One of the students who attended that trip recently published an article on his original field research to the International Journal of High School Research.

The fact is geoscience is solving the problems plaguing society, such as feeding the world’s population, equitable access to quality water, and managing natural resources. The role of geoscience in society is growing increasingly important. The future of geoscience resides in the K-12 schools. It’s up to geoscientists to access that resource and maximize its yield.

Thomas Anthony
Earth Science Instructor, Garrett High School
Garrett, Indiana

Dear Editor:

The last issue was jammed packed with great articles, notes and tidbits. Thank you!!

I read with interest James Howard’s article about “Geosciences in Modern Society,” and by the time I got to the examples of Stealth Education, I was excited to learn something. However, I have read and re-read those examples and they were a little ‘stealthy’ for me. I saw nothing that pointed to the specific value of geosciences to modern society. I was expecting something that pointed to the value of the geoscientist in understanding and resolving these critical natural resources issues, even if it was a soft-sell. But I think we missed the mark. Please pass along my comments to James and let him know I am looking forward to future examples – but hope they point the reader more directly to geoscientists helped resolve these challenges.

Other articles I enjoyed in this issue included: Letters (always worth reading); Hays Slaughter; Malibu, CA; Professional Ethics; and Why History Matters.

Thanks again,
Paul F. Putzier
Hydrogeologist Supervisor | Groundwater Atlas Program
Minnesota Department of Natural Resources

Response to Comments by Paul Putzier:

I read with interest the comments by Paul Putzier concerning my article on Geosciences in Modern Society. I feel that Paul has missed the point of the program in that he interprets the title of the discussion as a method of touting the geosciences to the public as a major mechanism for solving problems in modern society. In many cases, the insertion of an understanding of the geosciences into decision-making is vital to identifying critical elements of the process of problem-solving. However, a basic problem in the decision-making process is a lack of basic awareness by the public of the role which elements of the geosciences have played and are playing in critical facets of modern society.

One of the elements that must be avoided, except with selected audiences, is the overt “preaching” of the benefits of the geosciences in approaching the development of solutions to modern problem-solving. Such an approach will primarily result in the assumption that the individual making the presentation is biased, basically “tooting his own horn” and promoting his profession over the value of others. The purpose of the Stealth Education approach is to teach geoscience influence without overtly announcing the subject to the audience.

In the first article, the example used was one that can be applied to a variety of audiences. It was not intended to be other than an example of a core vehicle that could serve as a method for blending an individual’s own background in the geosciences into a subject that would be of interest to a broader, non-geoscience audience. Expansion of the subject material into a broader context of the geosciences would be the prerogative of the individual geoscientist involved.

As an example, the subject of the first article was the effects of climate change on human migration and empire building using the Egyptian Empire as a theme. If, for example, Paul Putzier, a hydrogeologist, was a presenter, his background would allow the insertion of brief discussion and illustrations of the water resource availability from water in deep wells derived from earlier wetter climate intervals in the region of the present Sahara Desert and its impact on the development of the modern North African nations as well as the potential crises associated with the ongoing depletion of that resource and the resultant impact on the population and resources of the modern-day migrants which utilize that resource. If appropriate, further extrapolation could involve the trend of depletion of the Ogallala Aquifer in the United States and the impact of that depletion on agriculture and economic development of the central and southern United States. This could also be linked to similar conditions in California, in which the major subsurface aquifers contain water that was stored during the Pleistocene wetter climate conditions and is now being depleted by overdraft. This overdraft is severely impacting water resource availability in both both population centers and agriculture. This impact is resulting in the promotion of desalination technology for new coastal developments as well as increasing investment in dam and pipeline infrastructure which further impacts public policy on potential environmental degradation and economic requirements.

In short, the slides and discussion involved in the articles on the Stealth Education approach are intended to merely provide a methodology for inserting the geosciences into areas in which most non-science trained audiences lack perspective. I do not intend to provide full presentations on selected topics. The first articles are intended only as illustrations of themes which can used to “piggyback” the insertion of the expertise
of the individual geoscientist into appropriate venues and broaden general public awareness. That broadening will, hopefully, allow a better understanding of appropriate elements of the geosciences in policy development for political, public and educational decision-makers. In other words, try to make them more receptive to ideas where geoscience influences are appropriate.

The follow-up discussions in this series will not involve long presentations but instead concentrate on groupings of one of more examples that can be used as springboards for expansion of a given topic area into the modern setting, where appropriate.

I hope this clarifies the intent of the Stealth Education approach. It is not to propagandize the benefits of the geosciences in decision-making but to provide examples of past and present-day events that geoscientists can use in their involvement in the program. You will notice that not all of the figures I use are from geoscience journals. Make use of other disciplines to interact with the geoscience principles you wish to emphasize but, in my opinion, do not use the terms geoscience or geology in the title of your presentation, except where geoscientists are the primary audience. Instead use titles that are familiar to the selected audience and then insert geosciences into the topics which are potentially most appropriate to the target audience.

Dr. James F. Howard, CPG-2536
Kentucky Section

Dear Ms. Wolverson and Dr. Johnson,

Last week's mail delivered the unexpected, and most pleasant surprise of your appreciation for my 40 years as a Certified Professional Geologist. Thank you.

The CPG certification has served me well over the years, and I trust my representation as such has served the AIPG equally well.

Ranging from my home base in the relatively remote fastness of Silverton, I rarely have opportunity to participate in person in AIPG affairs. But client cases do pull me out of my digs here from time to time. And many of those cases have involved expert testimony before courts of law, the US House of Representatives, and the internal Revenue Service. Sticking to matters in which I profess expertise, my credentials as expert witness have never been questioned. And, I am pleased to say, outcomes have always been positive.

I am indeed proud of my CPG-handle.

Thank you for acknowledging those 40 years.

John H. Wright, CPG-4828

Erratum

Dr. Richard Laton’s byline in the Apr.May. Jun 2021 TPG issue mistakenly identified his university affiliation. Dr. Laton, CPG-10544, is an associate professor from California State University, Fullerton.
Haiti’s Rock and Soil Engineering Challenges and Potential Solutions

Barney Paul Popkin, Consultant

Abstract

The Republic of Haiti is the poorest country in the Western Hemisphere. It is a low-income developing country, a failed tropical state sharing a large island on a West Indian island arc. It suffers from a very low gross domestic product/person of $695/year, poverty, illiteracy, unemployment, poor governance, corruption, and transparency issues. Haiti is burdened by high winds and humidity, hurricanes, floods and droughts, active faults and earthquakes, steep slopes, deforestation, inappropriate farming, mountain erosion and hillside creep, liquefaction, landslides and debris flows, expansive and swelling soils, sinkholes, and seawater intrusion. Approximately 90% of Haiti’s 11.3 million people live and work within its high-risk, natural disaster areas.

These challenges may be mitigated by proper and enforced impact analysis, zoning, land-use restrictions, and sound architectural and engineering codes and designs.

In addition, geotechnical measurements are the foundation for rock and soil engineering interpretations, decisions, designs, engineering, construction, structure operations and maintenance, and facility monitoring and evaluation. Uncertainties in sampling, testing, and measurement, and their assumptions are important to understand and account for safety, security, and sustainability.

There must always be attention to sampling, testing, measurement, variability, mitigation, failure, and litigation. Interesting challenges include sampling regimes, testing methods, probability analysis, risk assessment, ground stabilization, soil drainage management, and regulatory requirements.

Introduction and Background Issues

My experience in more than a dozen tropical and tectonically unstable countries underlies this analysis. In addition, my conversations with scores of geological and geotechnical professionals, and my uncle Ralph Popkins’ innovations in soil and materials testing were useful (EEECO).

The Republic of Haiti is located in the Caribbean Sea at 19° N, 72° W. It’s tectonically unstable, within the earthquake-, hurricane-, high-wind, and flood-prone area of the western third of the tropical island of Hispaniola. The country covers approximately 11,000 square miles (slightly smaller than Maryland), with a declining population due to emigration. Approximately 90% of Haiti’s people live and work within high-risk, natural disaster areas. Haiti has a warm, humid tropical climate characterized by diurnal temperature variations that are greater than the annual variations; temperatures are modified by elevation. Average temperatures range from the high 70s F (about 25 °C) in January and February to the mid-80s F (about 30 °C) in July and August (Encyclopedia Britannica, 2020).

Haiti has suffered from devastating cyclones, hurricanes, tropical storms, torrential rains, floods, and earthquakes. Its hurricane season lasts from June to the end of November, while its earthquakes may occur any time. Its hurricane winds historically vary up to 168 miles per hour (73 pounds per square inch or the load of a three-level building), and its earthquakes up to magnitude 7.0. Both have caused disastrous damage and loss of life (Wikipedia, 2019).

Figure 1 is a location map of Haiti in the Caribbean Sea. Haiti’s capital Port-au-Prince is approximately 217 miles southeast of Guantánamo in southeast Cuba.
Haiti suffers from high winds, excessive rainfall, high humidity, and frequent floods. Its young soils on steep slopes erode easily, and excessive rain or earthquake shaking causes large slides that block roads and bury structures. Its volcanically-derived swelling soils threaten pavements, sidewalks, and buildings. Because much of its bedrock is karstic cavernous limestone, sinkholes are common and structures are threatened by collapse into underlying solution cavities. As an island nation, Haiti also is burdened by rising sea levels, seawater intrusion, and salination of coastal and nearby riverine soils and groundwater.

Agriculture, as in most developing countries, employs most of Haiti’s people. However, it is severely limited in productivity because of deforestation and soil erosion, adulterated seeds, fertilizers, and pesticides. Overproduction of competing staple vegetable crops with no access to cold storage leads to gluts and wastage at harvest times, and to harvesting before crops are ripe in order to pay production costs. Output is also severely limited by flooded non-all-weather roads, and damage to produce caused by inadequate farm-to-market packaging during transit on these poor roads. Furthermore, tenant and squatting farmers are unable to make agricultural investments and commercial scams are rife in agriculture and agricultural finance. There is an inefficient vegetable distribution system through poorly financed “Madan Sara”, or street saleswomen, who often have daily working capital less than $25. Thus, truck vegetables frequently arrive at markets bruised, and mangoes often arrive mashed, because of the poor packing and rutted roads mentioned above.

Figure 2 shows several Madan Sara vendors.

My surveys, interviews, discussions, and observations in 2008 and 2013 found that most Haitians live in non-engineered, multi-generational, non-air conditioned, poorly constructed, hollow-concrete block and/or poorly constructed wooden homes. Their offices are not much better. These structures are susceptible to earthquake-tremor and hurricane-wind damage, settling, and failure. The non-rebar reinforced concrete (nRRC) structures frequently fail during tectonic events while rebar-reinforced concrete (RRC) structures are more likely to withstand tremors and wind.

These non-engineered buildings, shacks, emergency housing, and temporary shacks are prone to tilt, bulge, sink, or collapse. Haitian architects, engineers, and construction managers know their structures would be best served with RRC walls for safety and security, but the costs in such a poor country often preclude these sound construction practices.

As in many poor tropical countries, most Haitians spend much of their time outdoors engaged in non-economic activities, which saves many Haitians from death and serious injury when structures fail.

Figure 3 shows a typical Haitian small business shack structure.

These natural environmental challenges are exacerbated by Haiti’s poverty and poor governance. Poverty and governance...
severely limit the country’s ability to address them with well-funded and thought-out corrective and mitigative actions, and attract investors. Consequently, Haiti is dependent on international donors, philanthropists, and charities.

On the other hand, Haiti is a successful place for vacations, tourism, arts, crafts, and music.

The World Bank Atlas (2020) categorized Haiti as a “lower-income developing country” in 2019 based on its low gross domestic product per person. Transparency International (2020) scored Haiti as 18 out of 100 percent (Corruption Score 18/100, where 1/100 is highest corrupt percent) with a rank of 168 out of 198 countries (Corruption Rank 168/198, where 198 is most corrupt country). Corruption, bribery, cronyism, nepotism, fraud, looting, kidnapping, theft, customs delays and exorbitant shake-down fees, widespread illiteracy, and low life-expectancy are commonplace.

In addition, its French and Creole languages in an isolated island surrounded by Spanish- and English- speaking people is not helpful for its development. My colleagues note “endless double-digit unemployment, double-digit inflation, skyrocketing crime, out-of-control HIV, failing or non-existent infrastructure, a primitive waste disposal system, environmental destruction, and a hopelessly inadequate health system.”

As an example of Haiti’s living conditions, the hurricane early warning system constructed throughout the country with USAID funding was pillaged and destroyed so looters could sell the concrete blocks, diesel generators, plumbing and electrical features, and copper wiring.

Figure 4 shows significant Haitian hillside erosion.

Innovative Haitian demonstration agriculturalists have developed hillside vegetable crop strategies to reduce soil erosion by terracing, bed erosion and ditch recovery, and soil replacement, but these take out two thirds of otherwise cropped land, are labor intensive, and inefficient.

Figure 5 shows significant erosion from poor household drainage.

Figure 6 shows a flooded agricultural road after a light rain.

Haiti Construction Brief

Many homes and office buildings are routinely constructed with unoccupied ground floors to accommodate routine flooding, as does the U.S. Embassy post and USAID Mission in Port-au-Prince. These unoccupied areas are used as lobbies, waiting and greeting area, and inexpensive cafes. Living and working activities are usually performed on second stories and higher.

Wealthier homes are often sited on artificially high ground, and surrounded with high concrete hurricane and security walls for wind, flooding, and vandalism protection. If feasible, structures are constructed to divert flood water away from the building, but this is difficult in the western coastal flood plains and valleys where more of the people live and work.

Climatic Brief

“Climate is what you expect, while weather is what you get.” In designing for weather and resistance like high winds, flooding, tornadoes, and hurricanes, it’s wise to design for extreme events rather than average events for more security.
The geologic evolution of Hispaniola can be traced to the Mesozoic breakup of Pangea and the creation of the Atlantic Ocean. This process resulted in the formation of the Caribbean microplate, with subduction zones forming around the margins. The geology of Hispaniola, including Haiti, consists of igneous rocks formed within a volcanic island-arc, as well as abundant marine sedimentary rocks that have accreted at the oceanic subduction margin.

Figures 7 and 8 illustrate Haiti’s general structure in the Caribbean and its surface rocks, respectively. Note the major regional Caribbean and North American plates and Enriquillo-Plantain Garden and Septentrional faults, and distribution of rock types and major geologic formations.

Physical Geographic Brief
Haiti is a lush and rugged volcanic and karst carbonate island-arc with a long and varied coastline and thin alluvium. Steep slopes are prone to rapid soil and rock erosion, mass wasting, landslides, and debris flows. Rocks on geologic contacts are prone to slide. Carbonate rocks are prone to dissolve and form karst. Clays expand when wet and are prone to liquefaction. Haitian deforestation to replace coffee and other trees with cash vegetable crops contribute to hillside erosion and valley sedimentation.

Geologic Brief
To engineers, soils are loose or unconsolidated natural rock materials while rocks are consolidated solids often separated by fractures.

According to DesRouches et al (2011), rainfall is generally higher and more variable in the rugged hills and mountains above coastal Port-au-Prince.

Rainfall is generally higher and more variable in the rugged hills and mountains above coastal Port-au-Prince.
Haiti has abundant rainfall and streamflow; however, it suffers from serious water supply problems due to wastewater and agricultural pollution of its surface and ground waters, sedimentation of its surface reservoirs from deforestation, seawater intrusion, thin and narrow coastal porous media alluvial aquifers, and low-yield inland fractured rock aquifers (USACE, 1999).

**Soil Brief**

In general, if loose materials pass the 200-mesh sieve, it’s soil. There are several soil classification systems, depending on its potential use in agriculture, excavation, and construction. Soils may be deposited and transported by wind (aeolian), water (overland river flow) and rock-mass wasting, or developed in-place by chemical, biological, and mechanical rock decomposition over and within bedrock. To the engineer, soil consists of gas and solids, while agriculturalists are interested in organic matter, biological, and chemical properties as well. Haitian soils are derived from igneous, metamorphic, and sedimentary rocks, including its abundant carbonates.

The USDA-NRCS Soil Taxonomy system (1999) is based on 12 soil “orders,” and “suborders.” Haiti’s general surface suborder soils, Aridisols, Ultisols, Alfisols (forest soils), and Inceptisols are the soil orders prevalent in Haiti.

These soils are derived predominantly from calcareous materials with some basaltic material in several areas of the country (Louissant, 2006). Moreover, about 60 percent of all lands have slopes greater than 20 percent. Only 29 percent have slopes less than 10 percent. Interestingly, less than 20 percent of the land under cultivation is appropriate for agriculture. Haiti produces only 50 percent of the foods for its population. Soil erosion on terraced mountain and hillside slopes, recurrent drought, and absence of irrigation make crop production paltry. This issue, poor governance, natural hazards, illiteracy, and abject poverty contribute to Haiti’s Human Development Index of 169 of 189.

Maps of the impact of Haiti’s 2010 earthquake show the “extreme” and “violent” areas comprise the most highly densely populated parts of Haiti. Maps of Haiti multi-hazard risk, major disasters and severity (1998-2020) show that the highest risks are associated with earthquake faults and hurricanes.

**Potential Solutions**

There are several obvious and more subtle potential solutions.

Obviously, improvements and enforcement of design, engineering, and construction permits, codes, and regulations could be helpful, similar to the U.S. National Environmental Quality Act (NEPA, 1970), US court-ordered 22CFR216 (1976) for Foreign Assistance, and the more stringent California Environmental Quality Act (CEQA, 1970), as well as land-use zoning and use restrictions, similar to California and Oahu, Hawaii restrictions for permanent structures near active faults (Alquist Priolo Special Studies Zone Act, 1972) and tsunami and coastal flooding zones, respectively. Revisions, updates, and distribution of Haiti’s active fault, landslide, liquefaction, flooding, and karstic vulnerability zones and early warning system upgrades would be obviously useful. U.S. tsunami, US National Hurricane Center hurricane, California’s earthquake, and San Francisco Bay area’s landslide warning systems are good examples of what is feasible.

**Uncertainty and Risk Issues**

The importance of consultants and practitioners to be current in technology and litigation cannot be overemphasized.

The advances in geotextiles provide cheaper and more sustainable potential designs and mitigations to engineering soil challenges. As Albert Einstein said, “Once you stop learning, your start dying.”

Uncertainties and risks include: testing or incomplete observations can lead to engineering failure of structures or mitigation measures. These may lead to loss of life and destroyed property and infrastructure.

Observing, drilling, sampling, and testing in the wrong locations, lead to the wrong conclusions, recommendations, and thinking. For example, not observing thin, expansive clays or shales in soils, or solution cavities in rock can be catastrophic. Correct observing is essential. As Yogi Berra said, “You can observe a lot by looking”.

Another risk includes sampling and testing errors, and misunderstanding and misusing testing assumptions. For example, sampling and testing water-flow in solid rock and missing testing of rock fractures, and poorly testing soil pore water content, can be catastrophic. In addition, failure to appreciate that field conditions will change soil reactions over time and higher loads than tested can be catastrophic. My work in Sri Lanka indicated that dozens of accurate in-place permeability tests in limestone produced results similar to concrete and orders of magnitude lower than a half-dozen pond permeability tests which realistically accounted for limestone fractures.

Focusing on average test-results rather than risky-extreme test results can be dangerous.

As Syed (1982) taught me: “Soil engineering is the uncomfortable nexus, if not conflict, between scientific fact and engineering judgement in managing soils to support physical infrastructure.”

**Geological and Soil Engineering**

Table 1 on page 17 summarizes common problems, damage, and a potential remedy. These are not intended to replace detailed engineering studies, testing, and analysis. Because of Haiti’s extreme poverty, the cost of well-designed, engineered, and constructed safe structures needs to be heavily subsidized.

**Author**

Barney Paul Popkin is a geologist, hydrologist, soil scientist, solid waste and hazardous materials manager, teacher and trainer, and water/ wastewater, drainage/ flooding specialist, and monitoring and evaluation specialist with over 50 years experience in about 30 U.S. States and as many developing countries.

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<th>Problem</th>
<th>Damage</th>
<th>Potential Remedy</th>
</tr>
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<tbody>
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<td>High winds, including hurricanes</td>
<td>Roof and walls collapse; destroyed habitats; loss of property, livelihoods, and life</td>
<td>Steel-reinforced roof connects to wall beams; concrete-filled offset zig-zag block walls with epoxy-coated rebar</td>
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<tr>
<td>Drainage failure and flooding</td>
<td>Soil erosion; destroyed habitats; collapsed structures; buried and failed physical infrastructure; downstream sedimentation and destroyed agricultural fields; loss of property, livelihoods, and life</td>
<td>Vulnerability mapping; drainage control and flood management; water management; use of geotextiles</td>
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<tr>
<td>Expansive soils</td>
<td>Wall, floor, pavement, walkway buckling; concrete pad foundation and piling failures</td>
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<td>Hillside erosion and creep (mass wasting)</td>
<td>Soil loss; destroyed habitats; collapsed structures; buried and failed physical infrastructure; downstream sedimentation and destroyed agricultural fields; loss of property and livelihoods</td>
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<td>Valley and riverbank soil erosion</td>
<td>Collapsed structures; destroyed habitats; failed physical infrastructure; downstream sedimentation and destroyed agricultural fields; loss of property, livelihoods, and life</td>
<td>Reforestation; re-establishment of agriculture; constructed terraces and rock gabions; sediment walls, geotextile erosion-control blankets; widen channels</td>
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<td>Landslides and debris flows</td>
<td>Collapsed structures; destroyed habitats; failed physical infrastructure; downstream sedimentation and destroyed agricultural fields; loss of property, livelihoods, and life</td>
<td>Vulnerability mapping; land-use zoning and enforcement; mandated permanent structure set-backs; excavation of prone areas; reforestation, vegetation cover, rock gabions, and geotextile covers to assure soil drainage; monitoring and evaluation; early warning networks</td>
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<tr>
<td>Liquefaction</td>
<td>Collapsed structures; destroyed habitats; failed physical infrastructure; loss of property, livelihoods, and life</td>
<td>Vulnerability mapping; land-use zoning and enforcement; mandated permanent structure set-backs; excavation of prone areas; reforestation, vegetation cover, rock gabions, and geotextiles to assure soil drainage; monitoring and evaluation; early warning networks</td>
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<tr>
<td>Faulting and earthquakes</td>
<td>Collapsed structures; destroyed habitats; failed physical infrastructure; loss of agricultural fields, property, livelihoods, and life</td>
<td>Vulnerability mapping; land-use zoning and enforcement; mandated permanent structure set-backs; earthquake-resistant building codes; use of structural concrete to support loads; cement-grouting of buried caverns; monitoring and evaluation; early warning networks (including monitoring sinkholes)</td>
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<tr>
<td>Sinkholes</td>
<td>Collapsed structures, failed physical infrastructure; destroyed agricultural fields; loss of property and livelihoods</td>
<td>Vulnerability mapping; land-use zoning and enforcement; mandated permanent structure set-backs; cement-grouting of buried caverns; monitoring and evaluation; early warning networks which monitor sinkholes</td>
</tr>
<tr>
<td>Sea level rising; seawater intrusion</td>
<td>Soil and groundwater contamination by salinization of coastal and nearby riverine areas; reduced fresh-water supply and agricultural production; destroyed habitats; physical infrastructure corrosion and failure; loss of livelihoods</td>
<td>Vulnerability mapping; land-use zoning and enforcement; enhanced groundwater recharge; monitoring and evaluation; warning networks</td>
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For the 20th consecutive year (2020 was cancelled due to the COVID pandemic) the California Section of AIPG presented awards at the California Science and Engineering Fair (CSEF) via a virtual or online program format on April 13. Mark Rogers and Dave Sadoff, AIPG California Section Southern and Northern Vice Presidents, respectively, judged a total four (one Junior and three Senior Division) geoscience projects.

The First-Place winner was Ayush Agrawal with his project entitled “Early Detection of Arsenic Contamination Risk Using Satellite Imagery and Machine Learning”. The purpose of his project was to determine if a significant correlation could be established between hyperspectral imagery satellite wavelengths and arsenic contamination in soil (and to a lesser degree groundwater) at varying landcover locations in the U.S. Ayush’s motive in pursuing this project was improving public health and safety after some of his family members in India ingested arsenic-contaminated water. After making interference corrections based on errors resulting from satellite-based imagery vs. lab-based imagery, Ayush determined that machine learning (ML) regression model SD-BPNN was the best suited in detecting arsenic in soil (reflectance <0.8 mg/kg) of the four models studied and 16 correlations completed. Data improvements would include considering more variables (land / crop cover, soil type, proximity to bedrock / water source, elevation) going into the ML modeling that affects arsenic concentrations in soil to check repeatability. Ayush received an AIPG awards certificate and $250 for his efforts.

The AIPG California Section also presented Second and Third-Place Award Certificates (which included $150 and $100, respectively) to the following students (see abstracts at http://cssf.usc.edu/Current/Panels/):

- **Anneli and Mathilde Macdonald** for their project “Water Quality Conundrum: The Effect of Rainfall on Septic Levels in Rural Creeks”; and
- **Vivian Dang and Elizabeth Conrad** for their project “Tsunami Coastal Defenses – What is the Best Coastal Defense Against Tsunamis”.

Once again, it was a pleasure to discuss projects with such bright students who represent our future. We are hopeful we will be conducting in-person interviews at the CSEF in 2022. Congratulations to the winners!
As a young child, I was fascinated by the earth sciences. I recall wondering and daydreaming about what exactly could be inside of this beautiful planet. Finding the perfect place for the newest addition to my extensive rock collection was a primary, and seemingly unique, childhood concern. The more I explored and learned about the earth sciences, the more I was drawn to know everything there was to know about them. As I grew older, the importance of geology became evident to me and I realized how it truly affects the world beneath and around us. From our basic need for water and energy to the stable land that we build on, geology plays a key role in our society and survival.

In today’s world, the study of geology is especially relevant. Our society is facing an array of issues that are now in the limelight of geologic science as well as environmental science. We are facing real challenges regarding energy, water, and natural resources. We are aware of what the future may hold; and we are actively adapting by adjusting how we develop our lands and buildings. Now, more than ever, it is crucial that we think on a planetary scale. It is up to us to use what we know about the past to determine how we prepare for the future. How we plan to live with this planet absolutely matters and our tomorrow depends on our knowledge of geology.

Even as a child, I was astonished by the news of natural disasters. It is important that we are aware of what physical dangers there are around us: volcanoes, earthquakes, landslides, tsunamis, etc. Through science, we continue to study and understand these natural disasters. Today, there is a higher population in areas that are not traditionally inhabited, and more people are moving to coastal areas. All the while, we are seeing that geologic hazards are playing a main role in vital decisions; decisions regarding where we put our buildings and how society can alleviate these natural hazards. Geology is teaching us how to deal with living in areas that are prone to earthquakes, hurricanes, floods, tsunamis, or other natural disasters. Knowledge of these hazards has become very important. It is imperative that we understand where the hazards are, when they occur, how often they occur, and how they will affect people. This is only a small piece of the puzzle that has intrigued me to pursue a career in geology.

We are seeing a mineral resource stress on the planet right now. This mineral resource stress is due to more and more countries contending for less and less mineral products and commodities. Unfortunately, these products are being exploited at a very rapid rate. This includes commodities such as copper, iron, zinc, lead and nickel. It includes a variety of precious metals, semi-precious metals, and non-precious metals. It includes a vast number of other minerals that are particularly important for society. These are commodities that are running out and we need trained geoscientists to understand more about these resources. Trained geologists can discern where these deposits are, how we can find them, and ultimately how we can extract them in the most environmentally sensitive way.

As mentioned earlier, geology plays the lead role in harnessing energy. Geologists are often tasked with finding more oil reserves or finding alternative sources of energy. Energy resources still include traditional hydrocarbon, gas, and coal; however, it now also includes new emerging...
technologies with respect to alternative energy, such as wind power. We need geologic scientists and environmental scientists who can understand wind patterns, how wind changes, and how climate may change. Energy is not just traditional hydrocarbons. It includes new alternative energy and earth scientists are needed to be able to work on these problems.

Perhaps one of the biggest challenges to society right now is global climate change. Global climate change is something that we can measure readily in a number of places around the globe. It is one of the key challenges that society faces because we are living in a dynamic, changing environment. We need to understand the environment and how those changes will impact us short term and long term. We must know how those changes will affect our everyday ecosystem: where we live, our rivers and streams, the trees and the environment around us. This is a very important challenge that we must gain knowledge on and we must actively monitor.

Having experience and knowledge of geology is not only a very interesting subject, but it is also very relevant and practical to issues facing our country today. As a child, I recognized my passionate thirst for geologic knowledge. I continuously fed my hunger to know more about this amazing planet that we live on. As an adult, I am bound and determined to do whatever it takes to accomplish my goal and dream of being a geologic scientist.

Yueyi Che
SA-10774
University of California, Berkley
California Section

When snowflakes fell from the sky, I ran out of the classroom with my classmates, jumped into the several-inches-thick fluffy snow, and opened my mouth wide facing the sky to taste the first snow of the year. Growing up in Harbin, the City of Ice, I am always curious about glaciers and want to explore the high alpine and polar regions. I want to become a geologist who researches one mineral: ice.

In the summer of 2019, I participated in the Juneau Icefield Research Program (JIRP) and learned about glaciers in the field. During my two months on the icefield, I had a wonderful time drilling ice cores, digging glacier mass balance pits, and dragging a ground-penetrating radar across the glacier. My favorite research was collecting samples for Be$^{10}$ dating and analyzing the exposure age data. I never felt tired after field trips; I sometimes felt even more energetic to tackle problems because my heart was filled with love for nature. I was curious about the change of landscape over time and its relationship with global climate events. I was proud to present the JIRP research at the AGU Annual Meeting and engage with local communities in Alaska and British Columbia using my science communication animations.

After JIRP, to satisfy my curiosity for geochemistry lab work, I became a student sample preparation technician at the Berkeley Geochronology Center (BGC). The deeper I dove into geochronology, the more interesting questions arose from my research experience at JIRP. The sample sites at JIRP are glaciated and the exposure history under the glacier remains unknown. I was intrigued to learn more about the processes behind a complete deglaciation event at a fully deglaciated area, which led to my interest in the Tioga glaciation in Yosemite National Park. I successfully pitched my project to professors at my department, handled logistics of sampling at a National Park, as well as applied for and obtained $12,000+ of funding. With my results, I am going to develop a glacier geometry change model during deglaciation to help predict the glacier mass balance change under contemporary global warming and assist water resource management plans for adapting to our changing climate. I believe climate change is the largest issue humanity faces in the 21st century and I hope to help tackle environmental problems through research. The scientific research community is a special stakeholder that...
can guide industry, government, and global organizations in making decisions to adapt to our changing climate. I hope to broaden our knowledge of glaciers and their interactions with different Earth systems, how it would influence our water resource budget, and natural hazard risks. I will join the intellectual force of adapting humanity to the changing climate by solving smaller science puzzles that can support the advance of more areas. Nature has shown me wonders and stimulated my curiosity. I hope our next generation can enjoy nature as I do, instead of fearing its demise.

I want to be a geologist also because I want to advocate for increasing diversity, inclusion, and accessibility in geosciences and the wilderness. Nature’s beauty is what got me into geoscience. I have a dream that everyone who hopes to explore the wilderness can have the confidence and opportunity to set foot in the field, no matter their gender, age, disability, level of outdoor experience, ethnicity, or income. As the Chair-Elect for the Geological Society of America (GSA)’s Student Advisory Council, as well as the student representative of the GSA Education and International Committee, I delivered multiple speeches last fall to students and educators from North and South America, Europe, and Asia. I believe encouragement and examples are most needed for underrepresented students to study Earth science, a scientific field that people in their communities are not familiar with. I used my story as an Asian woman in geoscience to inspire our next generation to pursue their passion with confidence. By attending leadership business meetings of the GSA education and international committee, I expressed the student body’s hope for a more diverse science community, as well as the more accessible future of science by remote education I saw from the global pandemic. I have rich experience in science communication: from being science communication picture editor for the Institute of Geology and Geophysics, Chinese Academy of Science official social media for three years, to volunteering under NASA as a Lucy Asteroid Ambassador. I have spoken to the general public as a geoscience student, but in my future career as a geologist, I hope the diverse population living on the land could have their voice in geosciences. I want to be a geologist who fights for a more inclusive and accessible science community.

In order to get a better perspective of what I would be doing I decided to have a conversation with someone at my church who was a Professional Geologist. JJ Brown explained to me that geology was an in-depth discipline that is sort of all encompassing. From chemistry, physics, and math, to critical thinking, interpretation, and problem solving. She gave me a piece of advice that I still refer back to: “Pick the thing that sounds the most fun to you and go from there”. I pondered over this and continued to go back and forth until I declared my major on graduation day. I had chosen the department of geology and geophysics at the University of Wyoming.

After one intro class in the fall of 2018, JJ asked me to work with her over winter break. My knowledge was limited, but those few weeks made me appreciate my choice of study even more. Working directly in the mineral exploration industry, even with limited experience gave me the foundation for the research and work I would do later. With her guidance, I was able to edit technical reports, read over data, and just generally obtain valuable skills as I moved forward. I was fortunate that my work experience translated well to my class work, and vice versa. I credit a lot of the practical knowledge I obtained as being learned from JJ. She has been a large part of my decision to stick with the program and ultimately with geology altogether.

Over the past three years, I have worked for JJ intermittently, but every time I start a new project or new task, I learn more if I attempt to utilize problem solving, critical thinking, and now my new recent knowledge of geology and apply it to my work. Lastly, asking questions has been something I learned to do better. Asking questions enables me to do my job better and allows me to expand my knowledge which will help later on in my career. Moreover, having been in the program for five semesters and doing countless hours of research, fieldwork, core-logging, and lab work I realized that being a geologist encompasses all of the most interesting scientific aspects of the world in a way that will allow me to be a lifelong learner of the discipline. This is what I find most fascinating about geology (aside from the obvious new-found love for looking at rocks, minerals, core, etc.).

“Geology students are the happiest on college campus” I read in a Forbes article sitting in my independent study course my final spring of high school.”
After considering the previous statement, I would like to add that in addition to the fascination I have with our natural world, I haven't met a more fun-loving community of people outside of my peers here at UW. While we have all fretted about our exams, like everyone in college does, I can’t help but appreciate their support and guidance throughout my journey in school. Whether they know it or not, their help as a lab mate, study partner, or just socializing outside after class has brought me to realize that these are the same people I will work with everyday once I am done with school. With everything I have addressed I can confidently say that I know I want to be a geologist and that this was an impeccable choice. I am looking forward to my career in geoscience, lifelong learning, and sharing my curiosity of the natural world with those within my career field, and outside.

### Jamie Good
**University of Florida**

I am from a small farming community, nestled in the middle of Florida’s springs heartland. Growing up, the health of our local water resources was - and still is - a consistent issue. My father worked as an environmental engineer for our water management district. Many of my weekends were spent with him on the Suwannee River, where he told me about the aquifer and springs and their most pressing issues. Given my childhood, I was inspired to go into the physical sciences, in the hopes of eventually helping communities such as my own. Although the work I end up doing may not be as specific to my hometown as I had once imagined, I know that my work will be applicable to the relationship between a people and their occupied environment, and I would like to play a part in improving that relationship.

Once I graduated high school and began my secondary education at the University of Florida, I chose to major in geology on a whim. My father had told me of his geologist coworkers, who had many opportunities for field work and often reminisced on their times as an undergrad. I decided that for the time being I would explore geology. At that time, I didn’t understand the full scope of geology and thought it was “just about rocks,” as most people do.

However, upon taking my first geology class, I was hooked! I decided to go on an impromptu field trip which was led by some members of UF GeoClubs. That trip resulted in me falling in love with geology. I realized that geology is the intersection of nearly every branch of science, history, and exploring the great outdoors, all of which can be used to make sense of this messy world we call home. With each few steps, the Earth tells a different story and records millions of years. As a geologist, I get to piece together that history and I could not be more excited to do so!

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### Jessica Hiatt

**Colorado School of Mines**

Being a geologist can mean a wide variety of things, which is why it has always interested me. Having become acquainted with many geology professionals while studying at [Colorado School of Mines], this range has become more apparent to me and thus only strengthened my interest in integrating the liberal arts with science and engineering developments. The job versatility makes for an exciting and challenging career choice. I have found the field work in which I have participated has been incredibly fun and rewarding. I thoroughly enjoy developing an understanding of the processes that shaped the Earth. I hope to investigate how these processes, as well as geologic and geographic variables, influenced the development of past cultures and the preservation of their evidence. Looking at my past, it’s not surprising that my studies have led me to be where I am today. I always have been the kid who was picking up rocks and trying to figure out what kind of rock it is and how it came to be there. Who had touched it before, if anyone? I want to continue to be that person with that same sense of curiosity for the rest of my life, asking these and other questions.

Specific factors that have interested me are the abundance and ease of access to materials and specific landscapes and how those factors influenced where, when and how civilizations developed.”

The integration of well-preserved geologic and historical records can provide more descriptive stories of past civilizations, enabling a greater understanding of the world in which our ancestors lived. I also would like to investigate how the geology and geomorphology influence the probability of a successful excavation, as well as the nature of materials that may present themselves during such an excavation.

Looking at the geologic influence on the cultures themselves can provide a valuable context to understand the world of those inhabiting the landscape before us. Specific factors that have interested me are the abundance and ease of access to materials and specific landscapes and how those factors influenced where, when and how civilizations developed.
I would also like to analyze how the paleo-geomorphology of a location influenced where and how people lived. These prior geologic factors may also explain habitation trends, trading routes, and social habits. For example: island versus continental, or coastal versus highland environments. Lastly, comparisons could be made between similar cultures that experience different geologic and geomorphologic settings. Lastly, comparisons could be made between similar cultures of a region, but ones that have varying geologic and geographic settings, thus enabling examination of the disparities and similarities of the materials abundance and accessibility, can affect cultures to the potential of a relatively small scale.

Geologic and geomorphologic factors influence the degree of preservation, accessibility and likelihood of a successful excavation, as well as influencing the excavation methodology and overall feasibility of excavating a particular site. Categories to be investigated include the different rocks that characterize an excavation site, the geomorphology of the area, and the types of materials and volumes of such materials that are most likely to be present based upon observations. Geographically, research could also expand into evaluating the socio-political factors in the area of the proposed excavation, as well as morals and ethics of exploration of the region.

In summary, I hope to evaluate how the geological setting influences excavation, documentation methods, and potential excavation success by examining the influences of geology and paleo-landscape on culture development and behavior. I will not be working as just an archeologist, geologist, or engineer but all three of these. I will thus stand out as an individual with a strong technical, logical and scientific background that I can use to describe evidence of prior origins to explain how societies developed and failed based on the geologic environment.

Samantha Hillburn
SA-10970
Tulane University
Louisiana Section

I have been fascinated by the world around me – by landforms, rocks, fossils, and natural disasters – for as long as I can remember. Years of hiking and backpacking with family cultivated my love of nature and strong affinity for Earth science from a young age that only strengthened with time. Still, as many college students do, I lost touch with childhood passions and struggled to settle on a major until one introductory geology course brought me full circle. I owe endless gratitude to outstanding Tulane University professors who altogether altered the trajectory of my education and career with their inspiring lectures and academic support. Advanced geology coursework and small class sizes meant I could spend hours asking questions, reviewing concepts, and discussing ideas that left my mind reeling in the best way.

My geology classes covered billions of years of Earth history, from our early planetary origins to modern climate change. I learned that no matter how much carbon dioxide humans pump into the atmosphere, the world will keep spinning. When we say “save the planet,” we really mean “save ourselves.” Geology opened my mind to unfathomable timescales over which mountains are built and weathered down, oceans open and close, and entire lithospheric plates are recycled in the mantle. We can learn so much about present and future climate trends by looking at the past, the vast majority of which humans were not around to see. Likewise, we may not be around to see much of the future if our current carbon-intensive practices continue.

I want to understand how Earth systems operate from a geological perspective, yet I am dually intrigued by the complex interface between civil society, commercial enterprise, and the natural environment. These interests informed my decision to pursue degree concentrations in Geology, Environmental Studies, and Economics. My undergraduate research has so far taken me to Puerto Rico to study hurricane-triggered landslides and back home to northwestern Louisiana to investigate fracking-induced seismicity, two projects with implications that cross disciplinary boundaries. I observed firsthand these causes and consequences of climate change: hydraulic fracturing releases natural gas that enhances the greenhouse effect, which in turn contributes to the increasing intensity and frequency of hurricanes that devastate coastal cities like New Orleans – a place I will love and defend long after I graduate and move away.

The interconnectedness of Earth systems remains a subject of considerable if not dangerous uncertainty that geologists and other Earth scientists are working feverishly to unravel, and I want to be in that number. My undergraduate studies and research experiences in the classroom, laboratory, and field will inform my graduate school selection and future career evaluating the myriad risks and mitigation strategies of geophysical hazards, from landslides and earthquakes to global climate change. I ultimately aim to employ my background in both natural and social sciences to engineer effective solutions to global climate change that are scientifically informed as well as economically sustainable. Who better than a geologist to help save – or at least understand – the very planet that I will devote my life to studying?

Anastasia Ivanova
SA-10907
State University of Potsdam
Northeast Section

My love of geology was nurtured at a small age. When I was young, I would sit by my grandfather’s side, and listen to his adventures being part of a Field Geology expedition crew...
after World War II, working in the Kola Peninsula, the Arctic Circle Region in Russia. I would imagine myself in his shoes; the endless landscape in front of me, months without sunlight, Aurora Borealis dancing overhead, polar bears roaming the open tundra in below zero weather.

It was only when I was older that I understood the dark reality of his story. By 1937 the Soviet Government had organized all the countryside into state run collective farms. My grandpa’s father was part of such a collective farm located at a small village near the west border of the USSR. He was only 19 when grandpa was born. Desperate to feed his growing family, he stole seeds from the village seed bank, was captured, arrested and sent to the GULAG to die. His family became stigmatized, labeled as the ‘Enemies of the people’; ostracized by both children and parents who were afraid of the same label. With a heavy reputation, my grandfather was not able to attend school or find work. The only way out was exile, and when that opportunity presented itself as manual laborer position within a Field Geologist camp, my grandfather took it.

“**There is a need for highly educated professionals within the field, and I have the potential to make a difference despite the challenges, leaving a legacy just like grandpa had done.**”

Grandpa spent ten years working in the field and gained experience that brought him invaluable and extensive geologic understanding. Despite the pain, the knowledge grandpa gained had brought him independence, and he was able to find purpose once more in his life. He fell in love with the work and met my grandmother who was working as a kitchen aid at the same field camp. He continued to work for the same place, rising in the ranks over the years until he made a name for himself as a professional Field Geologist without having an actual degree. His story serves as an inspiration because it reflects my own life. My mother and I immigrated from Russia to America when I was only five. The transition resulted in cultural shock and financial difficulties. Living on our own on a limited budget, we found a simple way to cope with the hardship via connection with nature and everything it offers, as my grandfather did. We spent hours exploring upstate NY parks and forests. The most fascinating aspect of our walks as my grandfather did. We spent hours exploring upstate NY parks and forests. The most fascinating aspect of our walks for me were the rocks and fossils I would find and sneak back home in my pocket.

The challenges and sacrifices my family faced on a personal and financial level had shaped my individual self. It instilled in me the love of learning and understanding of the importance of hard work and dedication. I am proud to be the first person in my family to attend college and taken up two majors in Environmental Studies and Geology, with two minors in GIS and Wilderness Education. Geology has been my prominent focus within my academic pursuits. I was awarded the Seafret Dudley scholarship for being a Female in sophomore and the first day of class in “Evolution of the Earth” – “geologists are just storytellers, seeing who can tell the best story of how the earth came to be.” That quote has stuck with me ever since, and it’s inspired my own perception of how I can be the best storyteller for others who haven’t thought twice about the natural world.

In my first week of college, I took a chance by attending a lab meeting with Dr. Amanda Schmidt and jumped on a project investigating the impacts of deforestation in southwestern China, which led to a life-changing field experience in the rural Sichuan province. Since then, my academic work has revolved around understanding human impact on the surface of the earth and exploring how the impacts cause at a small scale translate onto a larger scale. By focusing on the geological and geomorphological processes we interact with, I feel we can have a better understanding as to how fluctuating landscapes play into solving complex issues such as the current climate crisis. Through my research on fallout radionuclides, I’ve been able to investigate and measure these changes which will contribute to advancing the collective knowledge of our environment and help solve the future challenges that we will face.

“**As a practitioner in the field after graduation, I want to work towards establishing sustainable tourism and educational opportunities portraying our relationship with our environment to better inform the public.**”

After presenting my preliminary research at my first geology conference, I was left feeling disheartened by the overwhelming lack of inclusion and diversity in the field. As a woman in STEM, it felt as though I didn’t have a place in some conversations and, therefore, uncovering a new motive and meaning in my role in becoming a professional geologist. Although, paving a way for those similar to myself still does not account for Black, Indigenous, People of Color and other marginalized groups who are even more widely underrepresented in our field. In my statement for becoming a student representative for my Geology Department Council, I specified my goal to uplift the voices of BIPOC individuals within earth
curiosity to not always be encouraged. While my spark was in fifth grade, this was sometimes an issue, and causing my desire to become a geologist.

The next experiences contribute to my distinction within what field I was studying. I originally came to Wayne State University with the intent to study environmental science; however, during scheduling I was given a choice between introductory geology and biology, and I choose geology. I am generally not a morning person; I don’t think I missed more than one lecture even though they were at eight am. This excitement I felt was only intensified by my professor, through his lectures, his passion for his work and over all geology was contagious. After this class, I switched my major to geology.

These experiences are the reason why I want to be a geologist. I have found my love for the world around me again and geology has sparked my imagination of questioning everything in it. The community I have found has encouraged my love to learning. This encouragement is why I intend to pursue graduate school after my undergraduate degree is finished. But there is something that I believe is more important than these experiences have taught me. I want to become a geologist to pursue my passions within the field, but that I want to spark those passions within others. I am thankful for all my amazing teachers in my life that have sparked this light within my life. I hope I can light the sparks in the future geologists, push for them to reach their limits, and to chase their passions. As I have had this done to me by my fellow geologists. These are reasons why I not only want but every day choose to become a geologist.

When I was a kid, I collected rocks and sorted them into piles by color and size. Later, I received a rock tumbler for Christmas; immediately I grabbed one of the piles and started the process of tumbling. Over the next six days, my parents started the process of losing their minds, for the tumbler - no matter where it was located within the house - was excruciatingly loud. While that may have been the only time I got to use it, it was one of my favorite Christmas gifts and I showed everyone the rocks that I tumbled. It was then that nature became a huge part of my life, and there are a couple of experiences that stood out that as I discovered I wanted to be a geologist.

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Science was my favorite subject when I started school. For I have always been curious about the innerworkings of the world around me. As a young chatty kid who questioned everything in fifth grade, this was sometimes an issue, and causing my curiosity to not always be encouraged. While my spark was dimmed due to the lack of encouragement, it was brightened again during an A.P. biology trip my junior year of high school.

Escaping to a small camp up north, we sat in the dirt discussing plant species, rock types, soil chemistry, local animal species and so much more. While these discussions were at a high school level, it created a passion within me. This passion and curiosity directed me to the path of environmental science.

These experiences are the reason why I want to be a geologist. I have found my love for the world around me again and geology has sparked my imagination of questioning everything in it. The community I have found has encouraged my love to learning. This encouragement is why I intend to pursue graduate school after my undergraduate degree is finished. But there is something that I believe is more important than these experiences have taught me. I want to become a geologist to pursue my passions within the field, but that I want to spark those passions within others. I am thankful for all my amazing teachers in my life that have sparked this light within my life. I hope I can light the sparks in the future geologists, push for them to reach their limits, and to chase their passions. As I have had this done to me by my fellow geologists. These are reasons why I not only want but every day choose to become a geologist.
some form of non-destructive geophysical survey in order to
determine where to dig, saving both time and money, and
revealing sites that would otherwise not be noticed. This use
of geophysics has revolutionized archaeology. Additionally,
remote sensing is increasingly being used to find archaeologi-
cal sites. Methods range from the simple to the complex, from
looking on Google Earth images for crop circles to scanning
thick forests with LiDAR. The future is bright for archaeology
because of geophysics, and I am eager to be a part of these
exciting developments.

This fascination with the applicability of geophysics to
archaeology prompted me to join a university research project
last fall that uses ground-penetrating radar (GPR), among
other methods, to locate unmarked grave sites. Finding these
sites is important both out of respect for the people buried
there and so the surrounding communities can protect and
sustainably manage them. Last fall, I used GPR equipment to
survey a historic military cemetery because the number and
location of burials at that site is currently unknown. While the
data is still being processed, the hope is that the survey will
reveal the location of the burials, so that those buried there
can be honored with a grave marker. Overall, this combination
of geophysical survey with historical research enables me to
apply both of my passions as I envision after college.

So, that is why I want to be a geoscientist. By using the
principles of the geosciences, I can investigate the past much
more efficiently and non-destructively. It is not a traditional
path for a geoscientist, but that is the greatest asset of the
geo sciences: they can be used in so many different fields and
applied to such disparate disciplines. I want to be a geosci-
entist because I love archaeology and have always loved geology.
And I am looking forward to being a geoscientist because of
the many exciting paths it offers.

Jessica Patrick
SA-10433
Miami University
Ohio Section

I never imagined I was going to go to college until midway
through high school when I realized the importance of an
education. I was on an IEP (Individual Educational Plan) in
grade school which is for students who struggle to keep up
with the rest of the class and I had a speech impediment (Oral
Apraxia). At the time, all I ever wanted to do was explore the
natural world around me and at the end of the day, I would
come home with my pockets filled to the brim with pebbles.
The different colors within each rock fascinated me, I wanted
to know how they formed. After taking environmental science
in high school, I realized there was a way to satisfy my curios-
ity while learning how to sustain the beauty of the earth. I
have surpassed many expectations set for me to get to where
I am, currently working on my Bachelor of Science in Geology
and Environmental Science Co-major at Miami University. I
have a cumulative GPA of a 3.83 and have received all A’s in
my major-specific courses. My excitement and desire for the
continuation of my education is a result of studying geology.
My research, classes and field experience have given me con-
fidence in my choice to become a geologist.

Through my core geology classes I have learned the value
of mineral resources. The instance that stood out to me was
when I realized how many cell phones the average American
goes through in a lifetime. This is not only wasteful but also
ignorant, as I did not understand the value of the rare earth
element ‘lithium’ within a cell phone. My mineralogy class
introduced me to other crucial resources that are used in every-
day products, for example mica is used in speakers. I quickly
became increasingly fascinated with mineral resources, their
economic value, and environmental impact. When I conducted
research on the origin of the Shoshone Granite from the Round
Mountain Gold Mine in Nevada, it was my curiosity for gold as
resource that made me look in depth at the pyrite within the
granite. I knew that the pyrite hosted the gold in the rhyolite
tuffs the company mined. By using the LA-ICP-MS on the
pyrite I found it to host small concentrations of Au. The small
concentrations of Au and the hardness of the host rock makes
it unlikely for the gold to be economically valuable.

After the completion of Miami University Field Camp, my
goal is to obtain a Master of Science in Geology in order to study
economic geology; specifically, mineral resources. Economic
geology incorporates many aspects of different geologic sub-
disciplines, while also having strong applications in industry.
Through my thesis research, I hope to help make mineral
resources more attainable through finding efficient ways to
locate and extract deposits. Because mineral resources are in
high demand, and will only increase in the future, I desire to
make mineral exploration more eco-friendly and economical.
Post-graduate school, I plan to work in a geoscience career
related to mining or environmental consulting to develop solu-
tions that are economic- and environmentally-mindful for the
average company to implement. Finally, I want to become a
geologist because I believe I can make a sustainable impact on
the earth by being environmentally conscious while working
in the economic geology industry.
As a child, I grew up reading books and watching movies about the hero archetype, books like the “Chronicles of Narnia” and movies like “The Lord of the Rings.” I was captivated by their adventures, travels, struggles, and triumphs. I also remember obsessing over the giant atlas my grandparents had, studying the illustrations of Earth’s core and the topography of the ocean floors. I dreamed of exploring this world and possibly others and embarking on adventures of my own, but I was not sure how I could achieve such a feat. I grew up in a small religious community that believed in creationism and groomed their youth to become theologians or medical professionals. They believed serving God and their community was best done through these professions. More than two-thirds of my high school senior class were expecting to attend college as a biology or pre-med major. I had always enjoyed science but never understood what the job of a scientist really meant or could be. Because the medical field was overly represented in my community, I believed it was easier to become a doctor than a scientist, but the medical field was just not for me. For the longest time, I felt my hopes of adventure were just childish dreams and my passion for science was just a casual interest.

"...I could become an adventurer and a scientist; I could become my own hero. At the age of 28, I decided to chase my childhood dreams and follow my passions by returning to school to become a geologist."

As an adult, I enjoy the mountains and I love to hike, climb, and snowboard. The best jobs I ever had were in the mountains such as a Ski Patroller, a Zipline Tour Guide, and a Ranger. As a tour guide and ranger, it was my responsibility to know about the local flora and fauna as well as the geology. I remember learning about how the bend in the San Andreas fault through the Cajon Pass resulted in the uplift of both the San Bernardino and San Gabriel Mountains and I was hooked. It changed how I looked at the land. Every landfill had a story and I needed to know more. I began to learn about all the different types of people who were responsible for the local wildlands; forestry services, environmental agencies, surveying agencies, etc. Every department or agency had a geologist. That is when I realized that I could become an adventurer and a scientist; I could become my own hero. At the age of 28, I decided to chase my childhood dreams and follow my passions by returning to school to become a geologist.

Being a geologist is not just a job title or awarded with a degree, it is a way of looking at the natural world around you. Since my first geology course, I have not been able to look out the car window or at a granite countertop and not think, “how did that come about?” Over the course of my undergrad, I have developed the heart and soul of a geologist. Geology has reawakened the childish wonder and sense of adventure in me and has become the first lens at which I view the world. To me, becoming a geologist represents the beginning of a new a journey and the opportunity to hear different geologic stories. But it also has become a conduit to serve a much larger purpose. Through geology, I hope to protect and serve both society and the wildlands I hold so dearly. I hope to become an exploration geologist in either the mining or petroleum industry, industries that can be detrimental to both the environment and people. I want to be a part of these industries to help build more sustainable and healthy practices and to clean up the mess of previous generations. Much like my high school classmates who went on to become medical professionals, I, too, can serve my community (humanity) and God (the environment).

Emily Sonnenberg
SA-10977
University of Florida
Florida Section

As someone who is pursuing my dreams for my own personal fulfillment as well as for informing and protecting human populations from future hazards, becoming a geologist is the ultimate satisfaction I can achieve in my lifetime. Being a geologist means that I can combine my love for working both in the lab with various chemicals and acids as well as trekking the outdoors and carrying far too many rocks in my pack than I should. I have spent an abundance of hours in the clean lab and experimental petrology lab, taking part in the vital processes it takes to obtain the data that will change or heighten the collective knowledge of significant topics in geology, such as the Lesser Antilles subduction zone and high Mg-suite of lunar rocks. There is nothing more challenging yet thrilling than to be an important cog in the overall collection and interpretation of geologic data that will ultimately be shared with not only other scientists, but to inquisitive minds of the public population.

"My desire to spread awareness of science and geology intertwines perfectly with the global drive to push consciousness of how we affect our world, such as climate change, through scientific evidence.”
Trisia Tellez
SA-10973
The University of Texas at El Paso
Texas Section

In the Summer of 2018, I experienced a lot of firsts. First time traveling on my own, first time in Pennsylvania, first time taking a geology course, and definitely my first time conducting field work. As an ambitious freshman at The University of Texas at El Paso (UTEP), with one semester under my belt, I applied for the Marcellus Shale Geology Field Course at The Pennsylvania State University (PSU). I realized how out of place I was during the class introductions on the first day; I was the only freshman in a senior geology course. As the tenacious individual that I am, I did not let my lack of experience stop me from excelling in the course.

My rock collection grew quite large before I discovered I could collect rocks professionally. Spending summers with my grandparents as a child left plenty of time for nature walks, and I could collect rocks professionally. Spending summers with my grandparents as a child left plenty of time for nature walks, and I could collect rocks. For example, sinkholes in central Florida are an increasing hazard and should be better addressed in order to recognize the warning signs, but it requires efficient communicators as to why this geologic topic is significant to acknowledge. Another instance would be minor towns located near a dangerous volcano where there is a high risk for eruptions, but not enough scientific communication to properly inform the population. Everyone, no matter where they live or how small the community, should have access to this information and have someone who can facilitate communication of these vital concepts, such as a geologist like me. For this reason, I am driven to make geologic information readily available and understood by the general population a major focus of my lifetime career as a geologist.

Alongside the effort to publicize geologic information, nothing has drawn me in more than the instinct to understand the complexities of our earth, let alone the universe as a whole. My career choice as a geologist is the perfect conjunction of major sciences like chemistry, biology, and physics that come together in unison to explain the history of the ground beneath us as well as the distant planets that occupy the same universe as us. I am blessed that there are opportunities in my career to conduct my own research ranging from understanding eruptive timnings for hazard mitigation all the way to understanding how geologic and volcanic activity occurs on separate planetary bodies. My career choice also includes being able to teach geology classes and inspiring undergraduate and graduate students through the academic platform. There is not just one motivation, but instead a diverse and colorful array of reasons for why I want to be a geologist.

As a university student, I decided to channel my aspirations by pursuing a Bachelor of Science in Environmental Science with a concentration in Geoscience and a minor in Chemistry at UTEP. Dedication to my academic performance can be seen through my consistent in-class performance, as reflected by my GPA, and my involvement in research opportunities.

"As a professional geologist I hope to inspire young people to indulge in the gifts that the natural world so freely offers, the same way my grandfather inspired me."

My comprehension for my courses has allowed me to bridge subjects together and immerse myself in interdisciplinary collaboration. Attending PSU in the summer of 2018 granted me opportunities to master geology field-mapping techniques, and experience for the first time what it was like to be a geologist. After learning the meaning behind the words “strike and dip” there was no stopping me. Independent from the comfort of my home institution, I improved my ability to communicate and produce results, in a collaborative setting. I brought home with me a clearer understanding of real-world applications for geoscience and new goals for my academic career. I continued to apply for summer research opportunities in the following years, and I was scheduled to attend the Summer Multicultural Access to Research Training (SMART) program at the University of Colorado Boulder in the summer of 2020 to conduct biogeochemical research. Unfortunately, due to the COVID-19 Pandemic my position in the SMART program was deferred until the summer of 2021. Although I have yet to attend, I am excited to return to field work with a slightly more experienced eye.

In my junior year, I am now working as an Undergraduate Research Assistant under the mentorship of Dr. Benjamin Brunner. I am conducting research on the formation of dolomitic caprock at a salt dome in Gypsum Valley Colorado. Utilizing geodynamics, we are investigating the conditions in which dolomite formation was thermodynamically feasible. By participating in such research, I am gaining knowledge on sulfur biogeochemical cycles. The tools that I acquire from this portion of my career are directly transferrable to my goals for graduate school. I intend to pursue research focused on carbon dynamics and interactions at the master’s level before advancing to a Ph.D. to further contribute to solving the sustainability issues our society is currently facing. As a professional geologist I hope to inspire young people to indulge in the gifts that the natural world so freely offers, the same way my grandfather inspired me.
I had always been a diligent student throughout grade school, but I never really had a response to the question, “What do you want to be when you grow up?” I floated around from subject to subject, such as chemistry, geography, anthropology, and so on, but nothing really gripped me as something I really wanted to do with my life. I was primarily online schooled throughout this time, so my education was almost always my own responsibility, and subsequently I never really had an impactful school experience. I had the motivation and ability to do well, but there was no external force to impassion me about any of my studies. For this reason, school was more of an annoyance at times.

This all changed when I started high school and took an introductory geology course through dual enrollment at Georgia Southwestern. My professor, Dr. Weiland, had such a profound impact on me, fundamentally changing within me my idea of what school could be. He lectured with such enthusiasm and childlike joy every class, that I was left no choice but to share his enthusiasm. To further fuel my curiosity, I learned that geologic studies implement techniques from many other disciplines, such as chemistry, physics, biology, etc. This was alluring to me, as I would no longer have to choose between my many interests, which was a fact that repulsed me from considering my future career up until that point. Furthermore, his emphasis on climate and environmental issues enlightened me to the sheer importance of geologic understanding. I was truly made aware of the evidence and impacts of climate change. I was particularly interested in measurements of atmospheric CO2 and its impacts on other meteorological systems. Essentially, I was shown climate issues from a scientific, rather than political, perspective.

Soon after finishing this course, I was sure I was going to major in geology. I was so certain, in fact, that when my family and I traveled to western China in the following summer, I designed and carried out data collection for a project concerning industrial efficacy of sediments in an economically challenged Gansu province, China. The main goal of this project was to highlight an abundant resource in a locally underutilized industry of ceramic arts, where the sediments have great potential as a low cost, high return industry for the poor region of China. Upon my return, Dr. Weiland then assisted me with analysis of mineralogical composition of the samples in X-Ray Diffraction and X-Ray Fluorescence, all of which he did in the summer, for a high schooler who was not even an official major yet. I would not have been able to accomplish something like that if it were not for his guidance, personal instruction, and (most of all) enthusiasm, which he passed on to me. I have since written and completed the project as a senior thesis for my undergraduate degree and intend on publishing it soon. I am profoundly grateful to him for introducing me to this field, one in which I truly feel like I can make a difference.

In essence, there are three main reasons for wanting to become a geologist. Firstly, it encompasses a wide range of disciplines, which is attractive to someone like me, who simply wants to learn as much as possible. Secondly, I had a very enthusiastic and kind professor who successfully guided me into this field, and early on facilitated my becoming a professional geologist. Finally, even if I as an individual do not directly make an impact on climate issues in my career, I shall, at least obtain awareness and appreciation for the earth we all take for granted.

In essence, there are three main reasons for wanting to become a geologist. Firstly, it encompasses a wide range of disciplines, which is attractive to someone like me, who simply wants to learn as much as possible.
...my main motivation for wanting to be a geologist is to be able to take what we know about the past to build a better future, become a role model for others, and travel the world.”

includes finding a way to adjust our way of life to consider things such as wildlife, natural occurrences, and the physical environment around us. Doing things such as finding a way to harness energy or purify wastewater from oil rigs, we can minimize man-made earthquakes by not disposing of it in the crust. By thinking outside of the box, we can accomplish a greener future through geology.

A very personal reason for wanting to be a geologist to be a role model for not only young women, but Hispanic women. When comparing the geologic timescale to a yearly calendar, humans have existed within the last second of December 31st. Similarly, in the time humans have been on Earth, very few women have been recognized contributors in science. As I learn more about the history and origin of geology, there are very few female names mentioned. Growing up, I never had a geologist I aspired to be like because there was no one I resonated with. Up to this point in my geologic education, even as an adult, there hasn’t been someone I felt a personal connection to. I hope, as a Hispanic woman, I can bring diversity and better representation to geology. More importantly, I hope I can be a role model for other young girls of all ethnic backgrounds who dream of pursuing a S.T.E.M career such as geology.

For my entire life, I have dreamt about becoming a geologist; those dreams have included traveling the world to do field research. For me, geology fulfills my desire for adventure. Through class field trips to locations to rockhounding on the weekends, I love to explore and learn about what makes different locations geologically unique. This desire motivates me to complete not one, but two different degrees that will afford me even more opportunities globally. I look forward to meeting new people, experiencing different cultures, and discovering what I can learn about the geology. To demonstrate both my love for adventure and learning, I am in the early stages of applying to participate in the National Student Exchange Program to attend the University of Hawaii Hilo for a semester. This school is my top choice because I want to be able to experience their highly reputable geology program and receive hands-on experience with volcanic environments and island geology. I cannot imagine spending the rest of my life working out of a cubicle, from 9 to 5 every day. I want a career I not only enjoy, but which will supply me with once-in-a-lifetime experiences, I would not find in any other job. Geology provides me with the opportunity to explore the world.

For more than half of my life now, I have wanted to be a geologist. I intend to continue to work hard to accomplish all my goals to become a geologist in the not-so-distant future.

**AIPG Member Photo Challenge**

**Challenge categories:**

1. **Scenic Wonder** - show us a beautiful landscape.
2. **Geologic Disaster** - geologic processes in action impact communities.
3. **Geologists in Action** - people at work.
4. **Environmental Impact** - manmade effects on the environment.

Entries must be original and taken by a member. Entry authorizes publication of the image in *The Professional Geologist* by AIPG with credit given to the photographer.

**Challenge Rules:**

Image requirements: digital, 300 dpi, 8.5”x11”, portrait orientation full color.

Members are allowed one entry per category with up to four submissions (one per category). All images must be original and taken by the member. Submit entries via email to aipg@aipg.org. Entries must include:

- Name
- Member number
- Section
- Title of image
- Less than 200 word description of the image
- Names of any identifiable persons in the image and permission to publish their photo
- Year photo taken

Entry deadline: November 1, 2021.

**Awards:**

First place in each category:

- Image published on the cover of *TPG* in 2022.
- Membership dues will be waived for winner for 2022 and donated to the Foundation of the AIPG in the winner’s name. AIPG will donate $100 for a winning student entry to The Foundation of the AIPG.

Runners Up in each category:

- Images will be published in the *TPG* in a special feature album. Runners up will receive AIPG gear of choice.
The Foundation of the American Institute of Professional Geologists needs your financial support. Every donation helps the Foundation to contribute toward building the future of geology. The Foundation supports a variety of programs of the AIPG that includes student scholarships, student and early career workshops, internship funding, educational programs aimed at practitioners, the public, and policy makers, and some special needs requested by AIPG or other professional organizations. The Foundation has already awarded $7000.00 this year for undergraduate and graduate student scholarships. Other financial awards are pending for proposed early career geosciences and student workshops. The Foundation is proud to serve AIPG and the geosciences by providing financial support for these programs. If you have any questions or comments about the Foundation, please contact me or any of the other Trustees of the Foundation for additional information.

Donations may be made by check payable to The Foundation of the AIPG and mailed to 1333 W. 120th Ave., Suite 211, Westminster, CO 80234-2710 or pay by credit card on the AIPG web site.

Be sure to check the Foundation web page on the AIPG web site https://aipg.org/page/Foundation for information about the Foundation, on awarded student scholarships, and for the list of our generous donors in 2020. Your continued support is greatly appreciated.

Thank you.

Barbara H. Murphy, RG, CPG
Chairperson, Foundation of the AIPG
480-659-7131 office phone; bmurphy@geo-logic.com

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Subscribe to the AIPG YouTube Channel and click on the bell to get notified of new videos including the ones listed below.

Geologists in Action! Reflected Light Ore Microscopy - Jim A. Paschis, CPG-8456 (pictured left)
Geologists in Action! Using Drones to Sample Man-Made Lakes - McGinley and Associates
Lessons Learned Along the Way
Honesty--Avoiding the Misuse of Models
Core Splitting: The Assumptions Underlying a Best Practice
Resume Writing and Interviewing
2020 Environmental Careers for Geologists
Early Career Professionals have opportunities to grow their leadership skills
The Knowledge Transfer is Invaluable
I've Found Opportunities I never would have encountered.
The preservation of freshwater resources is an ever-growing concern for society. Fresh water makes up less than one percent of the total water on Earth, but it is essential for human consumption, irrigation, and industry. Maintaining high quality freshwater resources is a challenge today and will be for generations to come. It is important to understand that fresh water is not an infinite resource. The ever growing and developing human population, now greater than 7.8 billion, has put a strain on water resources. Water is scarce in some regions and other areas have outgrown their local water supply. Some municipalities have polluted their fresh water supplies beyond timely remediation. New York City and Los Angeles are only able to sustain their population by redirecting outside water sources through aqueducts. Urban and suburban areas, for example, Long Island, live on top of their water resources. Industrialization, however, has led to leakage of contaminants into subsurface aquifers, compromising usable water and leading to public health crises. My time at the New York City Department of Environmental Protection and the New York State Department of Environmental Conservation taught me the importance of geological knowledge for the future of water resources.

Geologists employed in the environmental field work to locate, tap, monitor, and remediate freshwater resources. Of all of the freshwater sources, study of groundwater by geologists can be particularly valuable. Specific rock and sediment types create conditions more likely to store and transmit groundwater. Professionals educated in geology use their knowledge of surficial and bedrock geology to locate usable water supplies. For example, the population of the Town and Village of New Paltz in Ulster County, New York has grown beyond what the water resources in the area can sustain. New Paltz currently obtains extra water from the Catskill Aqueduct. But if the Catskill Aqueduct were to shut down, New Paltz would be unable to provide enough water to its population. Geologists have been tasked with locating additional water resources in the Ulster County region as a long-term backup supply. These resources include the development of groundwaters that will supply upwards of 400 gallons of water per minute, which will stabilize the New Paltz water supplies for years to come.

Contamination of freshwater aquifers has contributed to diminishing water supplies and, in some areas such as Bethpage, has caused public health crises. Geologists play an essential role in monitoring and remediating these aquifers. Geological data about regional tectonics and the capacity of rock or sediment to store and transmit water can be used to predict the movement of contamination plumes, and thus, where to locate wells that can remediate the plume. In Nassau County, New York, for example, the groundwater supply for the Town of Bethpage is contaminated by chemical leakage from the Grumman Aircraft Engineering Company. Geologists were tasked with assisting in the installation of monitoring and extraction wells and modeling the extent of the contamination plume. These two actions helped slow the spread of the contaminant plume and allowed treatment plans to be put into place before water supply wells were polluted. Geological knowledge saved the drinking water for the residents of Bethpage and the surrounding towns.

New Paltz and Bethpage are two of many examples that prove the value of a geological perspective when applied to environmental processes that impact the water supplies and public health of our communities. With increasing populations and spread chemical contaminants, community freshwater supplies are threatened. Geological education is important for professionals and also for civilians in order to properly understand and maintain our fragile freshwater resources.
When I was an undergraduate geology student, I took on a summer job working as an environmental field technician for a local environmental consulting firm. The pay was just above minimum wage, which was fine for summer work. The work was varied and often mundane: background research in the city directories; filling out paperwork for hazardous waste pickup and disposal; cleaning, prepping, and organizing spill mitigation equipment. Those tasks were probably the most common work I did during that summer. Occasionally, we got an interesting call and at those times the job became exciting or even a bit scary.

One such time came when we were summoned to the local railyard. Several damaged tanker cars were present, each of which contained animal fat that was destined to be shipped to a rendering plant to be processed into some sort of more useable form. (Note: what form was never revealed, but each of us assumed it was to be used to make dog food). The tankers were equipped with heaters to keep the fat from congealing and with pumps to move the warm liquid fat from the tanker to some ultimate storage unit. However, these cars had been damaged in an accident and the heaters and pumps were no longer in working order. Our task was to do a confined entry and remove the now congealed animal fat by hand, shoveling the fat into 55-gallon drums that could be removed via hoist.

We returned the next day, confined entry permit in hand, Tyvek® suits and full-face positive pressure respirators on the truck, ready to enter the tankers and begin shoveling. We suited up, taped all our suit joints and entered the tanker. The fat was between six and 12 inches thick and covered the bottom of the tanker. Our colleagues lowered in the first 55-gallon drum, and we went to work, using large aluminum snow shovels to fill the drum. The fat had the consistence of firm jello, and was prone to slipping and sliding off the shovels. Sometimes a large “clump” would break apart, unbalancing the shovel and causing it to flip or tilt. It was hot, dirty, difficult work.

About 20 minutes into the job, I felt something running down my arm and into my glove. I at first thought it was sweat, but when it began to accumulate in my glove, it felt oily. I asked my co-worker to check my sleeve for tears. He reported none. I began to feel the same thing in my other sleeve and at the knees, and again asked my co-worker if I had any tears in my suit. He reported again, none. We were scheduled for a 15-minute break every 30 minutes, so I waited. At break, I unsuited to find that the animal fat was being absorbed through the suit and was accumulating in my gloves and boots. Apparently, the stretching at the knees and elbows combined with my body heat to make my suit permeable. We called the office and asked if they would bring out a heavier-duty suit (my memory says it was Seranex®) and we completed the job with no more leaks.

For the next couple of days, I smelled like French fry grease and my elbows and knees were as soft and smooth as a baby’s cheek. Still, it’s not a beauty treatment I would recommend.

I share this story because I recognize that as geologists we do some very interesting things. To highlight those activities, AIPG has started a YouTube series called “Geologists in Action.” These short clips highlight geologists simply being geologists. Why? Because most people don’t really understand the broad variety of tasks that geologists perform as part of our everyday work. Our goal is to create and share a series of short (2-5 minute) videos that show geologists in action, doing what we do every day. I hope each of you will consider creating a short video that highlights what you do and share it with AIPG so that we can share it with the world. Of course, some of you may be doing proprietary work, or may work for a company that is not in a position to allow you to create such a video. That’s understandable, especially in fields where companies may compete for resources or in situations where legal challenges may be involved. The beauty of “Geologists in Action” is that we don’t just have to highlight the things we do for work. Some of us are mineral aficionados with personal mineral collections that rival those at major museums. Others are volunteers with the local stream team, or hobbyists who collect fossils. All of those things are “Geologists in Action.”

I encourage each of you to consider creating a short video. You can record it with your cell phone. It’s not supposed to be a professional quality, broadcast TV ready effort. It simply needs to show a geologist being a geologist. I hope you’ll consider putting something together for us.

With all my best wishes for a successful summer,

Aaron
As discussed by me and various other authors over the last year, membership in AIPG is in a steady decline. After review of the By-Laws and initiating discussion with the Executive Committee, a new Standing Committee will be formed to address membership in AIPG. To best serve our members and attract new members we must clearly define and then publicize the purpose and advantages of AIPG. This process is both internal and external. Internally, we need to retain our current members by continually offering them current ideas, expertise, education and techniques in the geosciences. Externally, we must publicize the advantages of membership across all geoscience specialties.

The following is my proposed description of the Membership Committee that will be discussed, revised and finalized at the June Executive Committee meeting.

The purpose of the Membership Committee is to create and implement a plan to increase and retain members in all membership categories. Coordination with the State Sections, Standing Committees and Ad Hoc Committees is critical to implementation of all Membership Committee activities. Subcommittees will be created as needed to implement specific activities/goals of the committee. Suggested Subcommittees are: 1. CPG and Professional Members; 2. ECP and Student Members; 3. Outreach; and 4. Program Enhancement. Subcommittees are at the discretion of the committee. This subcommittee will primarily require the participation of the full committee. The committee will report to the Executive Committee at their regularly scheduled meetings.

Chair: President or CPG Member appointed by the President
Member: President (if not acting as the Chair)
Member: President Elect
Member: Past President
Subcommittee Chairs and Members

Ex-Officio Members: Executive Director, Assistant Director, Membership Services Manager, Professional Services Manager

I envision the Membership Committee as a group of 10 to 15 AIPG members, plus representatives of the National Office, to assure a coordinated and consistent message. This is a big job which will require members from all geographic areas and geoscience specialties. To make the overall goals manageable, subcommittees will be formed to focus on specific membership categories and activities. To accomplish the goals, coordination with the State Sections and the National office is critical to assure a consistent and coordinated message.

The subcommittees defined in the committee descriptions above and below are what I see as critical components, but the overall organization, implementation and subcommittees will be decided by the Membership Committee’s members to carry out the plan that they define.

The CPG and Professional Member Subcommittee will focus on seasoned professionals. There are many reasons that geologists want or need certification including, 1. to give professional opinions; 2. requirement by a regulatory body or agency; 3. acceptance within a specialty or area; and 4. general acceptance by peers, among others. Professional members are often members that do not need the certification but are interested in the ideal exhibited by AIPG membership and the numerous resources available to members. This subcommittee will create a plan to target seasoned professionals in all geoscience specialties and coordinate with the rest of the committee to implement their plans.

The Early Career Professional and Student Subcommittee will include the ECP member of the Executive Committee and additional members from both categories. The primary task I foresee is to encourage student members to become Early Career Professional Members, and subsequently for Early Career Professional Members to apply for Professional Membership or to be Certified Professional Geologists. The growth and future of AIPG depends on retention and elevation of our members.

The Outreach Subcommittee will design plans to make AIPG better known throughout the geoscience community. This will require creative thinking, continual discussion with the other subcommittees, State Sections and coordination with the National Office. The primary purpose is to increase visibility of AIPG.

The Program Enhancement Subcommittee will review and work on enhancing AIPG’s program offerings to assure that we address the needs and interests of all classes of membership. The interests of Student Members are often different than the needs of our Certified Professional Geologists. AIPG is affiliated with several geoscience organizations (AGI, EFG, etc.) and their programs should be evaluated and included where appropriate. This subcommittee will primarily require coordination with the National Office.

I am looking for volunteers to join the Membership Committee and help us revitalize the Institute by focusing on increasing membership in all categories. Please email or call me if you are interested. nancyjeanw@aol.com 775-770-4615. The newly formed Membership Committee will report to the Executive Committee during the National Meeting on October 23, 2021, so please contact me by the first week of August to be part of this committee’s formation.
1. This geologic feature describes an isolated, remnant portion of an eroded nappe. The feature is an outlier of exotic or allochthonous strata overlying autochthonous rock:
   a) Guyot.
   b) Klippe.
   c) Tombolo.
   d) Barchan.
   e) “I have read these choices! Didn’t understand one word…”

2. The vast majority of these marine animals became extinct at the end of the Paleozoic Era. These so-called “sea lilies” were attached to the bottom by a stalk. Under what phylum are they classified under?
   a) Echinodermata.
   b) Arthropoda.
   c) Coelenterata.
   d) Chordata.
   e) Dude, eye niver stoodid pipilintooloogie.

3. In our studies of structural deformation, the term “thick-skinned tectonics” refers to:
   a) A local zone of concentration or stacking of nappes and recumbent folds.
   b) Divergent plate boundaries and the outpouring of large quantities of mafic lava/magma.
   c) Mass wasting of vast volumes of sediment.
   d) Crustal deformation involving basement rock and deep-seated faults.
   e) Techs who after consuming several vodka tonics can take criticism without getting too upset about it.

4. Of the following planets in our solar system, the one that most closely approximates the average Earth density of 5.51 gcm⁻³ is:
   a) Jupiter.
   b) Neptune.
   c) Mercury.
   d) Mars.
   e) Pululuto.

5. To a first approximation, what is the centripetal acceleration at a point on the Earth’s surface at the equator, knowing that the equatorial radius approximates 6,400 kilometers and that our planet rotates on its axis once every 24 hours? Recall that the centripetal acceleration is \( a_c = \omega^2 R \), where \( \omega \) is the angular velocity and \( R \) the radius.
   a) 3.39 * 10⁻² meters/second².
   b) 9.93 * 10⁻² meters/second².
   c) 11.4 * 10⁻² meters/second².
   d) 0.21 * 10⁻² meters/second².
   e) Dude, seriously, you must learn to fight the impulse of coming up with questions like this. I know a shrink that can help you…
Geoethics and sustainability

The geoethics approach promoted by the International Association for the Promotion of Geoethics has been a topic in a number of these columns beginning with column 157 (Jan. ‘16) and including columns 165 (Jan. ‘18) and 166 (Mar. ‘18), in my article, “Natural Resource & Sustainability; Geoethics Fundamentals and Reality,” (Oct. ‘20), and most recently in column 177 (Apr. ‘21). As Bohle and DiCapua point out, “The recent development of the concept ‘geoethics’ is a response by geoscientists to shape deeper engagement with their professional responsibilities and the wider societal relevance of geosciences. …[T]he development of geoethics to date, as a ‘virtue ethics’ focusing primarily on the role of the geoscientist, describes its meaning and function in relation to neighboring fields and explores how to situate geoethics in relation to a wider range of issues that require ethical consideration.”1 The 9th and 10th fundamental values of geoethics state, “9. Ensuring sustainability of economic and social activities in order to assure future generations’ supply of energy and other natural resources. [and] 10. Promoting geo-education and outreach for all, to further sustainable economic development, geohazard prevention and mitigation, environmental protection, and increased societal resilience and well-being.”2

The concept of sustainability or sustainable development is an important part of both these fundamental values and is part of the Geological Society of London’s Scientific Statement and my comments on James Howard’s, CPG-2536, “The Geosciences in Modern Society” discussed in column 177 in the last TPG. The most commonly cited definition of “sustainable development” comes from the UN Bruntland Commission, which states, “Sustainable development is the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”3 Thus, there are no limits on the life of a “sustainable development” as commonly used and understood. The problem is that individual natural resource deposits are finite in size, are depletable, and their extraction is time limited. As pointed out in my 2020 article, “The production of mineral resources and fossil fuels would seem to be activities that cannot, by definition, be sustainable, but extractive industries provide necessary contributions to society.”4,5 As the following topic, “Reuse of quarries as solar farms” points out, using the ponds occupying former quarries as the sites of solar panel arrays is a more sustainable use of such property than alternative solar panel array sites.

So what does sustainability mean in other areas and in the long term? My colleague, Betsy Suppes, commented, “I do think that the Earth has a sustainability limit—I mean, can we really have 18 billion people on the planet? Who gets to live in warmth? Who gets to eat meat? Who gets to drink milk? Cows take up a lot of acreage. Will cemeteries need to be consolidated? Will people only get to have one house? Are you allowed to have more than one vehicle per driver? Should all things be recycled? Is it more green to keep an old car going, as you are not needing to mine for more metals? Should all future homes have geothermal heating? What can poor people afford? Poor people can’t afford solar panels, geothermal heating, etc. Or electric cars.” Good questions with difficult answers. Who gets to decide the answers? Please send your thoughts and suggestions.

Reuse of quarries as solar farms

Fred Pirkle, MEM-1939, informed me following a presentation that dis-

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5. Peter Dohms, CPG-7141, commented, “David; I was quite taken with your Column 177. Your gentle criticism of the myopic attitude of IAPG with respect to practitioners in the extractive industries was a masterpiece of ironic understatement.”
Answers:

1. The answer is choice “b” or “klippe.”

In geoscience literature the term “klippe” has been used to describe three different types of standard tectonic features:

a) An overthrust or allochthonous klippe (as described in this example).
b) An autochthonous klippe, like the exposed crest of a mushroom-shaped fold.
c) A piercement-type klippe or diapiric structure.

Guyots are flat-topped sea mounts.
Barchans are crescent-shaped sand dunes with horns pointing downwind.
Tombolos are sand bars joining an island to the mainland.

2. The answer is choice “a” or “echinodermata.” The description indicates “crinoids” which are related to sea cucumbers, sea urchins, starfishes and brittle stars.

Marine arthropods are crustaceans including shrimps, crabs, lobsters and the extinct trilobites.

Marine coelenterates (phyla Cnidaria, Ctenophora) include corals, sea fans and anemones, jellies and sea pens.

Chordates include the vertebrates. This phylum of animals, during some period of their life cycle, possess a notochord (cartilaginous skeletal rod), a dorsal nerve chord, pharyngeal slits, an endostyle (mucus-secreting pharyngeal organ) and post-anal tail.

3. The answer is choice “d” or “Crustal deformation involving basement rock and deep-seated faults.” This contrasts with “thin-skinned tectonics” describing deformation related to shallow thrusts and folded strata comprising the sedimentary rock cover and not the underlying basement.

4. The answer is choice “c” or “Mercury” with an average density of 5.43 g cm⁻³.

Jupiter, Neptune and Mars have average densities of 1.33 g cm⁻³, 1.64 g cm⁻³ and 3.93 g cm⁻³, respectively.

5. The answer is choice “a” or “[3.39 * 10⁻² meters/second²].” The proof follows

Given:

\[ R = 6,400 \text{ kilometers} = 6.4 \times 10^6 \text{ meters} \] (1)
\[ T = 24 \text{ hours} = 24 \times 60 \times 60 = 8.64 \times 10^4 \text{ seconds} \] (2)

Then:

\[ \omega = \frac{\Delta \theta}{\Delta t} \] (3)
\[ \omega = \frac{2\pi \text{ radians}}{(8.64 \times 10^4 \text{ seconds})} \] (4)
\[ \omega = 7.27 \times 10^{-5} \text{ radians/second} \] (5)
\[ a_c = R\omega^2 \] (6)

Substituting (1) and (5) into (6), we obtain:

\[ a_c = 6.4 \times 10^6 \text{ meters} \times (7.27 \times 10^{-5} \text{ radians/second})^2 \] (7)
\[ a_c = 3.39 \times 10^{-2} \text{ meters/second}^2 \] (8)

Equation (8) is the answer to our problem, or the centripetal acceleration of a point on the Earth’s surface at the equator.
sessed the reuse of former mining properties, that his firm was involved with converting former water-filled quarries into solar farms by covering the pond surface with solar panel arrays. Figure 1 on page 35 is one of the pictures from my presentation. It shows a series of former sand and gravel quarries located along the South Platte River in the northeast Denver metro area that have been converted to water storage ponds. These and similar quarry ponds are providing water storage for those parts of the metro Denver area whose water supply was previously and exclusively dependent on rapidly depleting aquifers.

One of the problems with these storage ponds is their relatively shallow depth and resulting evapotranspiration water losses. Pirkle’s suggestion that these ponds be covered with solar panels solves several problems. The first is the evapotranspiration loss is reduced. The second is that the solar panels can be easily oriented to take advantage of day-long sunlight, something that a significant number of building roofs are not able to do. Third, one of the problems with solar panel farms is that they commonly occupy land that could be used for agriculture or housing development. Also, solar farms have negative environmental impacts on the ground underneath them. What can grow there? What animal life can be sustained? Quarry ponds covered with solar panels do not have these problems. Such use of former quarries should be encouraged.

Geohazards in Haiti and their potential solutions present ethical questions

Barney Popkin’s article, “Haiti’s rock and soil engineering challenges and potential solutions,” in this issue of the TPG presents some interesting ethical questions. As Popkin points out, 90% of Haiti’s very poor population lives and works within high risk geohazard areas stemming from high winds and humidity, hurricanes, floods and droughts, active faults and earthquakes, steep slopes, deforestation, inappropriate farming, mountain erosion and hillside creep, liquefaction, landslides and debris flows, expansive and swelling soils, sinkholes, and seawater intrusion. Mitigation of these challenges through the use of proper and enforced impact analysis, zoning, land-use restrictions, and sound architectural and engineering codes and designs based on adequate mapping, sampling, testing, risk assessments, probability analyses is needed. Such measures all fall within the protection of the public’s health, safety, and welfare, our fundamental ethical principle. However, proper delineation and mitigation of these geohazards costs a lot of money, which neither the people nor the government of Haiti have. What are the ethically appropriate ways of addressing these issues given the lack of money? Obtaining public support is needed for successful implementation of the various recommended mitigation strategies. Obtaining such public support is a social licensing exercise like that currently required for new mining and other projects. Please contribute your thoughts and suggestions.

Ethics question about potential project

A CPG who is a mining geologist asked me about a potential ethical issues with a possible project he was considering accepting. He had been asked to prepare an NI 43-101 report on a fluorite deposit in SW Mongolia on which 17 holes had been drilled. Most of the exploration records are old stuff in Russian that is barely legible due to repeated photocopying. The CPG noted that he has no Mongolian or fluorite expertise. He could only comment on a “decently written” report completed by another geologist. He also noted the NI 43-101 applies only to companies registered or planning to register on a Canadian exchange and that one of the NI 43-101 requirements was a site visit by the Qualified Person and that the CPG was not able to conduct a site visit. The potential client said they would contract with a local consultant to do the ground truthing. The CPG was uncomfortable with various aspects of the proposed project and contacted me.

I pointed out that while NI 43-101 only applies to Canadian registered mining companies, many firms are asking for NI 43-101-format reports because it is a recognized reporting standard. Canadian securities authorities are not thrilled by this fact, but it happens. I recommended that the report clearly state whether or not the project was to be filed in Canada. I also pointed out the importance of a site visit in current internationally accepted standards for reporting on estimated mineral resources and mineral reserves. If a site visit was not to be part of the project, it should probably be declined.

A competently prepared NI 43-101-style report begins with a discussion of the way in which the mineral rights to the property in question are obtained and maintained. Knowledge of the Mongolian regulations of mineral rights would be a requirement for a report on this property. While a reliable third-party report on this subject could be used for this part of the report, the new SEC Reg. S-K 1300 rules specify that such third-party reports must be provided by the registrant if the Competent/Qualified Person wishes to avoid legal liability for the contents of the third-party report. Lack of knowledge about Mongolian regulations can be another reason for declining the proposed project.

Lack of familiarity with fluorite deposits is another important point. Fluorite is an industrial mineral with a variety of uses including as a metallurgical flux and as a source of fluorine. Details about the chemical and physical properties of the fluorite on the property will be important information for the estimation of possible fluorite resources on the property. Competent evaluation of the deposit would require knowledge about the market for and price of fluorite in Mongolia. Absence of such information would preclude an estimate of fluorite resources. However, a report on a property can be done using the known information and pointing out the additional information that is needed in order to make a resource estimate.

The CPG withdrew from the proposed assignment due to the issues addressed above and other considerations. The CPG’s concluding e-mail to me stated, “I withdrew from the project this morning due to familiarity w/ fluorite, no site visit & lack of transparency. ... Hated to lose the $$, but my ethics got in the way.”
Building safe, inclusive, and respectful spaces in the geosciences

“Building safe, inclusive, and respectful spaces in the geosciences” is the title of a Society of Economic Geologists webinar presented by Susan Lomas, founder of the Me Too Mining Association, www.metoomining.com, and focusing on tools and strategies on allyship and bystander intervention so everyone can intervene safely when inappropriate behaviors happen to them or in their presence. When instances of harassment occur, the question arises, “What should I do?” to either the victim or bystanders. How does one step away from silence and into action? The first thing to remember is that the harasser is always responsible for the inappropriate behavior. Protests that “that wasn’t my intention” reflect an unwillingness to accept responsibility for inappropriate behavior. Intended or not, you cannot fully apologize for or prevent future inappropriate behavior until the inappropriateness of the behavior is recognized and accepted as inappropriate. Intended or not, you did it full stop. Elimination of harassing behavior requires bystanders to become allies of the victim. This requires recognition of the inappropriate behavior and then taking action. The webinar describes various strategies for taking action depending on the circumstances of the situation. This webinar is available at https://www.segweb.org/SEG/Events/SEG_Events/Webinar-Display-Archive.aspx?EventKey=WEB012

GSA 2020 Annual Ethics Report

The Geological Society of America has published its 2020 Annual Ethics Report that can be found at www.geosociety.org/ethics. GSA launched its Ethical Guidelines for Publishing in 2003, its Events Code of Conduct in 2016 that covers behavior at GSA meetings, and its Member Code of Ethics in 2019. The Annual Ethics Report provides GSA members and the public with information about the number of complaints received, the general categories of the complaints and their resolutions. Fifteen complaints were received since 2017 resulted in the following outcomes: 7 violations, 4 dismissals due to insufficient proof of violation, 2 complaints were withdrawn, and 2 complaints remain pending. GSA’s numerical experience with its ethics provisions is consistent with the experiences of other geoscience organizations; see Bonham, Oliver, Abbott, David, and Waltho, Andrew, 2017, An international review of disciplinary measures in geoscience—both procedures and actions: Geoscience Canada, v. 44, p. 181-190, https://doi.org/10.12789/geoscanj.2017.44.126. The difference between GSA’s experience and those reported by Bonham, et al., is that most of GSA’s complaints alleged instances of discrimination or harassment. This may reflect the fact that GSA’s Events Code of Conduct has been in force the longest and that discrimination or harassment issues are a main focus of this Code.

New Oregon Continuing Education Requirements

The Oregon State Board of Geologist Examiners adopted new continuing education rules for its Registered Geologists and Certified Engineering Geologists effective 1/1/21, www.oregon.gov/osbge/Registration/Pages/Continuing-Education.aspx. The annual continuing education requirement is 8 hours per renewal year. Up to 8 additional hours may be carried over to the following renewal year. A wide range of continuing education activities are permitted including: academic courses; CEU credits; field trips; professional seminars, meetings, and panels; professional presentations; authoring; and service to a professional society committee or as a society officer. However, a log of one’s continuing education activities should be maintained and example logs are available for download. Specific instructions on continuing education activities are available at https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=270681.

The new Oregon continuing education requirements are similar to the requirements of other states but are significantly less than those of mining-oriented groups like MMMA, the Canadian Provincial licensing boards, AusIMM, etc. that can require a yearly average of 50 CPD hours (150 hours of CPD over a 3-year period) and a professional ethics requirement. My thanks to Doug Bartlett, CPG-8433, for sending me the OSBGE’s announcement of these new rules.

Ethics questions #5—what do you think?

Three slightly different money-raising efforts are presented below. Are they ethically the same or different? What is your opinion about them? If there are differences, explain them. Please send me your thoughts.

Situation 1: an AIPG student chapter wants to raise money by selling geologically related t-shirts. It has asked its Section’s ExCom for permission to solicit Section members by sending an email to members and by placing an ad in the Section’s newsletter.

Situation 2: a senior Section officer has published a book on a geologic aspect of the Section’s state that is intended to have a broad audience. The senior Section officer will receive the profits from the sale of the book. The Section officer has asked the Section’s ExCom for permission to solicit Section members by sending an email to members and by placing an ad in the Section’s newsletter.

Situation 3: an AIPG Section plans to raise money by assembling and selling a book of field trips within the Section’s state. The field trips book will include some field trips that the Section has published and other field trips published by others.

AIPG provides a compilation of all writings published on the topic of ethics in The Professional Geologist on CD. Copies are available for purchase: $25 for members, $35 for non-members, $15 for student members and $18 for non-member students, plus shipping and handling. To order go to www.aipg.org.

The geetopix.xlsx file is available at www.aipg.org under “Ethics,” and the writings are also available by downloading the electronic version of The Professional Geologist.
Implementing Stealth Education in the Geosciences

James F. Howard, Ph.D., CPG-2536

As described in my first article of this series published in the Apr. May-Jun 2021 issue of TPG, Stealth Education is defined as the insertion of aspects of the geosciences into topics normally considered as non-geoscience related by emphasizing their role as causative or influential elements in human physical or cultural development or interaction.

As discussed in the first editorial, most of the resources of the professional societies involved in promoting the Geosciences have concentrated their efforts into two major areas:

1. Providing secondary school teachers with better materials to support their efforts to educate their students; and

2. Expanding the skill set of existing geoscientists to more effectively accomplish their career objectives in the facet of the industry in which they have obtained employment.

The Stealth Education approach is intended to increase overall awareness, especially to decision-makers, on the breadth of influence exerted by the geosciences on virtually every aspect of human culture. These aspects are active today and have served as influential elements in the historical development of society as we know it.

The primary target of the Stealth Education approach is the general public whose representatives control, through the vote, the processes of national and local policy and, in particular, primary and secondary school curriculum development.

A major problem in implementing a Stealth Education program is inherent with geoscientists. As with all scientific and technical disciplines, geoscientists tend to spend most of their time talking to each other. This, of course, tends to restrict interaction with other technical groups that are not directly associated with their background or their chosen career path.

A major goal of the Stealth Education program is increasing the awareness and appreciation of the value of the geosciences in other disciplines and interest groups. In order to achieve that goal, our professional organizations should expand and diversify their educational programs. Engagement of the public and decision-makers would involve the development of webinars, seminars and other programs that would be attractive to the general public, providing information and viewpoints on controversial aspects of modern society such as climate change, alternate energy sources versus conventional sources, mineral resource availability and projections of future needs, etc.

A second major goal of the program will be to encourage individuals within our professional organizations to utilize their collateral interests outside our traditional areas of activity, engaging the general public in discussions that would allow the introduction of geoscience background into their fields of interest or career groups.

Stealth Education encourages geoscience professionals to utilize their personal interests (history, hunting, warfare, ship building, fishing, travel, etc.), as entrees into groups or settings which allow them to add geoscience background into other disciplines and emphasize the influence of the geosciences as causative or influential elements in the history or development of the topic.

The technique is especially applicable to mineral resources, travel, ancient history, modern history, military science, human migration and societal development, empire development and decline, anthropology, archaeology, national parks development, environmental hazards, sea level changes, effects of glaciation, landform development, physiographic development, etc. Some topics are more conducive to the Stealth Education encourages geoscience professionals to utilize their personal interests (history, hunting, warfare, ship building, fishing, travel, etc.), as entrees into groups or settings which allow them to add geoscience background into other disciplines and emphasize the influence of the geosciences as causative or influential elements in the history or development of the topic.
approach than others, but virtually every aspect of human society or history has been influenced in some manner by the Geosciences.

An excellent example of the concept of Stealth Education is present in the student edition of the *The Professional Geologist* in the article by Barney Paul Popkin titled "The Hohokam of Southern Arizona – Geologic Environment and Agriculture". I recommend that all members read it to get the flavor of the approach. The article is based on the life style and decline of the Hohokam Culture in Arizona, but utilizes that vehicle to expand the understanding of the geoscience variables of climate change, hydrogeology, hydraulic engineering, tectonics, dendrochronology, and the degree to which each of those elements interacted with the social interaction of the Hohokam culture. I recommend those interested in Stealth Education and Outreach to read this paper.

In my first editorial, I included a brief example of Stealth Education which involved climate change as it influenced the development of the Egyptian Empire. It is my intention to provide additional examples as this series of editorials continues. In these editorials, I will not provide full presentations, but rather a few illustrations that can be included in lectures on collateral subjects. Follow-up editorials will be designed to provide examples of different topics with appropriate slides and commentary on geoscience elements appropriate for insertion into the presentation.

**General example – Man and the Americas**

The history of man’s entry into the Americas is highly complex, allowing the introduction of glaciation, ocean current movement, sea level fluctuations and the role of river systems and hydrology as migration pathways into the interior of the continents. The Bering Land Bridge figure below illustrates the changes related to sea level rise associated with glacial melting. This figure provides an excellent entree for introducing the concept of glacial advances and retreats as well as the elements of geologic time related to the multiple cycles identified in the geologic record. The inclusion of archaeological excavation sites on the figure also provides pathways for introduction of permafrost and fossil preservation, effects of permafrost melting, geoscience-related factors influencing human and animal migration and physiographic changes due to glacial advances and retreats (coastal terraces, meltwater lakes, inundated moraines as influences on commercial fishing activities, etc.).

The Illustration can be included as background information for presentations on travel to Alaska, archaeological and anthropological discussions of human migration, causes and effects of glaciation, multiple migration pathways associated with the entry of man into the Americas, commercial fisheries, coastal physiography, local and regional climate controls, etc.

A major potential pathway for early migration of humans from Asia into the Americas was by boat along the edge of sea ice along the coasts of Alaska, Canada, and the western United States. A facilitating element in that migration is the California Current, an oceanic current system along the west coast of the Americas.

Since the California Current flows southward, it provides an excellent pathway into the Americas, with the Canadian Inside Passage, Vancouver Island and the California Channel Islands, providing stepping-stones for southward movement from Beringia.

When combined with figure 3, illustrations of this type provide excellent entrees for insertion of discussions on Oceanography, oceanic circulation patterns and causes, bases for coastal climatic zonation, adiabatic influences on rain forest and inland desert forma-
tion, oceanic upwelling relationships to nutrient availability for commercial fishing, whale migration patterns, El Nino/La Nina impacts on weather and climate patterns, and, by extension, the importance of glaciation to water resource availability in the Western United States, both at present and in the past.

Expansion of discussion can be used in conjunction with figure 4 to introduce the concepts of coastal environments as factors in the development of early civilizations in Central and South America. These coastal environments provided effective oases of water and abundant food from marine and terrestrial sources. This in turn provided excess labor which allowed the labor specialization necessary for development of the civilizations (Soconusco, Mixtec, Olmec, Mayan, Incan etc.) of the coastal regions of Central and South America, which then expanded inland along streams and through gaps in the volcanic chains which characterize the western coasts of the central and southern Americas.

The influences of rivers and streams as transportation pathways from coastal regions to continental interiors provide entrees to discussions of mountain building, stream runoff and river development, physiographic and adiabatic controls on coastal climate variability, marine current and upwelling effects on marine life, weather patterns, monsoonal controls associated with the Intertropical Convergence Zone, as well as other elements directly associated with the tectonic setting of the Americas.

Figure 5 introduces the concept of land bridges as low sea level pathways for migration into what are now apparently isolated Caribbean islands. This figure illustrates the potential movement of humans and other terrestrial animals into the Caribbean islands with subsequent isolation into the modern archipelago. This discussion can be expanded to include other areas as well, e.g. the Mediterranean Islands, the South Pacific Archipelagoes, Japan, Taiwan, the Aleutians, Madagascar, Great Britain, etc.

Lower sea level associated with glacial maxima allowed island-hopping by reducing the open water separation between land masses. In some cases, direct connection with the mainland was present (e.g. Trinidad, Great Britain, and the Maritime Provinces of Canada). Now separated modern islands were often part of a single landmass at the time of human entry into the area as illustrated by Figure 6 showing the Anguilla Bank, once a land mass including the island of St. Martin, Anguilla and St. Bartholemy. Glacial melting over the past 10,000 years resulted in a 300+ foot sea level rise producing the present island chain configuration we know today as the Caribbean Islands.

These types of illustrations are very useful in allowing the introduction of glacial cycles, climate change, sea level rise

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The First Day of Class: How to Turn the Challenge into Opportunity

Rasoul Sorkhabi, Ph.D., CPG-11981

“Meeting a group of strangers who will affect your well being is at the same time exciting and anxiety producing for both students and teacher.”

- Wilbert McKeachie in Teaching Tips

As a new semester begins, both teachers and students get ready for classes and courses. The first day of class; however, is probably the most important. It sets the stage and the tone for the rest of the course. Picture a number of individuals from various walks of life and unknown to each other are assembled in a single room to study a subject matter that is of interest to them. The first class (or the first week of the course) is thus filled with excitement of learning a new subject as well as nervousness about performance and interpersonal relationships. In this equation, however, the instructor is also the navigator, and a great deal thus depends on him or her. Whether you are teaching the course in a physical or virtual class, the importance and the challenges of the first meeting remain the same.

Students usually spend the first week of the semester sizing up courses and instructors, and shopping for the best that suit them. As a teacher in love with your subject – earth science here – you do not want to miss this opportunity to share your science with a younger generation, or even worse, convey some unpleasant impressions about your course and subject. Here are some tips and suggestions to make the best use of the first meeting with your students.

Preparations in Advance

Preparations for the first day of class actually begins months before. Ideally, before the semester starts, the instructor has already designed the syllabus: its objectives, content, timeline, textbook (and other materials), teaching techniques, assignments, examinations, and so forth. A few days before the first day of class, it is wise to visit your classroom and ensure that all the facilities you need for teaching are in place and functional: Lights, Internet connection, projector, screen, white board, etc. It is also important to know who to contact in case you need technical support during the class.

Attire is always a good way of conveying a message about yourself: Are you well organized? Do you care about yourself? Do you respect the class? By dressing well (but not overdressing), you also inspire pleasant feelings and invite the students to respect the class and exhibit proper behavior. The image of an absent-minded professor with poufy hair and wearing no socks may be endurable for scientists like Albert Einstein (who hated wearing socks) but most of us are not Einstein.

The first day of class is the initial meeting between the instructor and students. It is a great opportunity for the instructor to introduce himself or herself, to learn about students, to attract the attention and interest of students to the course, to create a sense of teamwork and a positive learning environment, to articulate the significance and learning outcome of the course, and to show students a roadmap for successful completion of the course.

Introduce Yourself

Going to class a bit early, and greeting and welcoming students demonstrate your care and commitment. Start the class on time, and introduce yourself clearly: “Good morning (or good afternoon)! Welcome to the class of X. My name is X. I am delighted to be your instructor for this class.” It is also helpful to write on the white board (or already written on a slide) your name, contact information (email address and office phone), and your office hours.

You may also share with students some background information about yourself: Your education, your teaching experiences, how you became a geologist, what you love about geology, in what area of geology you conduct research, and so forth. Remember this is a formal class; talking too much about yourself and your accomplishments is not appropriate. Be modest in what you say and how much you say. Students feel comfortable with a teacher whom they know. They also appreciate a teacher who is enthusiastic about his or her job. Reveal yourself at best and show your passion for geology and for teaching it.

Let Students Introduce Themselves

Introduction has two sides; it is a two-way street. You also want to know about your students. Asking students to introduce themselves indicates that you care about them; it also helps create a feeling of belonging to the class. If the class size is manageable, request students to say at least their names and majors. Regardless of the class size, it is always good to pass pieces of paper to the class, and ask students to write down their names, majors, why they are taking your geology course, and what they expect of the course. This has two benefits. Firstly, you have a class roster for the first day, which you can compare with the roster provided to you by the college. (Colleges usually need this information for managing “wait-listing lists” for classes). Secondly, you have a written record you can review later to better assess the composition of your class. (Memory is very limited and it does not improve with age!)
Introduce the Syllabus and Roadmap

Then comes the review of the syllabus and all its ingredients:

- Textbook (and other educational materials) and where to get them – to be purchased or provided by the instructor. Remember that no textbook is perfect. Do not criticize the author or the book. This will only discourage students and they will wonder why you have even chosen it in the first place. Spend some time on how to use the textbook (and other materials).

- Course content and learning outcome. Some information about the course content is absolutely necessary; however, do not go into details or use unfamiliar technical terms (jargon). Relate the course content to learning outcomes. We will learn how to identify some common minerals; how rocks form and transform from one type into another; what causes earthquakes and volcanic eruptions; and so forth. Make a concise and charming list of the general points to be learned.

- Assignments and exams with their deadlines and a timeline for the course.

- Grading scheme and how you measure the performance of students.

- A roadmap on how to succeed in the course: What do you expect the students to do to get an A?

- Canvas. Many colleges in the USA utilize the Canvas platform for uploading teaching materials, posting tests, communicating with students, and so forth. Explain how this system works and where students can find things you upload or ask them to do.

- How students can contact you if they have questions related to the course. And how they can contact the department, library or college if they need assistance or if they are required to perform specific tasks.

- Detailed syllabus must be posted on the Canvas ahead of the class (and also possibly handed to the students in the class). Use the same file or document to review the syllabus and its contents with students.

Ice Breaking and Entertaining

The above tips and advice are all important procedures and can be used as a checklist. However, the first day of class also faces subtle psychological barriers. This barrier of anonymity should be lifted in a cordial and friendly manner. Many education experts call it “breaking the ice.”

In his article “Getting Started” ([Chemical Engineering Education](https://doi.org/10.1002/chee.19950100109), Summer 1995), Richard Felder remarks: “A relatively ineffective way is to stride into class, announce your name, the course, the course text, and start to write differential equations on the board.”

Remember that a class should not be a monologue, whether on the first day or on any other day. But the early days set deep impressions. Allow students to engage and ask questions. From time to time, ask students if they have questions, and treat each question in a meaningful and respectful manner. As the saying goes “no question is a stupid question in the class.”

Teachers are primarily teachers not entertainers; however, successful teaching also includes a certain degree of fun and entertainment. People love short stories. They also love visual materials. Play very short video-recordings related to what geology is and what geologists do (YouTUBE is a great source). Make your class teaching both informative and entertaining.

Geologists are lucky in the sense their subject-matter contains so many fascinating features – from gemstones and fossils to mountains and mines. Students will be thrilled to know how geology is related to the landscape, physical features, and natural resources of their enviros, cities, and states. Use some local examples to illustrate interesting facts about geology – a nearby volcano, fault, mine, mountain, lake, etc. There is no shortage of such examples wherever you live.

Some teachers use a problem-solving game to break the ice. Some teachers give a brief quiz test to attract the interest and attention of students to the course content. These are all useful; but they should not be overwhelming.

Make sure that students find you as a teacher who is objective, fair, and positive, and they also find geology a relevant interesting science, not dry and hard.

End the class with appreciative and welcoming words: “Great job! Thank you all for your attention and participation. Our next class will be on X day. Looking forward to seeing you then. Have a great day!”

In The Intelligent Professor Guide’s to Teaching (1995), David Champagne remarks: “What happens between you and your students in your classroom or lecture hall depends largely on what you want to happen. How you treat each other and how you and your students feel about being in that place with each other is modeled and influenced by you.” This is actually good news. It means that you – the teacher – is in control. But it also means that the teacher should prepare well for the entire course, and particularly for the first meeting of class. Teaching geology is an enjoyable and also useful job. It is indeed a privilege to share the science of our home planet with young people who are builders of the future of human society on Earth. Teaching is an art that is perfected through experience. Therefore, what happens on the first day of a class...
is not the final complete experience; it gets better over time if we have an attentive mind.

**For more information**

A number of universities and colleges have published tips and advice for the first day of class. I have also found the following articles useful to consult:

- Bennett K.L. “How to start teaching a tough course: Dry organization versus excitement on the first day of class.” *College Teaching*, 52(3):106, July 1, 2004
- Lang, J. “How to teach a good first day of class.” *The Chronicle of Higher Education*, January 4, 2019
- Weimer, M. “The first day of class: advice and ideas.” *The Teaching Professor*, 3(7), 1-2, Aug./Sept.1989

**Stealth, continued from p.43**

and fall associated with glacial cycles, physiographic development, volcanism with respect to origin of many of the islands and allowing contrast between carbonate versus volcanic origin for the islands in different areas of the chain. The Caribbean setting can also be used to discuss multiple cycles of reef development and volcanic activity within the same tectonic setting. If desired, and the audience is appropriate, the concept of Plate Tectonics and the relationship between plate movement and types of volcanoes can be introduced and further used for discussions on differences between volcanic soils and those more associated with carbonate deposition in agriculture.

In my next editorial, I will discuss how tectonics and associated features influence cultural development and the rise and fall of empires. The Spanish Empire in the New World and plate tectonics will be the bases for the discussion.
California’s 2020 Wildfire Season was particularly destructive, with nearly 10,000 incidents burning more than 4,250,000 acres, damaging or destroying more than 10,000 structures, and sadly causing 33 fatalities.

Fire disasters create a significant amount of debris, including ash, metal, concrete, building materials, hazardous materials, and contaminated soils. The California Governor’s Office of Emergency Services (CalOES) tasked California Department of Resources, Recycling, and Recovery (CalRecycle) to oversee the removal and proper disposal of ash and debris to reduce threats to public health and safety, protect the environment, and help communities recover and rebuild. Four operational branches were developed to respond to the regional diversity of communities impacted by the wildfires.

Geo-Logic Associates (GLA) is part of a team formed to oversee debris removal operations in six counties in northern California, including Lake, Mendocino, Napa, Solano, Sonoma, and Yolo counties. Project roles for each team member vary; GLA’s specific duties include:

- Collect and analyze representative soil samples from each geologic unit to establish background concentrations of heavy metals. These background concentrations were evaluated with the specific health risks for each metal to establish cleanup goals for the project.
- Perform site assessments to map debris fields, identify hazards, and document existing conditions.
- Following debris removal, collect soil samples and test for contaminants remaining beneath the debris footprint. Analytical results are compared to cleanup goals for the specific geologic unit on which the property is located. If concentrations exceed cleanup goals, GLA works with CalRecycle to dispatch the debris removal team to the site, and additional soils are removed. The process is repeated until all cleanup goals are met.
- When heavy metals concentrations are less than or equal to cleanup goals, GLA oversees placement of stormwater best management practices to control sediment runoff from the remediated property.

The project commenced in November 2020 and is expected to be completed in the summer of 2021. The project size and complexity has required resources from nearly every GLA office, and the associated networking has helped develop interpersonal relationships amongst GLA team members that normally would not occur. The sense of teamwork and support on this project has brought our staff closer together for the common goal of clearing sites of fire debris and contamination allowing homeowners to get back to their properties to rebuild.

On individual job sites, resources from several companies (including State and County agencies, arborists, biologists, archeologists, environmental specialists, asbestos assessors, and debris removal crews) join forces to remove debris and assist property owners return to a normal life. The entire project team is a guest of the community, and we commonly reinforce amongst ourselves to respect the fact many people lost their homes and most treasured possessions with little time to escape. Although the homeowners have experienced tragedy in the last year, many still greet us with a smile and gratitude for our work. The conversations I’ve held with homeowners regarding their experiences, including narrowly escaping the flames and their memories lost, has made me incredibly connected and passionate about our work.

All project personnel are required to maintain respect to the community and the environment, including concerns for waterways, creeks, trees, wildlife,

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Geology of Michigan

AIPG’s 2022 Annual Meeting will be in Marquette, MI. If you have expertise on any aspect of the geology of Michigan, especially of the precambrian rocks of the Marquette District, I strongly urge you to submit a paper to TPG by January 1st, 2022, for the July-Aug-Sept 2022 issue. Papers will be Peer Reviewed and indexed. Go for it!

Adam Heft, CPG-10265, Editor
Want to purchase minerals and other oil/gas interests.
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This service is open to AIPG Members as well as non-members. The Professional Services Directory is a one year listing offering experience and expertise in all phases of geology. Prepayment required. Advertising rates are based on a 3 3/8” x 1 3/4” space.

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AGI Webinar Series:

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High Resolution LNAPL Conceptual Site Models
CEUs: 0.20

Featured Speaker:
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This course is intended for geologists involved in Light Non-Aqueous Phase Liquid (LNAPL) assessment and remediation. This course provides information on the development of high resolution conceptual site models that can be used to guarantee the project goals are met. The class will cover advantages of a high resolution LNAPL Conceptual Site Model (LCSM); design and implementation of a high resolution investigation field program; case studies and end uses of a high resolution LCSM.

To watch this webinar, go to:
https://goli.americangeosciences.org/courses/course-v1:AIPG+AIPG001+2020/about

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Technical writings including peer review, student writings, field experiences, career development, member news, and more accepted.
Robert E. Pendergast, CPG-02247
Hutchinson, Minnesota
December 29, 1929 - February 16, 2021

Member Since 1971
Raised on White Bear Lake in Mahtomedi, Butch was a graduate of Breck Military High School and after earning a BA in Geology from Dartmouth College, went on to the University of MN Geology and Civil Engineering graduate school. A career geologist, he was the founder and president of Geotechnical Engineering Corporation (forerunner of American Engineering Testing), and founder and president of Pendergast Geoengineering, Inc. Always active in professional engineering organizations, Butch was also involved in civic and community groups including Rotary clubs, the St. Paul Club, and the 49ers Business Development Club as well as founding the Trilogy at Vistancia STEM club in Peoria AZ. Butch was ever the enthusiastic outdoorsman. He loved hunting anywhere, enjoyed hiking and biking in the Arizona deserts and mountains, and sailing in the Caribbean. Before settling in Arizona in 2001, he and Jackie were 20-year winter residents, and guesthouse owners on Culebra Island PR and spent summers on Lake Hook in Hutchinson MN, where he was the fifth of seven Pendergast generations to live in Hutchinson.

Robert was a long-time AIPG member, and received a Presidential Certificate in 1985.

Robert W. Rodgers, CPG-08032
Huntsville, Texas
April 28, 1935 - January 28, 2021

Member Since 1990
Excerpted from Robert’s obituary.
Retired UT Pan American geology professor Robert William Rodgers passed away Thursday, January 28, 2021 at the age of 85. Born April 28, 1935 in Huntsville, Texas, to Martin Leon Rodgers and Mary Alice Collins, he was preceded in death by his parents and his beloved wife, Peggy Rae Jacobs Rodgers.

A graduate of Baylor University, he taught geology at Pan American for 30 years where he influenced many future geologists and as well as many students who passed through his classroom. Following his retirement from teaching, he began a new career in consulting. A lifelong member of the American Geological Society, he was involved in promoting and researching geothermal energy and alternative fuel sources.

Honoring our members and their careers is important to AIPG. Every member has contributed to the field in one way or another. Help us honor their memory and be sure to notify headquarters of the passing of a member.
aipg@aipg.org
Rasoul Sorkhabi’s article, “Why History Matters,” in Apr/May/Jun’21 issue of The Professional Geologist begins by quoting Archibald Geikie’s observation that, “In science, as in all departments of inquiry, no thorough grasp of a subject can be gained, unless the history of its development is clearly appreciated.” Sorkhabi then observes, “The history of earth science has no place in the current geoscience programs in universities. The vast majority of geology departments do not offer a course on the history of earth science. Even geoscience textbooks focus on concepts with little information on the history.” I am quite disturbed and saddened by Sorkhabi’s observation because some interest in and understanding of the history of geology has always been part of my geoscience education. John Playfair’s account of James Hutton’s visit to Siccar Point describes an historically important geologic observation. Darwin’s Origin of the Species is a foundational work for fossil evolution and the Earth History course. Chamberlain’s insistence on multiple working hypotheses while working out field problems and Bowen’s reaction series are other examples of historically important geologic observations from my undergraduate days.

In my presentation, “Industrial minerals all around us: much used, little recognized,” I begin by noting that stone and flint tools and arrowheads and the potsherds beloved by archeologists result from stone age industrial mineral usage and mining. The location and mapping of flint quarries with distinctive flints and the mapping of the flint tools made from these distinctive flints are evidence of Native American trading patterns. Salt sources within continents are marked by the location of important cities, e.g., Salzburg, Austria or Salina, Kansas.

I took paleontology in the spring term of my senior year and the grade depended on writing a paper that reviewed the development of the geologic time scale and either defending its continued use or proposing an alternative. I found that the fossil-based Phanerozoic time scale worked was somewhat surprising given the different places and times of the initial description of the various periods as summarized in the following table.

That term paper also caused me to read many classic papers on the fossil record, extinction, and Earth History. When I was in grad school, the one universally required course for the PhD was on the development of geologic concepts, which involved

<table>
<thead>
<tr>
<th>Geologic Periods in Order of Definition</th>
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<tr>
<td>1795 Jurassic, von Humbolt</td>
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<tr>
<td>1822 Cretaceous, d’Halloy</td>
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<tr>
<td>1834 Triassic, von Alberti</td>
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<tr>
<td>1835 Cambrian, Sedgwick</td>
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<tr>
<td>1835 Silurian, Murchison</td>
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as well as the health and safety of the community and those directly involved with the debris removal operations. On a personal note, I arrived on a site that required additional work and found nesting birds within the work zone. I notified project managers and a project biologist mobilized to the site to evaluate the situation. Work for this site has been delayed until the nesting birds leave.

The widespread drought that has affected California over the last couple decades has made the area more prone to devastating wildfires. In the few months since the project began, the landscape has changed from charred hillsides and blackened trees to green grasses and beautiful wildflowers. Although Northern California is currently cycling back to dry vegetation, bringing back the threat for intense wildfires, we continue our efforts to support the community and get those affected by the 2020 wildfires back on their feet.

Geoscience History, continued

reading of classic papers. While I never took the course, I have enjoyed reading many of the classic papers over the years.

One of my favorite (historic) books is Agricola’s 1556 De Re Metallica, which contains everything you needed to know about mining in 1556 and still full of useful information due in part to the extensive explanatory footnotes by Herbert Hoover. Four examples illustrate the point.

Now a miner, before he begins to mine the veins, must consider seven things, namely: - the situation, the conditions, the water, the roads, the climate, the right of ownership, and the neighbors. Modern mineral resource and reserve classification systems basically expand the details of this 7-item list.

Three excellent pieces of investment advice:

[Investors] should not buy only high-priced shares in those mines producing metals, nor should they buy too many in neighboring mines where metal has not yet been found, lest should fortune not respond, they may be exhausted by their losses and have nothing with which they may meet their expenses or buy other shares which may replace their losses. This calamity overtakes those who wish to grow suddenly rich from mines, and instead, they become very much poorer than before. So then in the buying of shares, as in other matters, there should be a certain limit of expenditure which miners should set themselves, lest blinded by the desire for excessive wealth, they throw all their money away.

Moreover, a prudent owner, before he buys shares, ought to go to the mine and carefully examine the nature of the vein, for it is very important that he should be on his guard lest fraudulent sellers of shares should deceive him.

Shafts and tunnels should not be reopened unless we are quite certain of the reasons why the miners have abandoned them, because we ought not to believe that our ancestors were so indolent and spiritless as to desert mines that could have been carried on with profit. Indeed, in our own days, not a few miners, persuaded by old women’s tales, have reopened deserted shafts and lost their time and trouble. (Ben F. Dickerson, III, who quoted this passage in his “Rock in the Box” column in Mining Engineering, February 1984, p. 181, noted that “‘old women’ were undoubt-edly like those of today, i.e., little old males.”)

My other favorite (historic) book is H.E. McKinstrey’s 1948 Mining Geology, Prentice Hall, that was written for the recent graduate hired to work at a mine and explaining how the job is practically done. William C, Peters’ Exploration and Mining Geology, 1978 & 2nd ed., 1987, John Wiley & Sons, is an update version of McKinstrey but lacks McKinstrey’s great writing style. For example, here is McKinstrey’s definition of a prospect, “A prospect is a potential ore producer which is still in its early stages of development; not until there is enough ore to support a substantial output does the prospect achieve the dignified status of ‘mine.’ A prospect may be merely an untouched ledge of outcropping vein matter, or it may be a former mine that has produced thousands of tons, reduced again to the status of prospect by the removal of all its developed ore. These and other types of prospect have in common the fact that the ore reserves consist chiefly of hopes.” McKinstry footnotes this definition with the note, “Again I am using ‘ore’ in the technical sense of the word. A body of metal-bearing material is not an ore reserve until someone proves that it can be treated at a profit.”

McKinstry also has this excellent advice to consider when examining an old prospect, “The very fact that a prospect is inactive is a sign that something is wrong with it.” Others have examined the prospect and abandoned it for various reasons although the most common, if least mentioned by promoters, is lack of ore (a restatement of the last of Agricola’s observations quoted above). What observations can you make that changes the situation?

Geoscience is an historical science. We do not conduct experiments to learn what will happen. We look at an outcrop and work to decipher what did happen in its creation. This fact alone should encourage us to pay attention to the history of our science. As John McPhee observed in Basin and Range, “If by some fiat I had to restrict all this writing to one sentence, this is the one I would choose: The summit of Mt. Everest is marine limestone.” Consider for a moment why that is such a great summarizing sentence.

As Sorkhabi notes in the bibliography at the end of his article, there are a number of excellent books on the history of geology. I would add the following to Sorkhabi’s list:


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Adventures in Earth History, selected and introduced by Preston Cloud, 1970, W.H. Freeman; this is a collection of a large number classic papers.


The road to Jaramillo: critical years of the revolution in earth science, William Glen, 1982, Stanford University Press.


Recently, during an exchange of e-mails, Adam Heft, the incoming editor of The Professional Geologist, said to me that after all my nearly 50 years of college teaching at the Missouri University of Science and Technology (MS&T), I must have some interesting stories to tell. My initial response was that I have published more than 200 papers, but all those were technical in character and would not be suitable for inclusion in The Professional Geologist. Then, I gave some more thought about whether I had something that might be of interest, and I did remember an incident that might be amusing.

When I was lecturing once about the Mohorovicic discontinuity, the geophysical discontinuity that separates the earth’s continental and oceanic crust from the earth’s mantle, I mentioned the Moho, the abbreviation for the Mohorovicic discontinuity, and the students questioned what I had said. I repeated Moho and wrote “Moho” on the blackboard. The students had thought that I had said “mole hole” instead of “Moho” and the die was cast. The next edition of The Missouri Miner, the weekly university student newspaper, carried a feature article entitled “Geology Professor Hagni Lectures on the Geological Character of the Mole Hole.” The article then went on to discuss the geological character, origin, and importance of the mole hole, all things that I purportedly had said in the lecture. The students then came around to my office to ask if I had read that week’s edition of the student newspaper.

I did my best to deflate the student’s pride in their prank by responding that I had not read that week’s edition and that I had never read The Missouri Miner. I guess that it is time now to confess that I did indeed read that edition of The Missouri Miner and that I thought their article was really very clever and especially hilarious.

Member News

The following news story is reprinted from the Missouri University of Science and Technology’s Accomplishments website written by Velvet Hasner and posted to the webpage on December 1, 2020: https://econnection.mst.edu/2020/12/international-geology-association-honors-hagni/

International Geology Association Honors Hagni

Dr. Dick Hagni is one of five geologists in the U.S. to be named an honorary life member of the International Association on the Genesis of Ore Deposits (IAGOD).

Hagni is a Curators’ Distinguished Professor emeritus of geology. He retired in 2000 after serving the university for 44 years.

The International Association on the Genesis of Ore Deposits is the world’s top international professional organization on ore deposits. Through the years, Hagni gave many presentations at the association’s quadrennial meetings, led scientific sessions at several meetings, publishing numerous papers in the association’s Quadrennial Proceedings volumes, and serving as the editor for the 1998 proceedings volume for meeting in Beijing.

Hagni holds bachelor’s and master’s degrees in geology from Michigan State University and earned a Ph.D. in geology from the University of Missouri. He taught geology courses at S&T from 1956 until his retirement in 2000. He was named Gulf Oil Professor in 1984 and Curators’ Distinguished Professor of geology in 1999. He served as chair of geology and geophysics from 1985 to 2000 and taught a short course in applied ore microscopy at S&T and abroad in South Africa, Brazil, and Turkey.

Following retirement, Hagni has continued to conduct research, present papers at professional meetings, and publish papers. He has published 24 book chapters and books, 200 papers and given 395 scholarly presentations at geological meetings. He is a member of many professional geological organizations and served for a long time as chair of the Applied Mineralogy Commission of the International Mineralogical Association.

Professor Hagni Lectures on the Geological Character of the Mole Hole

Dick Hagni, PhD., CPG-00549

Recently, during an exchange of e-mails, Adam Heft, the incoming editor of The Professional Geologist, said to me that after all my nearly 50 years of college teaching at the Missouri University of Science and Technology (MS&T), I must have some interesting stories to tell. My initial response was that I have published more than 200 papers, but all those were technical in character and would not be suitable for inclusion in The Professional Geologist. Then, I gave some more thought about whether I had something that might be of interest, and I did remember an incident that might be amusing.

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Here’s a tale from the field that happened way back before three of us became exploration geologists. We got a good start.

During the Winter term of our Senior year at Dartmouth College, from January through March 1971, four of us worked on an independent Senior Honors project in Guatemala. This was part of an ongoing geologic mapping program spearheaded by the world famous Central American volcanologist, Richard Stoiber of Dartmouth’s Earth Sciences Department. We were nominally employed by the Instituto Geografico Nacional de Guatemala (Geological Survey of Guatemala).

Our project involved geologic mapping in the Guatemalan Highlands of south-central Guatemala. The map area was located a few miles east of Guatemala City. We stayed in the town of San Jose Pinula, where we lived with a Guatemalan family of two teachers and their two young children. We had previously taken an introductory Spanish class and our hosts spoke very little English, so we spoke only Spanish to them and they spoke only English to us. It was a wonderful learning experience for all of us. I remember that our host and hostess made sure that we learned about their culture and enjoyed ourselves during our stay with them.

The Instituto provided us with an old four-wheel drive vehicle and a driver who took us out to our field area every day. We spent most days looking at and recording the various rock types in the somewhat hilly terrain that was used by local farmers for cattle grazing and raising a few crops. The locals were often quite puzzled by these “gringos” who were walking around in their fields spitting on rocks and then throwing them away. We enjoyed seeing all the brightly-smiling little children lined up along fences to watch us pass by.

Our final product consisted of a geologic map published by the Guatemalan Instituto Geografico Nacional and a detailed report of the various volcanic rocks in our field area. The report became our Senior Honors Thesis, for which we each received a Citation.

Before leaving the states, Professor Stoiber presented us with a list of six things he wanted us to do to enhance our learning experience while there. Item number 6 follows:

“The sixth duty seems mickey mouse, but it has proved very helpful. Please write a letter to me every Sunday. It should include at least 7 sentences - one for each day. I want a running commentary of what is going on. If you each write on two Sundays this will about do it. I have letters from other years. I want them from this year.”

Being smart-alecky twenty-year-olds, in one of our weekly letters to Stoiber we wrote: “They shot two guerillas last night, but it wasn’t us.” We were pretty sure Stoiber did not see any humor in this because this was a time during the Guatemalan Civil War when militias could be seen on the highways and gunshots were sometimes heard. Sorry for being wise-guys, Professor Stoiber!

We had a wonderful time during our stay in Guatemala and learned a great deal about the people, culture, life-style and of course, geology. Having been born and raised in the very small town of Bath, New Hampshire, with a population of about 500 people, this really expanded the world for the two Lamarres.
AIPG BOOK CLUB

Join the AIPG Book Club!

Upcoming book club meetings are free; AIPG members and their guests are encouraged to join the discussions. The next two meetings are listed below:

June 30, 2021 - 6:00 PM Mountain Time (US & Canada)
Matthew Rhoades hosts:
Talking to Strangers: What We Should Know About the People We Don’t Know by Malcolm Gladwell
https://zoom.us/j/97415901884?pwd=YU5nd3M4diNoViAwNFLvc3FQNzA3QT09

July 29, 2021 at 6:00 PM Mountain Time (US and Canada)
Christine Lilek hosts:
Being the Person Your Dog Thinks You Are: The Science Behind a Better You by Jim Davies
https://zoom.us/j/99425255095?pwd=TkZIOVNKSG1YUFd0Y09WdnIYT2zzQT09

Brandy Myers, MEM-3175
Dawn Garcia, CPG-8313

Brandy Myers has organized a virtual book club for AIPG members and guests. The lack of in-person meetings sparked the idea of having a book club to foster more interaction and sharing between members in an informal setting. Brandy mentioned a leadership book that she liked, and quickly generated a list of volunteer presenters who also had some favorite books that dealt with topics such as leadership, communication and management. The book club isn’t limited to these topics, but it was agreed that it would be nice to have multiple books to explore those topics initially.

The first meeting was held on Earth Day, April 22, 2021. Dawn Garcia led a discussion about Thomas Erikson’s book Surrounded by Idiots, which describes and classifies behavior into four different groups for a quick method to understand and react to different personality types. The author is a Swedish economist who has worked in sales, and, by his own admission, was a very poor manager when young. He was spurred to try to figure out how to work better with others, and he used an existing human behavior model as the basis for this book. The behavior model was initially developed by William Marston in the 1950s and had four divisions: Dominance, Inspiration, Submission and Compliance (DISC), which later evolved into Dominant, Inspiring, Stable and Analytical (DISA). Erickson uses the DISA divisions and colors to represent each group. Most people are a combination of two or more colors. The book explains the traits of each behavior type and discusses the communications styles with lots of examples from the author’s own experiences, with anecdotes written in a lively and amusing style. The author emphasizes multiple times that human behavior is complex, and that this method is not a deep dive into psychology, but that many people have been able improve communications with others because they better understand the communication styles and behaviors of others.

About 20 people joined the group for interesting discussions about whether geologists tend to have a personality type, their own experiences dealing with different personalities, and how they have handled difficult situations.

The May 25, 2021 meeting was hosted by Brandy Myers. The featured book was Dare to Lead by Brené Brown.
Photo credit: Dawn Garcia

Members who would like to host a meeting are invited to contact AIPG headquarters. Meetings are between 60 and 90 minutes long, and are held using Zoom, which allows for breakout rooms for large groups to split into smaller groups of participants when desired. The host chooses the book and leads the discussion. We hope you will consider joining us for one or more of these upcoming topics!
New Prospects and Trends in Applied Geoscience

Rasoul Sorkhabi, Ph.D., CPG-11981

From education, public perception to employment, research and funding, geoscience is facing serious challenges and is competing with many lucrative fields, such as bioscience, nanoscience, artificial intelligence, business management, and others. In order to grow geoscience and publicize its value, it is imperative to showcase the means and manners by which geoscientists serve the wellbeing of society. This article reports on the results of a survey on how several areas of applied geoscience will be critical in the coming years, and how geoscientists can seize on these opportunities to strengthen their science, profession, and community.

Geoscience Education and Workforce

Most people including children are fascinated by minerals, fossils, and rocks, and are interested to know about the life of the dinosaurs, how mountains uplift, and other geological lore. Indeed, news about discoveries in earth science are popular (Sorkhabi, 2019). Ironically, however, Earth science is relatively underrated in our schools and K-12 education. A 2015 US survey found that only 22 states accepted an Earth and Space Science course for graduation, and only two states required a year-long Earth/Environmental Science course whereas the number of states for required Life Science and Physical Science courses for graduation were 50 and 30, respectively (Benbow and Hoover, 2015). Crisis in geoscience education is not limited to high schools. In recent years, college enrollments in geoscience programs in the US, UK, India, Japan, and probably many other countries have declined. According to Christopher Keane of the American Geosciences Institute (AG), geoscience majors in US universities decreased 21% from 31,744 in 2016 to 25,015 in 2019, and for the pandemic year of 2020 a drop of more than 10% was estimated (Saucier, 2020). Against this background, demand for geoscience jobs, according to the US Bureau of Labor Statistics, will increase by 5% from 460,242 in 2019 to 482,726 in 2029; most of these jobs will be in the environment, energy, and mineral resource sectors (Figure 1). Considering that 27% of the existing geoscientists will be retiring by 2029 and that new graduates entering workforce are projected to be 26,000, there will be about 130,000 deficits in geoscience jobs in 2029 (AGI, 2020a). Another estimate by Bartlett (2018) states that the US will need 14,000 new geoscientists in 2026 (compared to 2016).

It is thus important to communicate the value of geoscience to the public, school boards, mass media, and policy makers. This is a crucial challenge for the geoscience community; it is also a task that geoscientists can best perform. We also need to portray a new image of the geologist beyond one who digs for fossil fuels and loves earthquake incidences.

With this background, in 2019-2020, I conducted a survey of the most important questions and issues in geoscience. The survey was emailed to hundreds of geoscientists and circulated via community posts on the websites and email newsletters of Geological Society of America (GSA), American Geophysical Union (AGU), and American Institute of Professional Geologists (AIPG). A total of 136 scientists (75% from the USA) responded. Even though 75% of the survey respondents were from the academia, they still emphasized that several areas of applied geoscience (see Box 1 on page 57) will play significant roles in bringing direct benefits to society. The following topics were suggested by seven or more respondents as critical areas of research and development (Table 1).

Global Warming

Nearly 30% of the respondents suggested global warming as the most critical issue of our time. The complex issue involves many areas of research including in-depth understanding of climate change and carbon budget and cycle (sources and drivers as well as sinks and feedbacks), better forecasts and modeling of the impact of global warming on the environment.
and engineering is paved with concerns and challenges.

Since the 1860s, the petroleum industry has increasingly shaped the modern world; oil and gas have provided abundant and affordable supplies for lighting, heating, and transportation on land, the sea, and in the air, in addition to myriad petrochemicals and medicines. Since the 1910s, the petroleum industry has been closely associated with many universities. A large number of geology and petroleum engineering departments were founded in universities close to petroleum basins such as those in Texas and Louisiana. The industry has traditionally hired a large number of geology, geophysics, and engineering graduates, and has funded numerous research consortia and graduate theses, aside from the research laboratories and institutes that major oil companies operated themselves. Indeed, certain fields in geoscience, such as basin analysis, micropaleontology, sequence stratigraphy, organic geochemistry, subsurface imaging, petrophysics, well logging, and seismic and other geophysical surveys, were spearheaded and financed by the petroleum industry. Without these contributions, our knowledge of subsurface geology and stratigraphic record would have been limited to bedrock outcrops which cover only 34% of the Earth’s land surface. Given this history, oil market crashes adversely affect geoscience departments, education, and research. For instance, following the oil market crash of 2014 undergraduate enrollments in geoscience programs in the USA fell by 5% for the 2015-2016 academic year (Keane, 2017). The 2020 oil crisis due to the Covid-19 pandemic has also caused serious concerns (Sorkhabi, 2020). The petroleum companies and oilfield service companies have cut back on expenditures and have laid off a large portion of their workforce, particularly geoscientists. Given the worldwide movements to combat the global warming the future growth of the petroleum industry is not clear: Will the industry evolve and reinvent itself, or will it give way to other energy, mineral and environmental industries; and if the latter, will these industries be geoscience-intensive and highly supportive of research and education? These questions currently facing the geoscience community are at the heart of discussions on how to reform and develop geoscience education programs and research fields (Simmons et al., 2020).

In order for the petroleum industry to re-invent itself, it has to address two critical areas – environmental sustainability, and reducing exploration and production (E&P) costs per barrel of oil. Science and technology will play key roles in achieving these targets.

Table 1 - Priority fields in applied geoscience: This survey and critical needs were suggested by the American Geoscience Institute (AGI, 2020b).

<table>
<thead>
<tr>
<th>This Survey (total 136 geoscientists)</th>
<th>AGI (2020) Report</th>
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<tbody>
<tr>
<td>Global Warming (40)</td>
<td>Climate Change</td>
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<tr>
<td>Petroleum Industry and Geoscience (39)</td>
<td>Water</td>
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<td>Mineral Resources (16)</td>
<td>Energy</td>
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<td>Education and Workforce (15)</td>
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<td>Natural Hazards (12)</td>
<td>Soils</td>
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<td>Water Resources (11)</td>
<td>Mineral Resources</td>
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<tr>
<td>Energy Resources (10)</td>
<td>Oceans &amp; Coasts</td>
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<tr>
<td>Environmental Geology (7)</td>
<td>Waste Disposal</td>
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</tbody>
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Table 1 - Priority fields in applied geoscience: This survey and critical needs were suggested by the American Geoscience Institute (AGI, 2020b).
To be environment friendly and reduce its carbon footprint, the oil and gas industry has to invest in the science and technology of carbon capture, utilization and storage (CCUS), which currently plays a minimal role in the industry. As of 2019, there were only 17 operating CCUS plants in the world, capturing 31.5 million tons of carbon dioxide annually (Fajardy et al., 2019); most of these were industrial not power plants (Element Energy, 2018).

In the past decade the shale oil revolution in the USA has doubled the country’s oil and gas production. Nevertheless, the shale drilling and production technologies are far from perfect, and the shale revolution is still limited to a few basins in the USA. Some of the challenges facing the shale oil industry include:

- Avoiding gas flares in shale oil fields (and instead utilizing this natural gas resource)
- Reducing water consumption for hydraulic fracturing (or even adopting dry gas for fracking)
- Reducing methane emissions from the operating fields
- Control and mitigation of induced seismicity
- Optimization of well placement
- Treatment and reuse of produced formation waters
- Characterization and modeling of porosity and permeability types in mudrock/shale reservoirs
- Developing well logging technologies specific for mudrock/shale formations
- Shale structural geology and fracture mapping and analysis
- Modeling and calibration of hydrocarbon generation-migration-accumulation systems in shales
- Quantification of generated, migrated or residual hydrocarbons in shale plays.

To reduce its E&P costs and increase its profit margin, the petroleum industry must adopt smarter and more efficient methods. Some of the suggestions in this regard made by the survey participants include:

- Smart databases incorporating the 150-year legacy data in new digital formats
- Applications of machine learning and artificial intelligence to petroleum data analysis and interpretation
- Integrating petroleum geoscience and engineering in the industry’s workflows
- 4D modeling and improved subsurface mapping and imaging
- Improved recovery factors of oil and gas from reservoir formations

**Energy Resources**

Closely associated with the state of the petroleum industry is the energy transition. The world (as well as the geoscience community) is facing a huge dilemma. On the one hand, the catastrophic threat of global warming (mainly from the burning of fossil fuels) is an urgent call to move toward energy sources with the least carbon footprints. On the other hand, coal, oil and natural gas still account for 85% of the world’s energy supplies, and a rapid transition to replace these energy-dense fossil fuels will pose formidable political, economic, and technological challenges. Added to this dilemma is the fact that global energy demand will grow (not decline) in the coming decades as the flow of abundant, affordable and dependable energy is critical to life standards of the developed world and development of low-income nations. These trends provide geoscientists with both challenges and opportunities in exploring and developing energy resources. For developing renewable energy sources and massive electrification of transportation to replace oil, exploration and production of energy minerals (such as rare earth metals for wind turbines and lithium and cobalt for batteries) will be crucial.

The energy scenario in the coming decades will be a mixed-energy market (Figure 2), in which several resources and industries will compete for investments and profits as well as sustainability and social license to operate (SLO) (Figure 3).
Mineral Resources

Everyday life and modern industries all depend on a vast number of minerals and elements extracted from Earth. Mineral exploration has always been at the heart of geoscience but the field is expected to grow as global demand for minerals will increase and critical (strategic) minerals will dominate national security and geopolitics. The US Bureau of Labor Statistics (2020) forecasts that while geoscientist jobs for oil and gas extraction may shrink by 13% between 2019-2029, workforce demand for mineral industries will increase by 32% for that period (AGI, 2020b). The US Geological Survey has published a list of critical minerals and elements (Figure 4) that require domestic exploration and production in order to reduce the country’s dependency on foreign sources. The respondents in this survey envisioned that improved knowledge of reserve estimates, geographic distributions, geological concentrations, and industrial recovery (and environmental impacts) of critical minerals and elements will be important tasks for geoscientists.

Natural Hazards

Natural hazards are normal geologic processes; however, their tragic impacts on human life, structures and properties have increased due to population growth and concentration in megacities prone to natural hazards as well as unpreparedness especially in developing countries. Natural hazards include a diverse set of events resulting from tectonic, hydrological, meteorological, and climatic processes (Table 2), and many of them are inter-related, such as offshore earthquake-tsunami coupling. Large populations and settlements are located close to the tectonic plate boundaries with records of big earthquakes and explosive volcanoes (Figure 5). Earthquake geologist Robert Yeats has called megacities like Tokyo, Manila, Tehran, Istanbul, San Francisco, Los Angeles, Mexico City, Santiago, Lima, and several others as cities sitting on “earthquake time bombs” (Yeats, 2015).

Table 2

<table>
<thead>
<tr>
<th>Hazard Category</th>
<th>Hazard Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geophysical</td>
<td>Earthquakes; Mass movement (dry); Volcanic activity</td>
</tr>
<tr>
<td>Meteorological</td>
<td>Extreme temperature; Fog; Storm</td>
</tr>
<tr>
<td>Hydrological</td>
<td>Flood; Landslide; Wave action</td>
</tr>
<tr>
<td>Climatological</td>
<td>Drought; Glacial lake outburst; Wildfire</td>
</tr>
<tr>
<td>Biological</td>
<td>Epidemic; Insect infestation; Animal accidents</td>
</tr>
<tr>
<td>Extraterrestrial</td>
<td>Impacts; Space weather hazards</td>
</tr>
</tbody>
</table>

According to the World Health Organization, in the 20th century, more than 10 million people were killed as a direct result of natural hazards, including floods (6.8 million), earthquakes (1.8 million) and hurricanes or tropical cyclones (1.1 million) (Bryant, 2005). During 2000-2019, more than 7,000 geophysical disasters killed approximately 1.23 million worldwide (CRED, 2020). Natural disasters, especially those affecting megacities and infrastructures, indeed disrupt the world economy. Geoscientists and engineers can greatly contribute to studies of pre-
cise mechanisms of natural hazards, risk assessments and mapping, warning systems, mitigation, and construction of hazard-resistant structures.

**Water Resources**

Underground and surface freshwater resources used for drinking, irrigation and other residential or industrial needs constitute only one percent of the global water budget (Figure 6). Although water is a renewable resource, freshwater resources are unevenly distributed both seasonally and spatially, depending on terrain and climate. Geoscientists and engineers will play an important role in detailed studies of the hydrological cycle and water budget, underground reservoir mapping and characterization, drilling and extraction of groundwater, water resource management especially in arid environments, optimal practices of watershed modification, desalination projects, and so forth.

**Environmental Geology**

Despite the obvious relationships between environmental quality and human health, rapid industrialization of the world has created environmental pollutants of various types. Humans are now a geological force impacting every part of the planet from the atmosphere and the oceans to mountains and forests. In 2000, atmospheric scientist Paul Crutzen popularized the term “Anthropocene” for the influence of human activities on Earth. The term became widely and informally used, and some geoscientists consider 1950 as the beginning of the Anthropocene Age because it marked the accelerating trend of atomic age, space age, population growth, petroleum consumption, atmospheric carbon dioxide increase, telecommunication, international tourism, motor vehicles, and other human-caused factors (Zalasiewics et al., 2018; Ellis, 2018). Global warming, urban air pollution, acid rains, loss of biodiversity due to destruction of forests (with species that will never come back), desertification, nuclear and toxic wastes, plastic pollution of the oceans, silent erosion of top soil (that will take centuries to recover) and so forth are tragic records of the Anthropocene. Our failure to maintain the Biosphere 2 experiment (Nelson, 2018) demonstrates how precious and irreplaceable the Earth’s biosphere is, and one which we cannot afford to fail. Environmental geology is thus a great contribution of geoscientists to society, and the significance of this field and the workforce needed for its multitude tasks are expected to rise in the coming decades.

![Figure 5 - Global seismicity with earthquakes larger than magnitude 6 for the period 1900-2012. Many megacities are located close to active plate boundaries. (Source: USGS)](image_url)

![Figure 6 - Where is Earth’s water? Water, water, everywhere but liquid freshwater is like a drop in the bucket (after Shiklomanov, 1993).](image_url)
Applied Geoscience Comes of Age

It is important to study the interplay of geologic forces shaping and constraining civilizations on the one hand; and human use of resources and alteration of the environment, on the other hand. It is indeed possible to write the history and cultural development of humans in terms of their use of resources; from stones, water, soil, fire to metals, coal, petroleum, uranium and so on. At the same time, human populations and technologies have increasingly placed pressures on the environment and resources, and some scientists warn that, if these pressures continue relentlessly, the impacts will go beyond the carrying capacities of geo-environments. Applied geoscience will increasingly be useful in addressing the resource and energy needs as well as contributing to sustainable development and environmental protection.

The results of this survey are consistent with an AGI report (2020a) on a 9-point critical needs in geoscience research and development (Table 1), thus strengthening the importance of these trends and prospects in applied geoscience.

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