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THE PROFESSIONAL GEOLOGIST

VOLUME 60 NUMBER 3

JUL.AUG.SEP 2023

Student Scholarship Winners!

Stealth Education - Getting Down to Earth

Critical Metals Opportunity - Are We Ready?

Riverbank Lag Gravels - Argentina

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS
AIPG
-1963-
Competence · Integrity · Ethics

AIPG Member Photo Challenge

Challenge categories:

1. **Scenic Wonder - Grand scale landscape.**
2. **Off the Beaten Path - Unique feature/formation.**
3. **Geologists in Action - people at work/field trips.**
4. **Micro-Geology - Under the microscope.**

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, 2023**.

Awards:

First place in each category:

Image published on the cover of *TPG* in 2024. Winners will receive a personalized Estwing rock hammer engraved with their name and member number or AIPG Gear of choice up to $50.

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 up to $30.

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INSIDE THIS ISSUE

FEATURES

On the Cover: 2022 Photo Contest Geological Disaster Winner: Lawn Lake flood fan where the Roaring River meets the Fall River, Rocky Mountain National Park

Description: The Lawn Lake Dam failed in 1982 causing a flood on the Roaring River and then down the Fall River through the town of Estes Park, Colorado. Even today, this flood fan is a dramatic stop on the Fall River Loop of Trail Ridge Road through the Park. Taken: September 2001

Photo taken by: David M. Abbott, Jr. CPG-04570, Colorado Section.

2022 Photo Contest: Geological Disaster Runner Up on page 5.

DEPARTMENTS

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

American Institute of Professional Geologists (AIPG) is the only national organization that certifies the competence and ethical conduct of geological scientists in all branches of the science. It adheres to the principles of professional responsibility and public service, and is the ombudsman for the geological profession. It was founded in 1963 to promote the profession of geology and to provide certification for geologists to establish a standard of excellence for the profession. Since then, more than 12,000 individuals have demonstrated their commitment to the highest levels of competence and ethical conduct and been certified by AIPG.

The mission of the American Institute of Professional Geologists (AIPG) is to be an effective advocate for the profession of geology and to serve its members through activities and programs that support continuing professional development and promote high standards of ethical conduct.

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For AIPG news and activities go to www.aipg.org.

Unearthing the Power of Professionalism: AIPG's Credentialing and Networking for Geologists

Adam W. Heft, CPG-10265

Hello everyone! With the arrival of this edition, we are into the summer months. Students are out of school for the year or are at field camp. Some of the lucky ones have perhaps landed an internship before going back to school in the fall or have started their career. For those who were able to get an internship or a permanent position, did your participation in AIPG activities help you get that position? Please share your experience – our members, and our Executive Committee in particular, would like to know. I'm aware of a few instances where students who participated in Section activities were interviewed and subsequently hired as a direct result of attending AIPG meetings.

For our members, many who have not yet retired are hard at work with the busy summer field season. For some, this means long hours in the field, often behind a drill rig. Others are compiling information collected by others into reports. It often seems there are not enough hours in the day to complete everything that needs doing. "No rest for the weary" as the saying goes. Of course, working long hours for weeks on end often leads to another saying: "I'm getting too old for this s***," sometimes followed by a colleague remarking, "You look like hell." The point here is that we should all take some time to breathe on occasion. And if it seems that you are becoming increasingly busy with no end in sight, perhaps it is time to consider bringing on someone to help shoulder some of the load.

Mentoring junior staff while working directly with them in the field is a good way to do this. It helps them develop their skills in a way that your training influences and directs. That way, when you are unable to be on a job site for one reason or another – and it will happen eventually – you can be confident that the person you trained will be able to collect reliable information and get the job done the way you want it to be.

And mentoring a junior geologist can have other benefits too. In addition to showing them the ropes, it is an opportunity to introduce them to AIPG and show them why membership in a professional organization is (or should be) valuable to them. From establishing a network to gaining valuable skills by attending events or webinars that are relevant, or gaining continuing education hours to support a license, these are just a few of the reasons.

But what else can you do to help get new career professionals interested in AIPG? One thing would be to share a copy of *TPG* with them so they can see some of the activities that are planned or are happening across the organization or see the kinds of articles that we publish – we are always in need of more, and this is a good way for them to get their name into print.

This, the Jul/Aug/Sep edition of *TPG*, is smaller than usual, and features the annual undergraduate student scholarship essays on why those students want to become a geologist. Ten were selected as recipients by the National Education Committee and two were sponsored by their respective Sections (IL/IN and MI Sections). One additional essay by the recipient of the William J. Siok Graduate Scholarship was selected for his topic on the demands for jobs in the different fields of the geosciences. Besides the scholarship essays, this edition includes the final installment of the Stealth Education series by **James Howard**, CPG-02536 and a short technical piece on riverbank lag gravels by **Charlie Schlinger**, CPG-09554.

Another thing you can do to help get people interested in AIPG is to volunteer your time. Now, I know, your time is valuable; mine is no less so. But in early May, I volunteered to staff the AIPG exhibit booth at the north-central Geological Society of America (GSA) regional meeting that was held in Grand Rapids, Michigan. With our 2023 Michigan Section President, **Kalan Briggs**, MEM-3293, the two of us spoke with countless students and professionals at this meeting and encouraged them to become members over the course of two days. I know we had over two dozen completed membership cards, plus an unknown (but probably similar number) of individuals who scanned a QR code linking them to the membership application so they could complete the form online.

Kalan Briggs talks with students about the value of AIPG at the North-Centeral GSA meeting in Grand Rapids, Michigan.

What was the secret to our success at this meeting? There were three things that I believe were key in pulling in so many individuals. First, we had an interesting display to get meeting attendees to stop and look – for those of you who attended last year's meeting in Marquette, you may remember my exhibit of the Michigan bedrock formations. Who doesn't like to look at rocks, right? This helped break the ice and gave us time to talk to them about AIPG. The second thing was that on the second day of the meeting, we raffled off a pair of mineral specimens. We used the membership application cards for the drawing. We gave everyone the option of filling them out

Adam Heft's rock display featuring the formations of the Michigan Basin draws people and is a great conversation starter.

completely to become members, or only filling out their name, email, and phone number if they only wanted to be in the raffle. Most individuals chose to complete the form. And the third thing that helped was having two motivated individuals in the exhibit space who are passionate about the organization and its benefits. This way, when one person was occupied with talking with one or more people, the other was still available to talk to others that might just have gone on by.

So, give a little bit of your time; whether as a mentor, as an author of an article you submit for publication in *TPG*, or as a volunteer to talk to others about AIPG. It's a personally rewarding experience.

Why Professional Membership Is Important

I am a veteran petroleum geologist with 44 years of industry experience and am a 'Professional Member' in three jurisdictions, two in Canada plus the AIPG in the USA. Being recognized as a 'Professional Member' in my mind is very important.

1. It shows you are academically qualified.
2. It shows you have passed any *required* 'Professional Practice Exams' or tests.
   (Not necessarily required by all groups).
3. It shows you have relevant experience and have received qualified peer review.

Seeing that we live and do business in a 'watchdog' era nurtured by both government and non-government bodies, being a 'Professional Member' may actually allow the member to advance in their careers where others may not.

Today's hostile business environment, over-regulation and onerous rules placed on resource-based companies by 'regulator's', being 'recognized' allows the member to hold certain positions of authority requiring fiduciary requirements, particularly in public companies as they the member have the necessary credentials.

Banks and securities regulators such as the New York stock exchange and SEC in the USA and the various stock exchanges (TSX) in Canada and others worldwide are more adamant these days that companies submitting resource-based reports which will be used for money raising, lending and other banking purposes, require that these reports be coined and verified by 'qualified persons' under both signature and Professional Stamp or Seal.

Having membership in the AIPG not only shows academic achievement and experience, but it also shows that the member has professional acumen and integrity that goes with being a member in itself.

Being a member of a professional body such as the AIPG also ensures that the member will be backed by a body of professionals that will stand up for their members should the occasion arise.

Fred P. Rumak, P. Geol., P. Geo., CPG-7078

Calgary, Alberta, Canada

Dear AIPG,

I wanted to thank you for awarding me a $1,500 AIPG National Undergraduate Scholarship. I am deeply grateful for your generous award and support of my education. With this award, I will have the opportunity to focus more on my education and reduce the number of hours that I work while in school, which will allow me to dedicate more time to studying and holding leadership positions in extracurricular activities, like the Geology Club.

In addition to financial support, this scholarship has also given me confidence that I can be successful in a career in geology. I am currently a fourth-year student studying geology and creative writing at Michigan State University, and I intend to pursue a career in field geology after going to field camp next summer. I am passionate about conservation and geologic education, and I intend to apply to GeoCorps positions after field camp to continue developing my field and professional geology skills. Additionally, recent volunteering events with the Geology Club have shown me how much I enjoy teaching other people about geology, so I am also interested in having geologic education and outreach be a part of my geology career.

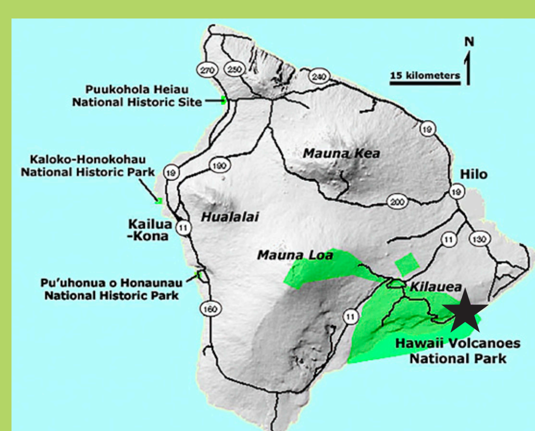
I am deeply appreciative of your support, and I look forward to staying connected with the AIPG throughout my student and professional career. I am committed to excellence and will continue to work hard to uphold the highest standards of integrity in my education, in the field, and wherever my future career takes me. Thank you again for your generous support of my education; I am incredibly grateful and honored to have been chosen as a scholarship recipient.

Sincerely,
Julia Rudlaff, SA-11675

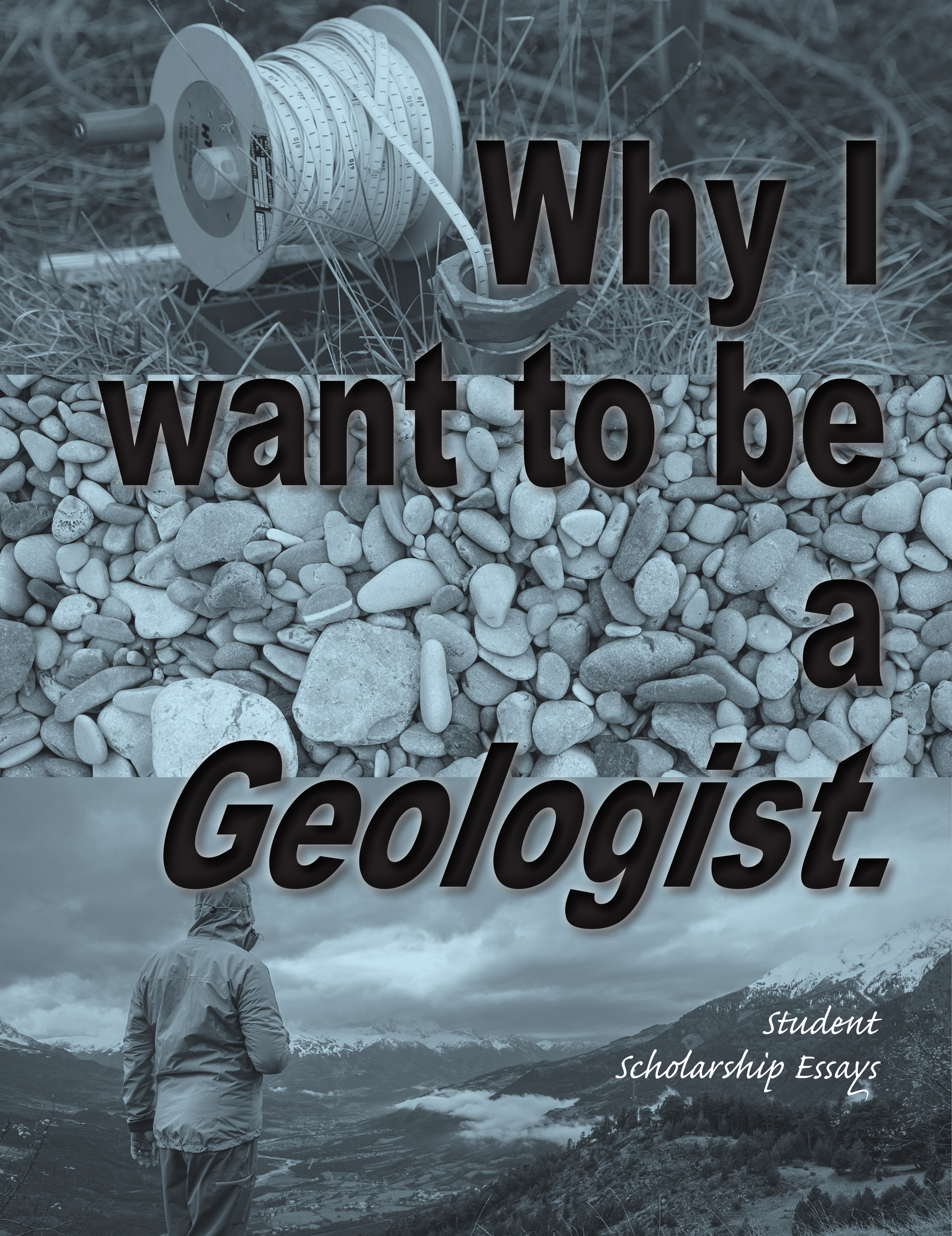
2022 Photo Contest Runner Up Geologic Disaster Category

A Pahoehoe Lava Feature. This stunning feature of Hawaiian Tholeiitic basalt is located at the southwestern end (terminated by a lava field) of Chain of Craters Road on the Big Island, Hawaii. The height is approximately 20 feet. This formation was created by the 2018 Kilauea eruptions that destroyed entire subdivisions.

Photo by: **Mary Moran, CPG-05079**, Carolinas Section



Why I want to be a *Geologist.*



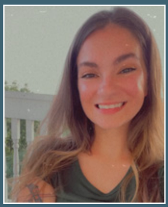
Student
Scholarship Essays

AIPG National is proud to announce that we have awarded 10 $1,500 scholarships to students pursuing geology degrees and careers. Two additional scholarships, sponsored by the Indiana-Illinois Section $500 band the Michigan Section $1,500, were also given. Scholarships are funded by national and the Foundation of the AIPG. As part of their scholarship application, we asked undergraduate students to write an essay themed "Why I want to be a Geologist." We are sharing their essays here.

We also awarded one William Siok graduate scholarship funded by the Foundation of the AIPG to a student pursuing their graduate level degree. We asked graduate students to write an essay focusing on a single theme of their choice, and explain how the profession of geology, over the coming decade, should best contribute to addressing a problem for the well-being of the public. They were asked to explain (1) Why their theme choice is significant and (2) How professionals educated in geology are essential to contributing successfully to addressing the problem. We are sharing this essay in this edition as well.

We are so proud of our student members and excited to see what they will bring to the future of the geosciences.

Congratulations students!



Kathryn Baumann

SA-11704

Middle Tennessee State University

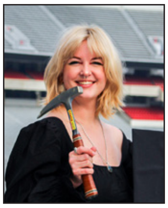
Tennessee Section

I made a choice my junior year of high school to pursue psychology in college. I was sixteen years old when I made that decision that would, due to the game of life creating a few roadblocks and detours along the way, lead me down a winding road that didn't end until I was twenty-five. Part of that educational journey catered to human development and the psychosocial patterns one experiences as they age. I wanted to know myself better, to understand how our human brains work, and why I make the decisions I do. I was right in the middle of Erik Erikson's fifth stage of development, identity versus confusion. Essentially, me versus the world. At that age we are looking for a sense of identity, who am I in this sea of billions of people on this great big planet and what is my role? I made that choice when I was still uncovering the essence of my identity. By graduating almost ten years after I made that decision, I had satisfied my mind and sense of pride in earning a college degree, but I knew I plateaued. That realm now felt too small. I wasn't just interested in myself anymore; my scope of the world had shifted and expanded almost exponentially.

My next decision was upon me. Do I try and do something with this degree in psychology or take a moment to keep working my job and save money while I figure out what I truly want? I went with the latter, which ended up serving me well through the pandemic. I was given time to reset and form goals to reach by age 30; one of them was to earn another degree. So, I started again in the spring of 2021 and graduated with a degree in Earth Science this past December. Earning a degree in Earth science has transformed the way I see the world. It has also helped define, organize, and explain many of the personal events in my life that I've had to deal with in ways my education in psychology could not. Geology has shown me how events separated by space and time connect to reveal an underlying story. Geology has served as a personal form of therapy, helping me piece together my timeline and approach multivariate problems.

I want to be a geologist so I can understand more of this world around me. It sounds so simple and a bit cliché, but it is the fundamental explanation I keep coming back to. I want to understand this planet I walk on every day, the elements that compose my home. I want to travel and explore other continents and unique landscapes, correctly identify rocks I find on adventures, and hypothesize the journey they traveled to reach that exact destination. I want to bust up some rocks, take samples back to my lab and analyze them in an x-ray diffractometer. I want to publish papers on my work and contribute to a global network of knowledge. I want to be outside in nature, instead of perpetually trapped in an office building with fluorescent lights. I want to build friendships with people who share my interests and can show me what they see, their ideas, and teach me how to be better person and a better camper. I want to be a geologist because it aligns with my soul.

I've only barely scratched the surface.



Grace Cantele

SA-11703

University of Georgia

Georgia Section

There's a quote by Paul Harvey from a speech read at the Future Farmers of America National Convention in 1978 that reads,

"Despite all of our accomplishments, we owe our existence to a six-inch layer of topsoil and the fact that it rains."

Interdependence is in the very nature of living—all life as humans know it has to depend on something else to survive. The fresh air to our lungs. The sun to our skin. The earth beneath our feet. What a wonderful way to describe the impossibly complicated web of life with only a few simple truths. I think that's where science comes in; to try and explain and over-complicate. Most sciences are that of observation. We take stock of what we can see and write it down and then use those experiences to make predictions about what could happen next. The beauty of humanity is that we share what we have learned in the hopes of making others' lives easier, and that love accumulates into the collective knowledge that we have today. Over the years, we have gotten better at observing—however this has led to even more questions being asked at a rate that outpaces any answers that we find.

As I age, and the trajectory of my life starts to become a little less fuzzy, the reasoning behind why I love earth science has grown with me. When I was a child, it was because I thought rocks were pretty and I had spent a good chunk of my time appreciating them with my grandmother. I loved the look of the mountains, the desert, the ocean, the cool rock I found on the side of the road, but I never knew how any of it got here nor how it worked— only a surface level appreciation for what was in front of me. I carried that same sentiment until my first geology course in college. It quite literally felt like my eyes were being opened for the first time and every time I would come home from an interesting lecture I would immediately tell my roommates about it. I very specifically remember doing an exercise on how to locate where an earthquake was based off of three different seismic stations, and I forced my roommate to practice it with me. And that was just the introductory course! Discovering new facets of geology with every new professor in every new class was one of the most interesting things about my undergraduate degree.

Granted, I still had to work for it, and it was by no means easy. I typically take a long time to thoroughly understand the assignment in front of me, and I used to struggle greatly with writing assignments. I was always working at least one job, combined with clubs, classes, and research that meant I stayed many nights in the geology building well past when the janitorial staff left (they were always very nice). The Geology Department at UGA has world-renowned staff and their expectations match the quality of their teaching. While the work was demanding, I do feel that my education was worth it. It gave me a new understanding, not only of the geology itself, but also what life is like in the industry and in academia itself— where I will hopefully end up in a few years' time. I think it also taught me the importance of collaboration with my cohort. I would have drowned without the other students around me, if nothing else for the emotional support and fun that we had while being miserable together.

As I enter the final stages of writing my senior thesis on volcanic hazards research that I have been a part of for two years, I'm greatly appreciating the practicality of being a geologist. Other than the field of medicine, geology has some of the greatest potential to actually help the people around you. From researching soil erosion, to water quality, to mitigating the effects of natural hazards like earthquakes and volcanoes, earth sciences is an incredibly useful field to study in that isn't really appreciated enough. The person who discovered the earth was warming was a geologist, and the accurate age of the earth was discovered by a geologist, leading to the invention of clean labs. Geology is going to be indispensable in the wake of the wrath that climate change will bring/ is currently bringing, and I feel very honored that the field that I am devoting my life to will be so influential in bringing real change to the earth.

"As I enter the final stages of writing my senior thesis on volcanic hazards research that I have been a part of for two years, I'm greatly appreciating the practicality of being a geologist. Other than the field of medicine, geology has some of the greatest potential to actually help the people around you. "

Why do I want to become a geologist? Because the earth is so, so unimaginably old and I think she's finally happy to have some company— but she can only share her secrets with those that know how to look.

Juliana Curtis

SA-11692

Miami University

Ohio Section

I grew up in a rural Ohio town, with my childhood home nestled in the woods and a creek trickling next to it. Throughout my childhood, this creek served as my haven. As early as I can remember, my older siblings would dress me up in some old clothes and old shoes, and we would go "creekin". I would observe the creek and how it would change from season to season, how big storms would erode and alter the banks, and how large debris would be carried along with rocks and sediments downstream. Most importantly though, I would begin to collect rocks. As a child I greatly enjoyed finding fossils. I was intrigued by the classic Ohio Ordovician limestone, with brachiopods and crinoids littered throughout them. My favorite fossils, however, were horn corals. As I grew up and began to read more about the fossils I was finding, however, I was shocked to learn that horn corals were not, in fact, dinosaur teeth.

It would seem that I knew I wanted to study geology from very early on in my life. However, I was actually very unsure about what I wanted to do with my future. I grew up a lover of nature: I played many outdoor sports, went looking for morel mushrooms in the woods with my dad, and of course, spent a lot of time at the creek. During my high school career, I quickly became interested in the sciences. Specifically, I fell in love with chemistry during my AP Chemistry course. So, when that big question came up about what I wanted to do with my future, I asked myself "How can I be outside all the time and do science?"

At first, I was very hesitant about studying geology. I wasn't sure how geology would really fit into my interests and logistically, how I could even get a job with a geology degree. My path as a geologist was solidified, however, during my second year of undergrad when I took a mineralogy course. It was in this course that I learned how my love for chemistry could be applied to rocks and minerals, and how these applications can be very significant. I owe all of this to my professor, who not only taught us the necessary topics such as crystallographic symmetry, solid solutions, etc., but also interesting, real-life applications of mineralogy such as the use of apatite to bury radioactive waste or make synthetic eyeballs for patients.

After my first year as a geology major, I quickly discovered the wide applications of geology. As an undergrad, not only have I been able to research Mesozoic arc magmatism through a suite of granites from Nevada, but I've also been able to study the use of reflective spectroscopy to find makeup smears in forensic investigations in the context of violence against women. I've found it so interesting that the field of geology intersects with so many other disciplines in significant ways. Through my involvement in the lab, I have been able to work with social justice majors, environmental science majors, and biology majors. The opportunity to incorporate others who might see things differently on an interdisciplinary research project is really astounding.

Geology has given me a deep sense of community and belonging. I have found a discipline where I can be intellectually and physically challenged, apply both my love of nature and science, and explore other interests relating to other disciplines. I can work collaboratively with intelligent people on research projects that will make a difference. Lastly, I can travel to really cool places and see awe-inspiring landscapes off the beaten path. I am greatly honored to be part of such a dynamic and interesting field, and I'm excited for my future as a geologist.

Phoebe Valerie Ann Futcher

SA-11510

West Virginia University

Virginias Section

I had a very imaginative mind as a child. Spending my vacations along the Jurassic Coast of England, when looking back at the cliffs I used to pretend that each lithological layer represented pages in a book. With each fossil introducing a new character and each stratigraphic boundary, an ancient chapter. It took until I began studying geoscience at university to realize perhaps the musings of my younger self weren't too far from reality. Unwrapping the mysteries of such ancient stories is what continues to motivate me in pursuing geology academically and professionally to this day.

It is undeniable that geology is paramount to our survival as a species, and that the way in which we utilize Earth's resources will ultimately decide the fate of generations to come. I believe that education about the complex processes which occur beneath our feet are the key to preserving our planet for future life. In studying geology as an international student, I have had the privilege to visit several sites of geological significance across different countries. In doing so it has revealed to me that the relationship and opinions we have towards our exploitation of resources varies significantly across the globe. I want to be part of the generation that bridges the gap and aids in innovation to invent technologies which allow us less dependance on Earth's finite resources. Last year, I had the opportunity to tour the only known Roman gold mine in the United Kingdom at the Dolaucothi Gold Mines of Wales. It reminded me that the discovery and exploitation of mineral resources is one of the oldest professions in the world. Yet, thousands of years later only now are we beginning to realize how our use of these mineral resources is affecting our planet and society. The dichotomy of this very modern problem stemming from such an ancient profession I believe emphasizes the importance for professional geologists in society and further fuels my pursuit of geology.

However, my passion for geology has not always been a linear progression. Like many students of my generation, the COVID-19 pandemic had majorly disrupted the way in which my education was delivered in the beginning years of my undergraduate program. Feeling dissatisfied with the lack of hands-on experience I was able to gain, I applied to study abroad. Only in coming to the U.S and studying at West Virginia University have I felt for the first time in my academic career that I have been able to gain back what I had been missing. Through laboratory exercises to class field excursions, I have gained invaluable experience and knowledge.

> **"...ultimately, I will enter the workforce as a professional geologist with the knowledge and skill to preserve Earth's resources for the generations that succeed me. "**

Not restricted by a rigid curriculum, but this time guided by my own autonomy. The global nature of geology leads me to wonder where else I could study, and likewise what remains to be discovered? Therefore, I want to be a geologist so I can understand more about other areas of the world and possibly learn about myself in the process.

The ability to travel and explore has always been a core motivator for me, even from a young age. Perhaps coincidentally or luckily, geology happens to be one of the few subjects where the outdoors truly is the best classroom. Therefore, I have had the unique opportunity to combine one of my favorite hobbies with my education. Studying in the United States has broadened my perspective on geology and allowed me to view many concepts on a grand scale that I have only ever learned about through a textbook. I have gained so much joy in pointing out formations and features to my friends and family, many of whom have never studied any form of geology and explaining their geological significance. Unravelling the complexities behind something that others may take for granted in the hope of inspiring others, is a sentiment I endeavor to pass on during my academic and professional career.

A year away from graduation, and yet my journey so far only feels like the beginning. Despite the sinuosity of the path I took to get here, I am confident I will not lose sight of my goal. Through graduate school, I hope to inspire others with my enthusiasm for the industry in which I have dedicated my adult life to studying. Then ultimately, I will enter the workforce as a professional geologist with the knowledge and skill to preserve Earth's resources for the generations that succeed me. These reasons capture the essence of why I see myself in no other career path except geology.

Reid Jansen

SA-11673

Miami University

Ohio Section

I started my pursuit of geology as a shocking number of geologists do - by enrolling in college as a marine biologist. It took about a week of classes for me to realize that biology was not meant for me. The lecture that hinted me towards geology was surrounding planetary formation. Something about the accretion and differentiation of materials in our solar system had me on the edge of my seat. It helped that one of the professors teaching the introductory marine science course, Dr. Larry Peterson, had gone down a similar path. He also began his college career as a marine biologist before being convinced to come to the "dark side."

While the physical science aspects of my intro courses were what interested me, I decided that I needed to take a bona fide geology class before making any rash decisions. Similar to how it only took a week for me to decide against marine biology, it took one week of Earth System History for me to realize that I was home. It was not even the class itself that convinced me. As much as I love the rock cycle, the first week of Geology 110 did not teach me anything new. It was the realization that another piece of advice I learned from Dr. Peterson was true. When I first showed interest in being a geologist, he told me, "Geology attracts a certain type of person, and you seem the type." He was right. Every geologist I have met has a shared trait that I have yet to pinpoint. Whether it is the universal love of rock-based puns or just a genuine passion for the science, there is some force that draws us all together. Every geologist I have met from that first class up until now has only furthered my passion towards the career. I cannot count the number of times that a professor or one of my peers have gone out of their way to assist me with no regard for themselves. Even when being more than altruistic, the level of brilliance maintained while keeping a sense of humor has always amazed me.

While the geologists themselves helped draw me into the profession, I have a burning passion for the science itself. As a kid I would spend hours outside scouring for the perfect rocks to run through my tumbler and digging through sediment piles in the pursuit of gold. It was no surprise to my family when I made the leap from biology to geology. As much fun as I had playing with rocks as a child, I have more fun as an adult reviewing sediment cores and analyzing speleothem bands. What appeals to me about geology is the thorough understanding it instills about the world we live in. Walking through a national park I am no longer filled with wonder and mystery but comprehension and amazement. Knowing the intense requirements that structures within our world must have gone through to form gives me a sense of appreciation greater than ever before. I like to think of it similar to watching a movie. You can watch a movie with no prior understanding of the intentions or events surrounding the film and still love it. Knowing the details and underlying meanings adds a whole new level of enjoyment.

Why do I want to be a geologist? It is a two-fold answer. The science of geology ignites a spark deep in my soul like nothing else. Nothing gets me excited like the idea of taking home a fresh sample showing an attribute of our world unique to my collection. While studying earth processes is thrilling in itself, the appeal of geology is heavily reinforced by the value of camaraderie found in this profession. Geology really does attract a certain type of people, and they are the most kind, funny, interesting group of people I have ever met. You never find yourself put out when you are surrounded by a group of rock-loving scientists. This is exactly why I chose to pursue a career in geology.

"Geology really does attract a certain type of people, and they are the most kind, funny, interesting group of people I have ever met. "

McKenzie Miller

SA-11294

University of North Carolina - Charlotte

Carolinas Section

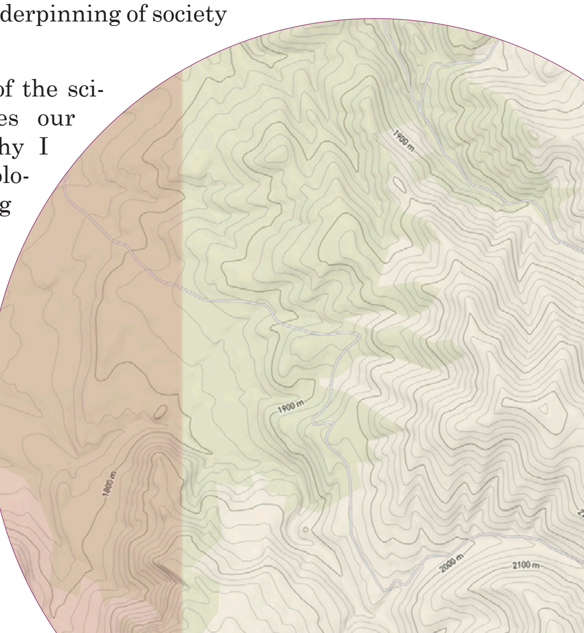
For some geology undergrads, field camp is an irksome hurdle between them and graduation. Personally, it was the promise of gritty field work that drew me to the discipline. Reading about the exotic work professors at my school did in Antarctica, the Mojave and beyond is what inspired me to change from a premed track to geology back in 2020. A lifelong lover of the outdoors and applied science, geology classes fit me like a glove. Though I had scarcely handled a Brunton, I began dreaming of becoming a field geologist. With covid spoiling the chance for any school field trips, I looked forward to field camp like a light at the end of the tunnel. Before I knew it, it was time to go.

The work of generations of geologists who have turned the real and messy reality of rocks into comprehensible maps and models loomed large in my mind during the weeks before camp. As the drive out to Idaho drew near, a little anxiety fluttered in my stomach. I wondered if three years of zoom education had really prepared me to map even a twentieth of a quadrangle. Though I had gotten into geology to become a field geologist and wondered if perhaps people dreaded field camp for legitimate reasons.

The moment we were released into our first map area to take strikes and dips and debate over unit boundaries, however, I knew I was in the right place. Trudging up steep talus slopes while discussing whether we could see evidence of the Antler Orogeny here made perfect sense. I love traversing rugged terrain with stellar views all while puzzling over how it got to be there. It is incredible to me that this work that feels like a thrilling adventure-puzzle can be a career.

In a world where many jobs can now be performed fully on a computer, I am grateful to be on a path towards work focused on what we can observe with boots on the ground. As they say, "what is not farmed must be mined." While much of geology is not mining, per se, I feel this quote exemplifies the importance of geology in our society. Without hydrology, our water supply would be a mess. Without geotechnical engineering, we wouldn't have the infrastructure we have today. Without sedimentologists, we wouldn't have a gas-powered world. Without paleoclimatology, we wouldn't know the impact that reliance is having on climate. Without mining, we wouldn't have any of the technology that dominates our lives. We couldn't be able to look towards greener energy technologies. Geology is the underpinning of society as we know it.

Being a part of the science that makes our world tick is why I want to be a geologist. The feeling of resting tired legs while carefully turning a day's worth of rocks into a cross section is why I want to be a geologist. Geology is the world's



best kept secret, hidden in plain sight. It offers endless intellectual curiosities, excuses to be outside, excellent colleagues, and an impactful role in society. I have never been "bored" since becoming a geology student, even when taking mineralogy over zoom. Geology amplifies my appreciation for this world and my personal satisfaction with my role in it. For all these reasons, I cannot wait to be a geologist.

Bhooma Parthasarathy

SA-11632

University of Houston - Downtown

Texas Section

My inspiration to pursue a career in Geoscience transpired in the most unique manner. Here is my story. When I embarked on my educational journey by enrolling at Lone Star College – University Park to work toward an Associate of Science degree, I did not have a designated major. I registered for the core courses involving English, History, Government, and math while trying to figure out my specific path.

Shortly after starting my educational journey, my father was diagnosed with Alzheimer's disease. My mother needed support in being the primary caregiver to my father. As a family, we decided that it would be best for my parents to move in with me. As I handled the multiple responsibilities of single parenting, employment, caring for my parents, I also realized what helped me deal with the stressors and anxieties that accompanied these responsibilities. As I sat in the parking lot of my children's extracurricular activities preparing for my calculus exam, it was the sound of the birds nearby that brought on the calming and focus. When I went with my parents for a walk around the nearby lake, it was the sight of the shore birds, squirrels, and butterflies moving between flowers that relaxed me. Time and time again, it was nature that provided the calming influence that helped me balance the responsibilities that filled my plate.

Sadly, anthropogenic activities have compromised the environment causing many of these species to become endangered. I started researching to learn more about what I could do as an individual to help with environmental protection. I gained knowledge from Texas State Parks, Houston Audubon Society, and other resources, attended volunteer events such as prairie restoration at Sheldon Lake State Park and loblolly pine replanting at Bastrop State Park. Through these experiences, I realized the anthropogenic effects on terrestrial and marine environments. Gradually, I started changing my lifestyle by replacing plastic water bottles with reusable water containers, biodegradable dish cleaning sponges, and actively recycling at home.

As my knowledge and engagement in conservational efforts increased, I decided to pursue a field toward environmental conservation. Of course, this could be accomplished through environmental biology, or chemistry, or geology. Marcus Garvey once said, "A people without knowledge of their past is like a tree without roots." Extrapolating Garvey's perspective toward our planet implies that it is important to understand the present-day earth as a function of the defining events of the past.

Our planet is 4.5 billion years old. During this time, it has been through multiple transitional cycles between icehouse and greenhouse conditions. This timeline has been characterized by sea level transgressions and regressions, crustal uplift and basin formation which filled with sediment, temperature and climatic variations that produced Carboniferous coal deposits, and the effects of the Milankovitch cycles on climate which played a role in the sinking of the Titanic. We are presently in the interglacial period where the climate is gradually warming, and the sea levels are rising. However, the difference between the previous interglacial cycles and the present day is the anthropogenic effect. All the previous transitions between icehouse and greenhouse conditions were affected by natural causes such as seafloor spreading, volcanic emissions,

> **"...it is important to understand the present-day earth as a function of the defining events of the past. "**

and tectonic events. Human contribution is an added factor in the current transition by altering the oceanic, terrestrial, and atmospheric conditions. It is important to know the past events and their effects on the icehouse-greenhouse transitions to understand the role of anthropogenic influences. Before we start interventions to tackle the present-day environmental crisis, it is important to know the influential factors of the past.

With this understanding, I transferred to UHD as a Geoscience major in Environmental Geology concentration because I wanted to understand the current environment and its problems from a historical perspective and be a part of the solution.

Julia Rudlaff

SA-11675

Michigan State University

Michigan Section

Home is Where the Rocks Are

I am fourteen years old, lying on my stomach on a Lake Michigan beach, elbows pushing into the Earth, hands sifting through layer after layer of small rocks. Every once in a while, my neck begins hurting so I fold my arms into my sides and rest my left cheek on the pebbles. They're cold, but softened by a touch of the sun's warmth. I feel cradled, like my body was meant to be held this way, by lake-weathered stones.

I barely hear the waves cyclical crashing and receding – I'm too busy listening to the rocks. They absorb the sounds of the lake and build themselves from it. Every striation, crystal, and swirl of color is a note, every different texture, density, and shape a lyric, the sum of which creates melodies so beautiful I get lost in them. A rocky beach is my symphony.

I am eighteen years old, on the shore of Lake Superior, holding a water-level agate the size of a small blueberry in my hand. It has pink and white horizontal banding and an amethyst center visible through a small, translucent circle. It is around one billion years old. This little rock has witnessed one billion years of Earth's history. Most likely from inside a vesicle within a basalt. This agate was born from volcanic processes, heat and magma, silica pooling and layering in symmetrical patterns. I feel awash with gratitude holding something so beautiful and perfect; I can almost feel the thrum of its history in my palm.

I am twenty years old, lying on a pile of dirt in a forest in Maine. I'm digging for amethysts at a mineral collection site. I feel so happy there, in the forest surrounded by trees, boulders, and squirrels. I'm looking for crystals, but also peace. I revel in the quiet. The first amethyst I see is the size of a pencil eraser, with a deep purple hue and a sharp point. The discovery takes my breath away. I am astonished once again by the precise beauty of the Earth. I feel as though the whole planet is an art museum.

I have always loved rock hunting. No matter where I am – Lake Michigan, Lake Superior, Texas, New Hampshire, New Jersey, creek beds, river rocks, forests, or gravel parking lots – if there are rocks on the ground, my body follows: knees bent, nose to the Earth, fingers picking and turning. I feel for the textures between my fingertips: smooth, resinous, botryoidal, sandy, sharp. I examine the geography: ridges, cracks, craters, bumps. I admire their colors and luster. I appreciate rocks for their precise beauty and their preservation of Earth's history.

Rock hunting is what first sparked my interest in studying the Earth. As much as the science of geology moves me, beauty is what drew me to the lakeshore, to the mountains, and to the natural world. Beauty is what I am chasing when I study mineralogy, tectonics, or petrology. Beauty and understanding.

I was hiking through Big Bend National Park when I decided to study geology. I was looking out at all the awe-inspiring red rock formations and the rainbows of mineralogical diversity beneath my feet when I felt an overwhelming desire to understand it all. I wanted to know when the mountains formed, what the minerals were, and why there were marine fossils in the desert. I had always loved rocks, but right then I had so many questions, so much curiosity about the Earth, and I knew geology was where I could find my answers.

It took me a long time to find geology, despite my early interest in it, which is why I have so much appreciation for it now. I started college as a civil engineering major, and studied mechanics, concrete, and calculus for two and a half years before accepting that it wasn't going to make me happy. Engineering kept my problem-solving mind engaged, but I was otherwise restless. I wanted to be out in the world, moving around and studying the environment that I was so curious about.

I study geology now because it moves me, because I have an intense curiosity about and love for the Earth, and because I know it matters. There is nothing more important than the planet we live on. I want to understand the Earth so I can be a steward for it – through writing, research, and field work. I hope to use my background in geology and English to aid conservation efforts, communicate scientific knowledge, and protect all the places I love most.

KeMia Smith

SA-11701

University of Illinois - Urbana-Champaign

Illinois/Indiana Section

I feel like I have been a geologist all my life, even though I did not know what a geologist was until two years ago. I was three years old when I held my first map. My family was stuffed in a minivan heading to Stone Mountain, Georgia. My mom bought me a road map from a rest stop, and I held onto it the rest of the trip. When I was eight, I would use atlases to plan imaginary expeditions where I assembled a team to hike through rainforests and mountains of faraway places. In the summers, I would spend hours collecting rocks at the Kankakee River. My hometown is full of interesting geologic evidence such as the Kankakee Torrent, caves, and state parks but many students in my town are not exposed to the Geosciences or other STEM fields.

I often think about other Black girls who know they have a penchant for something but were never given the resources to explore it. My high school was predominantly minority students and over a third of the residents in my hometown live below the poverty line. It wasn't until college that I learned more about career paths in the sciences. I started off as a chemistry major but the material was so abstract, it never encouraged my natural curiosity. The night before an exam, I was searching the university course catalog instead of studying. I read about the geology major and distant memories from my childhood of collecting rocks flooded my mind. I immediately switched to geology. I have fully immersed myself in the field ever since.

I enjoy geosciences because it's integrative; it combines chemistry, biology, and physics to tell the story of our planet. I find it fascinating that you can pick up a rock and hold millions of years of time in your hands or look at a valley and imagine how a glacier carved the landscape. I also think it's very interesting that data can be collected to make predictions and models of the future. In my career I want to conduct high-impact research to investigate our planet's processes and address environmental concerns. My preferred areas of research are geochemistry and environmental geology. As our planet's climate is changing, it is important to observe human impact on a local and global scale. Minimizing environmental harm is one of the main reasons why I want to be a geologist.

Even though I didn't know what a geologist was until two years ago, I am certain that I want to attend graduate school and become a professional geologist. I believe part of the reason why I gravitate towards research is because I see firsthand how the lack of representation affects underrepresented communities. I want to use my education to research and address environmental injustices. When I was in high school, a local water company supplied lead contaminated water to a town near me that is 90% African American. There are no safe levels of lead in water. Residents were told not to use the water for consumption. Instead, they had to use bottled water and filters. It took over a year for residents to be able to use their faucets for consumption. I remember my high school told us not to drink any of the sink water as a precaution.

Research is an essential tool to addressing environmental injustices that happen every day. Many environmental issues impact marginalized communities disproportionately due to inadequate infrastructure, polluted resources, and lack of regulation. Despite this, only a small percentage of scientists who research and communicate about environmental concerns are from minority groups. The gap becomes even smaller when you include gender as well.

Diversifying scientific communities helps bring attention to environmental injustices that often happen towards Black, Brown and Indigenous peoples. I am grateful that I have had the opportunity to pursue an undergraduate degree and gain experience in field work and research already. I hope to contribute not only scientific research to the geology field, but also efforts to make it more accessible. One day, I hope other children who are fascinated by the natural world are given the resources and opportunities they need to succeed and become geologists as well.

"The night before an exam, I was searching the university course catalog instead of studying. I read about the geology major and distant memories from my childhood of collecting rocks flooded my mind. I immediately switched to geology."

Hayley Woodrich

SA-11647

University of Illinois

Illinois/Indiana Section

"What do you want to be when you grow up?" The age-old question that five- to ten-year-old's have the pleasure of being bombarded with any time an adult isn't sure how to talk to them. For a long time, my answer was that I wanted to be an artist. Other times, I wanted to be a lawyer or an astronaut – likely due to the influence of my parents' love for Law and Order and the space games I loved to play on my LeapPad. At one point, my Barbie books had me thinking about becoming a teacher. When I started playing flute in the fifth grade, I wanted to be a musician. The point is: I had no idea what I wanted to be. If I heard about it, I wanted to be it.

I kicked off my time in college undeclared with that same sentiment: I had no idea what I wanted to do. I felt that my interests were all over the place and choosing felt nearly impossible. I remained uncertain until a floormate suggested political science seemed like something I was interested in. So, I declared political science as my major and tacked on a communications major a year later. It wasn't until my last semester when I was already committed to a marketing job and graduation that I took a geology class that opened my eyes to a profession that I wanted to do. On the class field trip, I was struck by the memories of something that interested me as a child: collecting rocks. I had no idea that studying rocks was a job, but it was clear to me in this class that 1) it's called geology, and 2) I was going to be a geologist.

Coming back to pursue another undergraduate degree is a big commitment as you are ineligible to receive federal grants and scholarships, not to mention the confused looks I get when I explain that I'm pursuing a second bachelors. Naturally, I have had some reservations about coming back and often had thoughts questioning if this is what I wanted to do. These thoughts led me to reflect on my childhood and think about all those things I wanted to be. What if I had pursued law school? Or maybe I could self-train in art and start an online shop?

But geology was already a lot of what I wanted to be and more. There is art in taking complex data and representing it in ways that are more accessible to a range of audiences. Geologists are often keen on environmental policy and what they want to see change. While I am not tall enough to board a rocket ship, geology gives the opportunity to look to the skies for answers and insights about our home planet – like how my peers study volcanoes on Venus. I also teach every time someone asks what I do. I get to tell them all about how geologists study rocks and the infinite reasons why; I also get to tell them that computer models are a significant part of what I do and why volcanoes are important to study. And is there a better sound than geologists hard at work, discussing ideas at an outcrop interspersed with rock hammers exposing fresh faces?

"Perhaps the biggest success of any scientific work is one that effectively informs the public and policymakers, thus sparking positive change in how we interact with our earth."

I am also fortunate enough to have a new perspective of how my previous degrees can be purposed. Perhaps the biggest success of any scientific work is one that effectively informs the public and policymakers, thus sparking positive change in how we interact with our earth. Why constrain eruption windows if not for saving lives and providing the government with information on how to construct evacuation plans? Why study climate change if not for passing of regulations to save our planet? The earth and its people – us – are one and communicating our knowledge of it to one another is at the center of building better communities and our survival.

While the title I will be awarded is "geologist", in some ways I'm also an artist, an astronaut, a lawyer, an educator, a musician, a political scientist, and a communicator – all on top of studying the earth! And, that's more than my younger self could have ever imagined.

Section Sponsored National Scholarship Winners

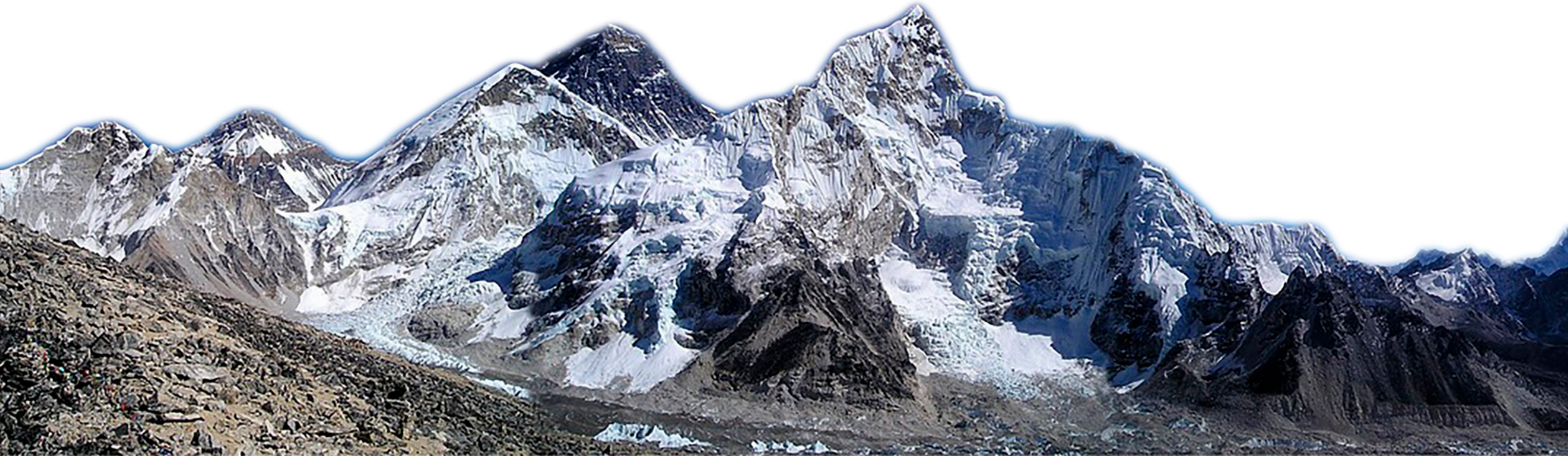
Anthony Kilber

SA-10999
Eastern Illinois University
Illinois/Indiana Section

As a kid I played outside a lot, and often brought the outside back inside with me, much to my mother's dismay. Often times this took the form of collecting rocks that I thought looked cool, maybe because they were smooth or had a lot of holes, or because of their colors. As I got older, I would stray from the family during vacations to climb and explore rocky outcrops or creeks like those found in the Black Hills, where some of my family resided. I did not know at the time that each of those rocks, outcrops, and creeks tells a story about the area in which they are found. At that age, I did not even fully understand what a geologist did.

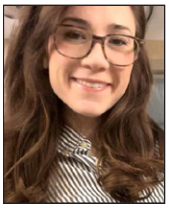
Geology is so much more of a broad field than I ever could have imagined. There are so many amazing careers to choose from, and many of them are exactly the kinds of things that kids want to learn about. No one came to my school and said, "Hey, who here is interested in volcanoes? Earthquakes? Dinosaurs? Other planets?" If they had, they might have recruited some future geologists from that small town. Though there are many other areas of study for a geologist, those listed are the kinds of buzzwords that get kids' ears to perk up.

After studying geology for several years, I now find it hard to look at any natural formation and see something stationary, the final product of a finished process. The earth is alive and constantly moving. I look at undulating synclines and anticlines and I see molten tidal waves frozen in time. I see uplifted strata and it looks like a movie was paused right as something was about to punch its way through to the surface. While our existence is fleeting, we can peer into a realm that is everlasting and retrieve from it the stories that fuel our imaginations. With this information, we manage not only to paint pictures of the past, but to predict what the future holds as well. We can predict where and how to mine for limestone, copper, coal, or oil, where to build our skyscrapers and our houses, or where to expect earthquakes, tsunamis, and volcanic eruptions.



I want to be a geologist because I want to understand why the earth looks the way it does. I want to be able to answer those questions that we have as children and in which we lose interest as adults. “Why are those mountains so high? Why is the river shaped like that? What are those pink specks in this rock?” I want to understand what is happening beneath our feet, what has happened and what will happen. When I know how to answer these questions, I can give those answers to people who need my expertise to make informed decisions that could minimize financial loss, optimize economic gain, or prevent loss of life.

That kid that used to love collecting rocks never went away, he just got buried, tucked away in the recesses of my mind much like the rocks he collected were tucked away in a box of forgotten things. You might see that same kid in the eyes of a student in a mineralogy lab as they grasp a block of galena in disbelief of how dense it is, or as they examine terminated crystals of fluorite or garnet and wonder how nature could make such shapes without human intervention. I once had a professor tell my class that if he did his job correctly, we should be leaving with more questions than answers. His statement echoes the quote often attributed to Aristotle, among others, “The more you know, the more you realize you do not know.” There exists a synergy between a professor who is passionate about teaching and a student who is equally passionate about learning. It allows a lecture to turn into story time where students’ imaginations can reawaken and take flight.



Madeline Sigler

SA-11318
Wayne State University
Michigan Section

I added my geology degree halfway through a BA in Comparative Cultures after taking an interdisciplinary science course. I was motivated by the connection I saw between humans and our social relations in response to geologic events. While I was cautious to add an entire degree, it has proven to be an ideal merging of fields.

I participated in Michigan State University’s Antarctic study abroad in 2016, where I engaged in science with people from around the world. I noted the difference between the lessons taught aboard the 80-passenger ship, the various ways the same information was taught to a very wide audience and by professionals with different backgrounds. I held a personal interest in becoming a cryosphere geologist and conducting research with international teams, envisioning the types of cultural relations converging on glacial research teams. I thoroughly enjoyed the glaciology course that followed and read about basal slip rates and glacial melt hydrology in my own time. Captivated by a book I had bought in Glacier National Park about the melting glaciers and their predicted timeline, I thoroughly studied the material provided on the study abroad and in the course. I felt as though I had to race against the geologic clock in order to earn my degrees in time to measure the melt rate of the remarkable ice.

After completing my first bachelors, I made the decision to take several years away from academia before returning to finish my geology degree. The changes to Earth's cryosphere from 2017 to 2021 were severe enough for me to reconsider a career in glaciology and I began to contemplate applications of my geologic interests in an unsure and changing future. Still intrigued by melt rate and volume loss, I found the field of hydrogeology to be compelling. While I personally feel it is too late to seek training in glacial recession, I was inspired to pursue an education and career in availability and remediation of fresh water sources.

I found that along with the cryosphere, there had been shifts in the understanding of Earth Sciences. While I had been cautioned when I added a geology degree as a political science major; I returned to school to find many Social Science programs offering Earth Science related minors, and many Geological Science programs offering social policy and environment courses. Though the glaciers might be melting, and Earth might be changing faster than previously thought, the science community has quickly adapted to the understanding that the future requires interdisciplinary work.

During the last year of my geology degree, I participated in an interdisciplinary research project. I enjoyed learning knew material outside of my background, as well as how much my previous education helped inform my understanding of the collaborative work itself. Though the entire project was a wonderful experience, my favorite moment was seeing Dr. Glen Hood's reaction to the first version of the model. To see his decade long work in a modeled graphic form was exciting for him and inspiring for me.

I believe that science is only as useful as it is understood. Through my previous degree in comparative cultures and my current degree in geology, I have witnessed that most people have an interest in learning about science and most scientists have an interest in sharing their knowledge. I have found there to be an area in the middle that requires both scientific background and social relations practice in order to accurately convey information. It is valuable that the scientific community has begun to shift into this understanding, and ever more important that it continues to do so. I aim to be a hydrogeologist that not only has the experience to perform their work, but I also intend to be able to communicate the importance of my findings

to the community at large. I want my work to be more than complete, it must be applicable.

As climate change continues to drive temperature, weather pattern, and geologic changes, I am committed to protecting our clean water resources and engaging with the cultural relations necessary in order to do so. I feel the same urgency as before with glaciology, but now with our aquifers. Water is our most important asset and while we might not have been able to save the glaciers, we have time to adjust our water usage and treatment for a better future.

I want to be a geologist because they are the people that tell Earth's narrative. Whether it is the story of the past through historical or hard rock geology, or potential tales of the future with morphology modeling, geologists are interpreting the story of our geosphere. I wish to pursue a career that understands how to successfully apply and model geologic research of Earth's narrative, in order to accurately convey what needs to be done.

AIPG/SME Conference Abstract Call

AIPG will be hosting two sessions at SME's next annual meeting in Phoenix (February 25-28, 2024),

SME/AIPG: Pure Geology: Discoveries from Geologic Exploration Programs

SME/AIPG: Geological Review of Critical Minerals.

The focus of the sessions is to highlight site specific local geology, the exploration that has been completed to date, and any future plan. Not a real focus on the engineering or economics, but rather just to look at what the exploration data has shown to date and a detailed review of the local geology. The ideal presenter would be working for or with a mining company that would allow for their data and finding to be shared in a public setting and be an AIPG CPG.

If you are interested in presenting as part of the AIPG sessions, please contact Deanna Wolfe (Deanna.Wolfe@nacco.com). Official submissions of abstracts will begin in June and end in early August here: https://www.sme2024.abstractcentral.com

A paper is not required, but papers can be submitted with your presentation. The SME conference registration starts in October and all speakers are required to register. All authors and AIPG members will receive a discounted price for conference registration.

The session chairs are Deanna Wolfe, PG, and Joe Brinton, CPG.

In addition to the two sessions, AIPG is also organizing three geology field trips that will be part of the SME conference schedule. Additional information will be available at conference registration.

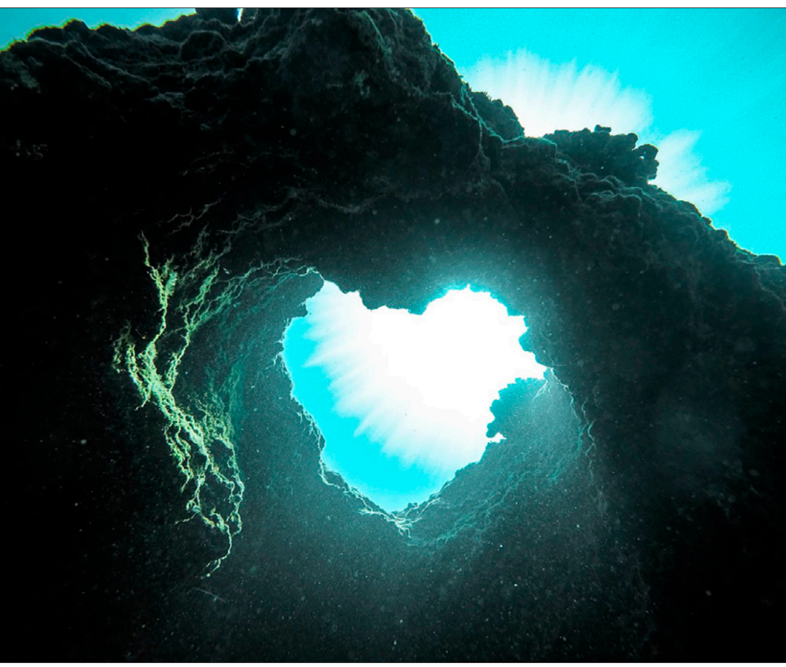
Luke Gezovich

SA-11543

Colorado School of Mines

Colorado Section

According to the U.S. Bureau of Labor Statistics, the number of geoscience job positions is expected to grow by 5% over the coming decade. The BLS also expects that geoscientists will be responsible for discovering and developing alternative energy sources which could further increase job demand over the coming years. Increasing threats of anthropogenic climate change and the goal of a carbon-neutral future will further necessitate the creation of many new jobs and industries in the geosciences.



Currently, there exist multiple industries where jobs for geologists only exist in very small numbers or do not exist at all. One such industry is the deep-sea mining industry. Deep sea mining involves the collection, transportation, and extraction of polymetallic nodules located thousands of meters below the surface of the ocean. There has been no commercial deep-sea mining done since the discovery of polymetallic nodules in the 1960s. Currently, the International Seabed Authority has granted exploration licenses in the Clarion Clipperton Zone. The Cook Islands have also granted exploration licenses in their economic zone. Some companies are currently testing advanced collection equipment on seafloor polymetallic nodules. Polymetallic nodules contain extremely valuable metal deposits such as cobalt, lithium, zinc, and manganese as well as rare-earth elements (REE). These metals and REEs are essential for electric cars, solar and winds farms, and batteries. To achieve a carbon-neutral future, it will be necessary to meet the increasing demands for metals and REEs. Deep sea mining presents a unique opportunity to collect the resources required while minimizing impacts on the environment. One drawback associated with deep sea mining is that the mining process could affect sea life and damage benthic ecosystems. Current terrestrial mining is extremely destructive for the environment with impacts including toxic water runoff, deforestation, and soil contamination. As deep-sea mining techniques mature, technology can be adapted to minimize light and sound pollution in the ocean and minimize destruction of benthic communities.

Another industry that will grow in importance over the coming decades is space resource collection. Space resource collection has two different aspects: return to Earth and in-situ resource utilization (ISRU). ISRU is the process of collecting and using materials found in space that replace materials that would otherwise have to be transported from Earth. One aspect of ISRU that is currently being developed is the extraction of water ice from lunar regolith. Water ice is essential for the establishment of any long-term human presence on the Moon. Water can be used as a propellant for future rocket launches from the moon. As humans venture beyond Earth, geoscientists will be required to understand the geology of planetary bodies. Almost all geoscientists have a certain level of bias in their knowledge; they learn and study Earth geology. However, space and planetary bodies are extremely diverse. The geology of the Earth is unique and very different from that of the Moon, Mars, and asteroids. A great deal of research is required to understand the diversity of geology that exists just within our solar system. For example, much of the Moon is covered in regolith. The fine-grained lunar regolith has extremely different properties from terrestrial sediments and soils.

One key theme for both new jobs is the ability to use innovative thinking and integrate a diverse set of skills to address problems in these new fields of study for geology. I believe that future geoscientists must be able to integrate and synthesize many skills including data science, geospatial information, and geologic knowledge to address the pressing issues of time. This will be necessary for the development of new industries such as deep-sea mining or space resource collection.

The Critical Metals Opportunity

Are We Ready?

William C. Feyerabend, CPG-11047

For decades my checking account depended on getting that phone call. That call only came when the stars aligned on the metals free market. A decade ago, I got a call from a new client to write a tech report on something new - a lithium brine property in Nevada. Then another. And another. That was my first experience with work generated not by the metals free market but by a change in technology. Since then, lithium has probably given me more work than gold. Technology change and not the free market created an opportunity for me.

We may now be looking at a repeat of new opportunities with rare earth elements (REEs) and critical metals. Are we prepared?

Whereas once we worked for corporations with lots of internal resources, now a lot of the dynamic exploration is done by small groups. By definition, they do not have corporate resources and the honest ones look to a geologist for guidance. This article is intended to help you give that guidance.

So, what could go wrong in this new world? Plenty actually:

- Imprecise analytical methods
- No commercial QA/QC standards
- Unproven metallurgy
- Obscure markets
- Inexperienced management
- Difficult capital markets

These deposits often have multiple elements, and you will probably be using analytical techniques that generate analyses for tens of elements. There are decision makers who think that adding all the pennies contributed by all the elements to reach some fabulous sum is what investors want. That is not true. Investors want a handful of elements that make the deposit economic and which they can wrap their heads around. Your long-term goal should be to give investors what they want and a thread through this article is whittling down the number of elements to do so.

Step 1 is part of selecting sample preparation and analytical techniques. We all want analytical numbers as accurate and precise as possible. You will get the opposite if you let each geologist working on the project select sample preparation and analytical technique. The obvious solution is to do your homework ahead of time. Since no analytical technique does all elements, you may find you need multiple analytical techniques for the multiple elements. As a first winnowing, go through the available historical data to find the elements that exceed crustal abundances by a factor of your choosing and focus on those. Plan an in-depth meeting with your labs to talk about each element and each analytical technique to decide what best suits your project.

Methods need to be tested. You might think four acid is better than two acid dissolution, but four acids on your rocks might set off interfering chemical reactions, so two acids might be better suited. A reasonable first step is to get a sample(s) from outcrops, workings, or drill material as large as a lab can prepare in one run, typically 40 pounds, and use that to test preparation and analytical techniques and then enforce those choices on all laboratory submittals.

From the start, make the storage of all sample materials neat and organized. Also conduct due diligence. You can do the simple things like checking with the Bureau of Land Management for restricted areas such as Wilderness Areas or Visual Resource Management classifications 1 or 2 but you need a mining attorney and professional land man to sniff out the subtleties that later can bite back hard.

There are two things you know from the start. One is that with multiple elements your analytical spreadsheet will have many columns. The second is that you will have geologists with varying ability to corrupt your Excel spreadsheet. There are software solutions to that. Check Geospark Consulting, Geotic, and Datamine. Acquire is popular with major companies.

You probably will find there are no commercial standards available for all the elements of concern. For the first round, a blank, a sample of the highest-grade material available based on historic analyses and systematic duplicate analyses within your sample shipment can go a long way to making results acceptable. If no commercial standards are available, you can make them once you have accumulated sample materials. Your lab should help you set up the round robin of assays.

Metallurgy can be a killer and it should be addressed from the start. Initially, the challenge would be to try different methods like float, gravity, or acid leach to see what does not work. Then begin refining the methods that show promise.

See who has done the work on similar mineralogies to those of your project. Cast a wide net in your search. A lot of work has been done outside the US and outside the West. Do not forget university metallurgical departments. Whichever group you choose, work out a detailed plan of what analytical techniques will be used and what the deliverables will be. Metallurgical results may help you cut down your list of elements of interest. If you cannot recover it, it does not count. You should also review your analytical methods again. You may be able to drop an analytical method because you were using it for one or more elements that are no longer a factor.

You are in for an education when you get into the market value. Begin to research market prices and market size for each element with a simple internet search. If the Project develops you can get into paid services provided by companies such as CRU, Wood Mackenzie, Abamas Intelligence and Shanghai Metals. Internet information is, well, internet information and can be like saying the price of gold is between $700 and $3,000 an ounce. That is true and not very satisfying but can still be useful. You can begin to put parameters on things and separate elements with a vague but high value and even more vague market from those with a moderate price and reasonably understood market. With the first, production from one more producer might flood the market.

Now it is time for you to really earn your money. Those small dynamic groups doing much of the exploration need your guidance. They might include people with financial or stock experience, corporate background, etc., but maybe not mining per se, nor critical elements specifically. Let's go a little easy on them – we all start knowing nothing. Still, they can create issues. With metallurgical recovery and market value, you can begin to put a dollar value on elemental values. Your job will be to be the spoilsport in the playroom and point out that the calculations for chemical grade calcium, elemental sulfur and medical oxygen do not give you the market value for gypsum. You are there to keep things reality based.

With things progressing under your guidance, you are going to arrive at the end game. Down the development curve, a Property requires a large investment to get into production. When you look at how the financial system works, funding is based on the market size and transparency for the products, and the professional history of the principals. What could possibly go wrong? One financial person at the Prospectors & Developers Association of Canada's 2022 convention said he would evaluate one of the specialty minerals projects not as a mine like with gold, but as an infrastructure project with a mine attached.

A trajectory for some projects is likely what was seen in lithium where an established company with the resources to handle the risks and challenges took over. You will have earned your keep with the clean and complete data room you have overseen and the neatly stored and organized sample pulps and rejects that are ready for due diligence.

Congratulations on being prepared.

Michael D. Campbell, P.G., P.H., CPG-3330, just announced that he published his Memoirs. He is I2M's Chief Geologist (https://i2mconsulting.com/michael-d-campbell-pg-ph-curriculum-vitae/) in Houston, Texas:

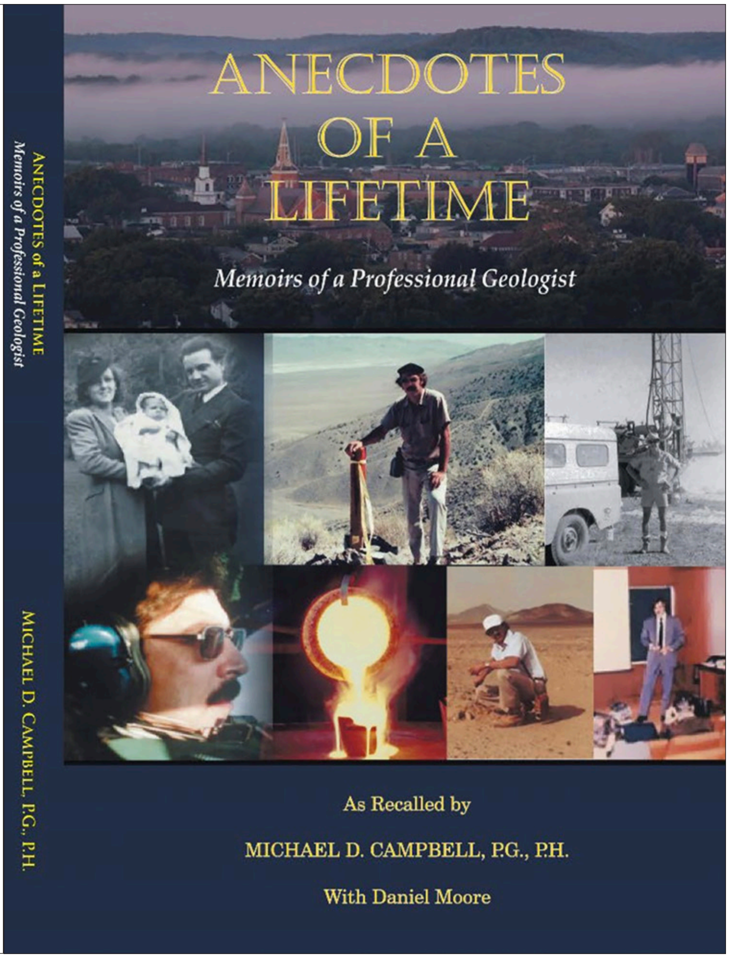
Anecdotes of a Lifetime: Memoirs of a Professional Geologist

He also serves as the Vice President - Eastern Texas for the AIPG Texas Chapter.

He indicated that over the past eight months, Mr. Campbell has been working on his memoirs and the book is now available on Amazon.com and Barnes and Noble.com He said that his primary objective was to make a record for his grandchildren of the life of their grandfather who grew up in the mid-late 20th Century and lasted well into the 21st Century. The book is in Hardcover and Paperback, and will soon be available in Kindle and E-Book. It contains 17 chapters of 442 pages, 229 footnotes of hyperlinks, 274 photographs, 12 graphics, and an Index of characters and major topics.

For more information on the book:

https://i2massociates.com/downloads/AnecdotesRelease2023.pdf



Riverbank Lag Gravels

The Dynamic Roles of Tides and Groundwater in Forming Armored Riverbanks at Rio Gallegos, Santa Cruz Province, Argentina

Charlie Schlinger, CPG-09554, RG, PE

Lag gravels are observed in various geomorphic settings, including deserts, where they may be known as pavements or armored surfaces, as well as atop high bluffs, such as found in certain locations along the margins of the Great Lakes of North America. Various mechanisms are at play in their formation. In a much different geomorphic setting, in this case along the banks of the Rio Gallegos, in Santa Cruz Province, Argentina, armoring by gravels and cobbles along laterally extensive long slopes subject to large variations in ocean tides is observed. The combination, probably not unique to the Rio Gallegos area, of suitable sedimentary fluvial deposits and a large tidal fluctuation are key, as are many cycles of groundwater infiltration and exfiltration.

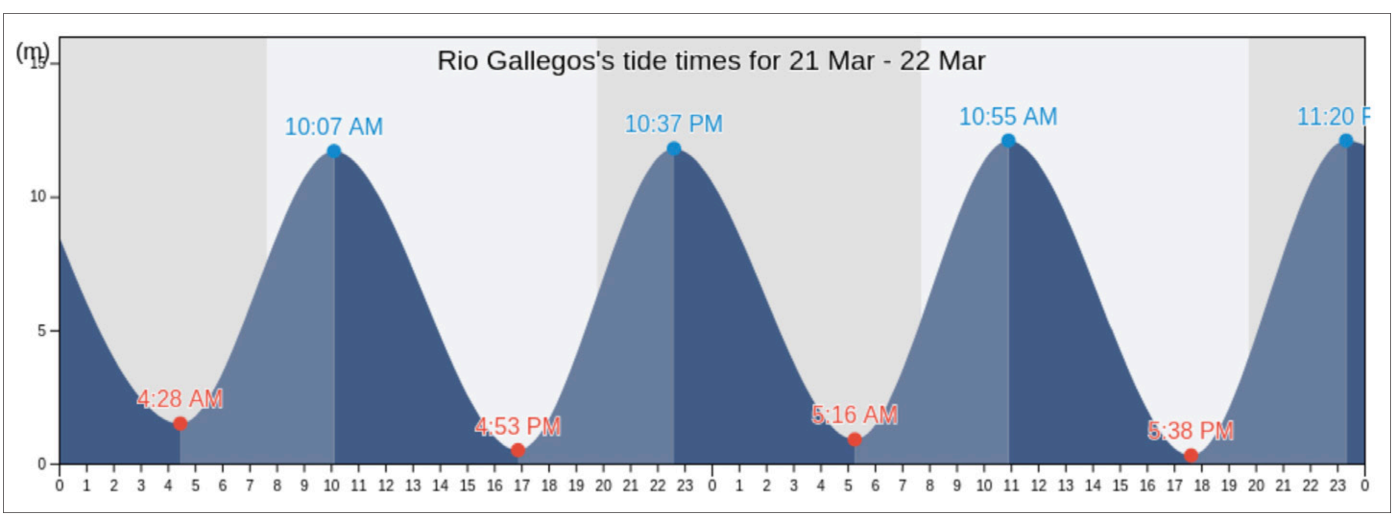
On March 21, 2023, I was in the city of Rio Gallegos, Argentina, and while there I visited a locale on the banks of the Rio Gallegos near where the river meets the Atlantic Ocean. More specifically, the site is where the remains of a ship, the Marjory Glen, form part of a Malvinas Islands (Falkland Islands) war memorial.

At this location I observed, that for reaches along the Rio Gallegos in this area, the banks are armored by well-

sorted (poorly-graded gravel). The gravel is characterized (visually) as having roughly 90% of the particles between 5 mm +/- to 5 cm +/- in size – see the two images to the right. There are some cobble-sized particles also present. These deposits are somewhat similar to what is known as shingle beach deposits, but they are not beach deposits. The deposits are also reminiscent of lag gravel deposits found in more arid settings, but some of the characteristics of lag gravels, such as faceted surfaces formed as a result of wind-blown sand movement are not present.

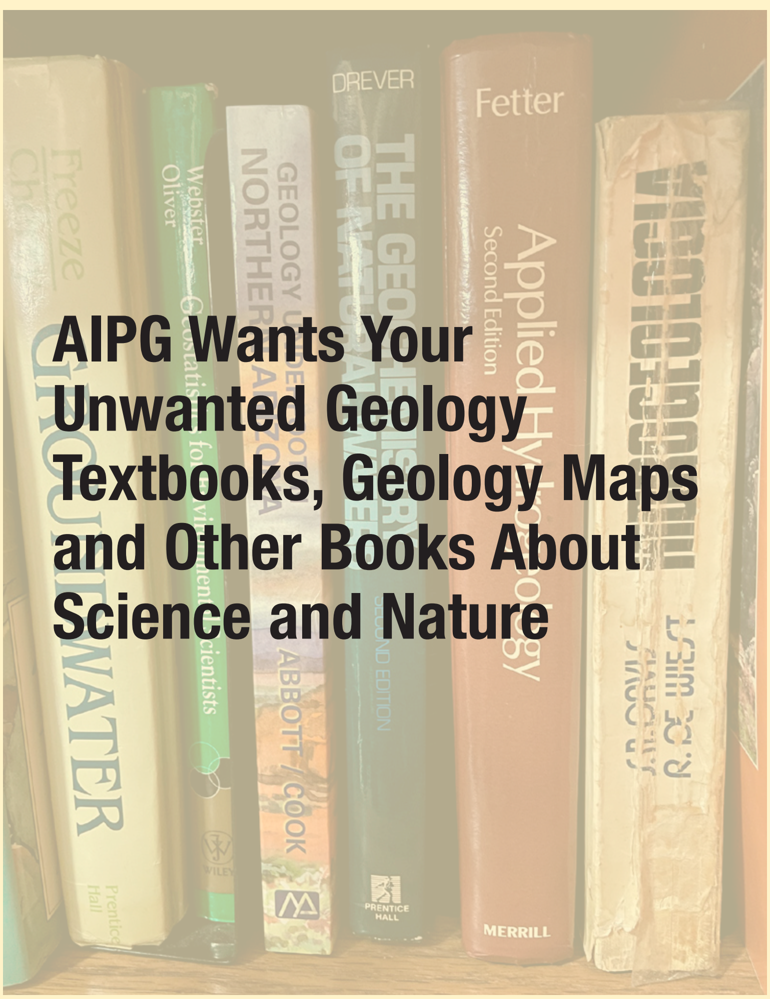
There is a large tidal range at this location. At the time of my visit, close to low tide, the tidal currents were both visible and audible. On that date, the tidal range was approximately 11.5 m, which was within a meter of the tidal range at the renowned Bay of Fundy. These ballpark estimates were developed from commercially available data visualization tools and are approximate. Below is a graph of the tidal fluctuations for the area on the date (3/21/23) of my visit.

Along the bank slope and closer to the river/ocean edge, groundwater was seeping out. See the image on page 23. It appears that this many-times repeated cycle of groundwater drainage and infiltration has resulted in all the fines being pumped out, leaving behind primarily gravel. This is an extreme case of pumping of fines by groundwater flow – something that may be of concern for earthen dams but not of concern in this case. In this area, the fluvial deposits presumably have a grain size distribution that is not particularly strong in the clay suite, otherwise the cohesive fines would probably not be



so readily mobilized and hydraulically piped out of the bank by the cycles of tidal fluctuation.

It seems that geomorphic surfaces armored by gravel can also form through the action of tides, which give rise to many cycles of groundwater infiltration and discharge, accompanied by removal of fines. I do not claim to be the first to have observed this, but I believe that the observations will be of general interest to at least some geoscientists, hydrologists, and hydrogeologists. As I conducted my informal and somewhat strategic, though necessarily limited literature review, it occurred to me that the intelligent scouring of a multitude of published articles, in a multitude of languages, for keywords might be a good application for contemporary algorithms – lumped together under the catchall term Artificial Intelligence. Of course, intelligent supply of keywords, and separating the wheat from the chaff, remain vital human functions.



AIPG Wants Your Unwanted Geology Textbooks, Geology Maps and Other Books About Science and Nature

Do you have overflowing bookcases? Piles of geologic maps? Feel like doing some spring cleaning or looking for a good home for your unwanted textbooks and coffee table books? AIPG wants to help you reduce, reuse, and recycle!

AIPG has a long history of partnering with a public university in Hermosillo, Sonora (Mexico) to help them populate a library for their geology students. Books on any discipline related to geology, chemistry, hydrogeology, engineering geology, environment…you name it and if it's related to natural sciences, it can be useful. The department would also be very appreciative of maps and field guides. The books can be in English (and of course books in Spanish are also useful!). The geology students are encouraged to have a working knowledge of English, which is a big boost in their future careers.

What are the logistics of donating books and maps? You would need to ship materials to Tucson, Arizona. The US Postal Service has a special book rate called "Media Mail". The cost is based on weight and the cost can be calculated at postcalc.usps.com. For example, a 12-inch square box weighing 10 pounds costs about $10 to ship from Illinois to Arizona. AIPG will sort, organize, and arrange transport to Mexico.

To make a donation of materials, please contact the AIPG headquarters (email aipg@aipg.org or call 303-412-6205).

A mind needs books as a sword needs a whetstone, if it is to keep its edge.

- George R.R. Martin

In Memoriam

John W. Jewell, CPG-01547

Houston, Texas

March 21, 2023

Member Since 1967

Obituary provided by John's son Bill Jewell.

A man of boundless passions and countless accomplishments, John Jewell died March 21st in Houston, Texas, at the age of 97.

John was born in Providence, Rhode Island, to Dr. Willard B. Jewell and his wife Ann Hennessey Jewell. An accomplished athlete, he grew up primarily in Nashville, Tennessee. There he attended West End High School, lettering in football, basketball and baseball. He graduated early from West and volunteered for military service during World War II. After completing his hitch in the Army Air Corps, John came back to Nashville in 1947.

Taking advantage of the GI Bill, he enrolled in Vanderbilt, ultimately earning BA and MA degrees in Geology. This delighted his father who was then Chairman of the Geology Dept. at the university. During his college years, John met Mary Anna Locke, a coed in the Nursing program. They were married in 1950. Soon enough, John and Mary Anna became the parents of three sons.

John pitched for the Vanderbilt baseball team and received feelers from pro baseball scouts after graduation, but he decided his fastball lacked the necessary pop and embarked on a life of global adventure instead.

Initially, he explored the desert southwest, prospecting for uranium and precious minerals. After these efforts produced only modest success, he decided to focus on petroleum exploration. Working for various oil companies, he developed prospective fields in remote regions of Turkey, Libya, Sicily, Brazil, Indonesia, Honduras, and other daunting locales.

After years of world travel, John decided to come back to the U.S. so his children could get a proper education. He and Mary Anna resettled in Nashville in 1967 where the boys attended Montgomery Bell Academy.

John secured a job with the Tennessee Geological Survey, but his love of prospecting was undiminished. He soon concluded that forsaken areas of rugged east Tennessee might have oil hidden beneath them. Those hills are now peppered with pump jacks, a number of which sit on land that he correctly surmised presented drilling opportunities.

Most of the rest of John's long career was spent hunting for oil and natural gas in Tennessee and Kentucky. Sons Bill, Roger, and Rick grew up and developed their own professional interests but, sadly, Mary Anna's health declined, and she died in 1993.

A few years later, John reconnected with the widow of a fellow geologist he had known in Sumatra. They hit it off, and Nancy Patrick became his second wife. John then joined Nancy in Houston where they shared a love of all-things-geological, birdwatching, and the hometown Astros. John had two sublime joys in the later years: his growing family (both kin and in-laws), and the two World Series championships won by the Astros.

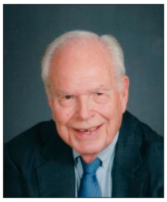
All who knew John were enlightened and enriched by the connection. He was a man of enthusiasms, always upbeat, always animated, always fascinated by the human condition. Even in his 90s, he retained a youthful spirit that infused and brightened every day of his life, as well as the lives of others.

Leonard (Charlie) C. Davis, CPG-02029

Missouri City, Texas

April 1, 1933 - September 23, 2022

Member Since 1969



Obit and photo excerpted from information published on the Dignity Memorial website.

Leonard Charles "Charlie" Davis was born in Alamo, Texas on the 1st of April 1933 to Leonard Cecil Davis and Helen Mary (Martin). Charlie died peacefully, surrounded by family at his home in Missouri City, Texas on the 23rd of September 2022.

Charles, as he was known by family, graduated in 1950 from Tivy H.S. in Kerrville, Texas. He went on to serve four years in the U.S. Navy from 1951-1955. A wartime veteran of the Korean War, Charlie returned from the Philippines aboard the USS Midway, which he was able to step foot on again just nine years ago. After service to our great country, his college education began at Schreiner College in Kerrville. After two years, he transferred to Texas A&M University in College Station, graduating in 1960 with a B.S. in Geology.

Charlie led a long career in the oil and gas industry and was recently recognized for 50 years as a Certified Professional Geologist by the American Institute of Professional Geologists. Companies he worked for include Sinclair, Arco, and Houston Oil & Mineral. Charlie's work was his passion. He taught us that hard work pays off and doing what you love is most important. He wrapped up his career with a great group of Aggies at W. D. Von Gonten & Co., retiring one day before his 83rd birthday.

A round of golf, a hunting trip, a beer with a buddy, or watching sunsets in South Padre, Charlie made the most of his free time. Cheers to a one of a kind, irreplaceable man!

Louis T. Mellinger, CPG-02538

Somerset, Pennsylvania

November 20, 1939 - February 10, 2023

Member Since 1973

Obit excerpted from information published by The Daily American.

Louis Todhunter Mellinger, 83, of Somerset, died February 10, 2023 at The Patriot. Born November 20, 1939 in Pittsburgh, he is the son of the late Frank Millin and Helen (Todhunter) Mellinger. Survived by his wife the former Barbara Eileen Maurer to whom he was married 30 years. Louis was a 1957 graduate of Country Day High School and the University of Cincinnati. He worked until his retirement as a geologist for Commonwealth Contracting. He was a member of Lodge 358 F&AM, GSA, American Institute of Professional Geologists, Yankanuck Club, and Somerset Alliance Church. In lieu of flowers contributions may be made to Somerset Alliance Church 708 Stoystown Road Somerset, PA 15501.Alistair is survived by his wife Kristen of 55 years, three sons David (Marlene), Richard and Alan (Christie), five grandchildren, his brother Graham (Linda) and his extended family in New Zealand. He was an incredibly supportive, loving, and considerate person and will be missed.

Note from Alistair's wife Kristen Turner

At the time of his death, he was a self employed consultant following a long and successful career in economic geology in the USA (Stillwater Complex in Montana, Alaska with the Anaconda company) consulting to Pan Palladium Ltd, Boulder Steel Ltd in North America, as well as expertise in Australia and South Africa. Alistair was responsible for many publications as a single author and in collaboration with other Geologists.

I know he very much enjoyed his long membership with the American Institute of Professional Geologists.

William (Bill) R. Ellis, CPG-08179

Eagle River, Alaska

July 29, 1947 - March 18, 2022

Member Since 1993

Obituary information excerpted from published content in the Anchorage Daily News, March 23, 2022.

Bill was born on July 29, 1947, in Grass Valley, California to Allan and Mary Ellis. He spent his formative years traveling the country and living in Germany as a "military brat" until ultimately graduating from Sparks High School in Nevada and enrolling in the Mackay School of Mines' geology program.

Before he could complete the program, Bill was drafted into the Army in 1967. He would then go on to fight in the Vietnam War as an infantryman in A Company, 2nd battalion, 506th Infantry, 101st Airborne Division. Staff Sergeant Ellis was awarded the Silver Star Medal for his actions on hill 937, aka Hamburger Hill. Before being released from active duty in 1969, he was also awarded the Bronze Star, Purple Heart, two Air Medals and Army Commendation Medal with "V" device for valor displayed in combat.

After returning home, Bill completed his Bachelor of Science in geology and began his trek north to Alaska. He spent several years bouncing back and forth between the Northwest Territories, northern Idaho and the Brooks Range in Alaska before finally moving to Eagle River in 1979, where he would live for the rest of his life. In 1999, Bill co-founded Alaska Earth Sciences in Anchorage, where he worked until his retirement in 2021.

Bill met his beloved wife Carolyn in Alaska and they married on March 23, 1990, in the Cook Islands. Bill loved fishing, hiking, camping, downhill skiing and traveling with Carolyn and their two dogs, Rosie and Lily.

Michael J. Wahl, MEM-0952

Austin, Texas

November 16, 2022

Member Since 2006

Obituary and photo excerpted from information published on the Dignity Memorial website.

Michael was born in 1959 in Seguin, Texas to parents Louis and Norma (Elbel) Wahl, and was the youngest of three siblings. He didn't stray too far from home when he moved to Austin during the summer of 1977 to pursue a higher education from the University of Texas. It was at UT, in his calculus I class that he met his beloved, late wife Donna. She liked to joke that their love was the only thing either of them got out of the class. They married in 1981 at the University United Methodist Church on the UT campus and were happily together for 40 years.

Michael always said that he "played with dirt" for a living. As Quality Control Manager, he served as an Engineering Specialist for Rodriguez Engineering for nine years, testing soil and other materials to ensure proper safety measures.

Michael absolutely loved food, but more importantly, he loved sharing his experiences around the table with others. He went on many Texas BBQ adventures with his children, and once he even received free crepes for life… with a price of only one minor head injury. He loved to tell that story, and many others, with a few dad jokes sprinkled in. His humor, selflessness, and thoughtfulness made others proud to be at his table.

James P. O'Brien, CPG-10089

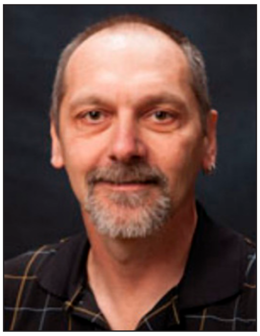
West Vail, Colorado

December 26, 1961 - May 7, 2023

Member Since 1997

Obituary information excerpted from published content by VailDaily.

James Patrick "JP" was born December 26, 1961 in Mt. Kisco, New York and passed peacefully May 7, 2023 at his home in West Vail. JP moved to the Vail Valley in 1971 and graduated from Battle Mountain High School in 1980 as a member of the ski team. He then went on to attend Colorado State University and then earned his geology degree from Fort Lewis College and a master's degree from Idaho State University. JP's choice of schools allowed him to maximize outdoor fun. He was an accomplished back country skier in his time. JP returned to Colorado and worked in the Denver area for about 10 years. As he had always dreamed, JP fled the Front Range and returned to the Vail Valley in 2000. JP then invested in real estate, taught geology and orienteering at CMC and worked for CGS on the mountain. He concluded his career as a hydrologist at Eagle Mine in Gilman. JP was a free spirit who lived life his way.



CPG Credentials & Our Profession

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

I recently spent some time speaking to a retired geologist who finished their university degree in 1960 and went to work in the oil patch straight from college. Now well into his 80's, this gentleman recalled the landscape of the oil and gas world then as being, "the wild west." That AIPG was founded in 1963 is no coincidence, as it was members of the American Association of Petroleum Geologists who recognized the need for a professional organization that was dedicated to the ethical, professional, practice of geology and that would certify geologists and hold them to an ethical code. As we approach the 60th anniversary of AIPG, our dedication to and promotion of these ethical and professional principles is as important now as ever it was.

The Certified Professional Geologist title has become a globally respected credential that ensures that geologists who hold that title will act according to the best practices in their field. The Institute and our CPG title is recognized by CRIRSCO (the Committee for Mineral Reserves International Reporting Standards), allowing the holders of that title to act as Competent Persons for mineral reserves reporting codes that are under the larger CRIRSCO umbrella. These codes include: JORC (Australasia), PERC (Europe), NACRI (India), KAZRC (Kazakhstan), CCRR (Colombia), CH 20235 (Chile), KCMI (Indonesia), MPIGM (Mongolia), SAMCODES (South Africa), and UMREK (Turkey). The CPG title is also recognized for the purposes of reporting reserves and exploration results under Canadian National Instrument 43-101 (NI 43-101) and under the revised Securities and Exchange Commission requirements for reporting, commonly referred to as SK-1300.

As geology becomes an increasingly global undertaking, we are hard at work, warranting that the CPG title remains relevant in the global marketplace. To that end, AIPG has entered into mutual recognition agreements under which holders of the CPG credential can apply for and receive the credential of other professional organizations. These reciprocal agreements allow the holder of a CPG to apply for the Chartered Geologist title from the Geological Society of London, the European Geologist (EurGeol) from the European Federation of Geologists, and the Professional Geologist (PGeo) title with the Institute of Geologists of Ireland. We continue to work with professional organizations around the world to enhance the value of the CPG.

As you know, the Institute is more than just the CPG credential. We work hard to stay abreast of international, national, and local issues that will impact our profession. In the international realm, AIPG is a founding member of the Global Geoscience Professionalism Group (GGPG) and the International Raw Materials Observatory (INTRAW). The GGPG works to provide a common ethical and professional language so that geoscientists practice under a common ethical framework, anywhere in the world. INTRAW provides authoritative, specialized support on raw materials cooperation, diplomacy, and foresight, within the larger global raw materials supply chain. We also are represented in the Expert Group on Resource Management, which is under the larger umbrella of the United Nations Economic Commission on Europe. Here, we push for the requirement that professionals who do resource evaluations demonstrate that they are competent to do so. At the national level, we monitor federal legislation and rule-making that could impact our profession or our members. Currently, the Executive Committee and I are reviewing a proposed Bureau of Land Management rule that would define conservation to be a land use on par with other uses and that proposes 'conservation easements.' You can rest assured that we will provide a clear, concise, well-supported, comment to the BLM regarding this new rule and its implications for professional geology. At the local level, we support state registration and work with AIPG sections to address legislation that could impact geologists at the state and local level. We're currently working with the Illinois-Indiana section to provide feedback on a new proposal that would require Continuing Education for state registration in Indiana. We do our very best to monitor legislation at the state level and we welcome your input with regard to legislative issues that arise in your state.

The 60th Anniversary meeting, scheduled for September 16-19, 2023, in Covington, Kentucky, is a chance to celebrate the history of AIPG, recognize the great work that we are doing now, and chart a path for our future. I invite each of you to come to Kentucky, take part in our field trips, sit in on technical sessions, attend our Executive Committee Meeting, and share in our celebration of excellent members during our Awards Banquet. Our first 60 years have been a tremendous success. I believe our next 60 will be just as successful. Come and help us chart the path forward.

I hope to see each of you in Covington in September!

Best Regards,

Aaron

Aspirations of Youth Have Shaped the Professional Geologist Who Makes a Difference

Dawn Garcia, CPG-8313
dawnhgarciacpg@gmail.com

When I was in grade school, all students in my class were required to prepare a short talk about the environment. This was the early 1970s, about ten years after the publication of Rachel Carson's book "Silent Spring", which documented the environmental harm caused by the indiscriminate use of pesticides. This was the time that the Environmental Protection Agency (EPA) was a fledgling agency. Saturday morning cartoons were interspersed with public awareness advertisements. It's unusual to find anyone of my generation who doesn't recognize "Give a hoot – don't pollute" or the deep, gravelly tones of "Only you can prevent forest fires" as Smokey the Bear promoted safety in the woods. Television viewers were inspired to care about the environment, to pick up trash and to keep America beautiful. I was the kid who wandered fields and waded in streams, really liked animals, and spent time outside. I grew up influenced by the environmental movement, and, in my professional career, my work projects have been heavily weighted with environmental applications of geology. For me, it's not possible to separate my career as a geologist from the aspirations of preserving the Earth.

I didn't immediately see the connection between applied environmental geology and geology when deciding my career. I just knew that I liked math, science, and nature. Once I started working, however, things became clearer and the technical knowledge I obtained in geology became a foundation that supported my specialization in applied environmental geology. Geology, which combines all the natural sciences with sprinkles of engineering, provides a holistic view with the skill set that is needed to not just recognize, but to prevent and manage, environmental impacts. The geologist is an incredibly useful team member because the geologist brings a wide range of knowledge and can see how things are inter-related, with multiple perspectives. Working as a geologist is not just about being a gravel monkey who identifies rocks. Geologists analyze and solve difficult, complex, and important problems.

> *"Geology, which combines all the natural sciences with sprinkles of engineering, provides a holistic view with the skill set that is needed to not just recognize, but to prevent and manage, environmental impacts."*

Someone who aspires to help the planet needs to recognize that technical skills, not just lofty aspirations, are critical in achieving a green future. Next time you hear a student express a desire to help the world, point out that geologists do just that. Geology is a field that encompasses all earth systems and provides the knowledge base to tackle thorny issues. Although I didn't know anything about geology when I was in grade school, my deep satisfaction in my career as a geologist has been enhanced by my desire to help the environment. By the way, I won a prize for my talk and was advanced to a regional competition!

Global Geoscience Professionalism Group (GGPG)

AIPG is a member of the GGPG, which is a non-profit, professional organization that promotes a greater understanding of the role and importance of geoscience and geoscience professionalism and facilitates communication and collaboration between geoscience professional organizations. AIPG has been involved in GGPG since the group's inception. The group intends to provide easy access to geoscience professional organizations' standards, codes, continuing professional development program information, and pathways to attaining geoscience professional qualifications. It will also provide sample disciplinary guidelines.

AIPG is a founding member of CGPG, which is the offshoot of the International Union of Geological Sciences Task Group for Global Geoscience Professionalism. That Task Group was disbanded in 2020, allowing GGPG to form as a new, permanent organization. The other founding members of GGPG are the Australian Institute of Geoscientists, European Federation of Geologists, Geological Society of South Africa, Geoscientists Canada, and International Raw Materials Observatory. Additional members and observers have joined: the German Association of Professional Geoscientists; West African Institute of Mining, Metallurgy & Petroleum; Geological Society of Zimbabwe; Geological Society of Africa; Geoscience Council of Namibia; Botswana Geologists Association; and Spanish Official Professional Association of Geologists.

Our AIPG Executive Director is a regular attendee at GGPG meetings, and I was able to participate in several meetings this year as well, including an in-person meeting that was held during the Prospectors and Developers Association of Canada (PDAC) conference in Toronto in March 2023. Representatives from even more groups including the Institute of Geologists of Ireland; GeoAnsata (Brazil); Committee for Mineral Reserves International Reporting Standards (CRIRSCO) and Ordre des

Continued on p. 34

Answers on Page 30

Robert G. Font, CPG-03953
robertfontphd@gmail.com

1. In our field work we identify a "gastrolith." What have we found?
   a) A well-cemented limestone pervaded by fossil gastropods.
   b) A stone swallowed by some animals to help grind food and aid digestion.
   c) A large, elongated, belly-shaped concretion of competent strata embedded in a ductile matrix.
   d) The mineralized muscular foot of a gastropod.
   e) A rarely-found petrified stomach.

2. The flow rate (Q) and velocity of flow (V) in a river channel may be calculated by using Manning's equation:

$$Q = V*A = (1.49/n) * A * R^{2/3} S^{1/2}$$

In the above equation, "A" is the flow area, "n" is the Manning roughness coefficient, "R" is the hydraulic radius and "S" is the gradient. In natural streams with little vegetation, what value of "n" would be appropriate to use?
   a) n = 0.012
   b) n = 0.043
   c) n = 0.025
   d) n = 0.035
   e) Deranged stratigrapher genius says: $n = \int(ax^2 + bx + c)dx + \int e^x dx + ...$

3. Which of the following is a divalent cation that is commonly found in soil?
   a) Sodium.
   b) Magnesium.
   c) Ammonium.
   d) Potassium.
   e) What breed of cat is this dude? Never heard of it! My cat doesn't go outside, anyway…

4. In twin gliding:
   a) Rows of atoms may be displaced laterally one interatomic unit along the glide plane. The crystal changes shape but the lattice structure is not distorted.
   b) Rows of atoms are displaced a fraction of an interatomic unit along the glide plane. The lattice of the displaced part of the crystal is symmetrically altered with respect to the undeformed part.
   c) Deformation occurs by granulation, fracturing, gliding, sliding, rolling, and rotation of rock fragments.
   d) Two distinct sedimentary layers slide and glide as a unit along the slip plane of a slope.
   e) Pairs of identical twins compete in the flying of unpowered aircrafts.

5. In our fieldwork we inspect an outcrop with a sequence of parallel beds. One of these layers has visible boudinage. The boudins are composed of relatively brittle rock which is surrounded by and encased within a more ductile lithologic unit. The geometric shape of one particular boudin structure may be approximated by the formula [$x^2/9 + y^2/4 = 1$]. If the units are in feet, what are the dimensions of this feature as seen on the face of the outcrop?
   a) 9 feet (horizontal) by 4 feet (vertical).
   b) 3 feet (vertical) by 2 feet (horizontal).
   c) 3 feet (horizontal) by 2 feet (vertical).
   d) 6 feet (horizontal) by 4 feet (vertical).
   e) Dude, my favorite boudins are made of buffalo meat. They don't sell them that big, however.

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

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

Compiled by David M. Abbott, Jr., CPG-04570
5055 Tamarac Street, Denver, CO 80238
303-346-6112, dmageol@msn.com

False and Misleading Mining Exploration Press Releases

Christopher Dail, CPG-10596, wrote, "Thanks for highlighting the nebulous world of public news releases in the mining sector in the recent [False and Misleading Mining Exploration Press Releases] topic in column 185 in [*The Professional Geologist*, Apr/May/Jun '23]. Your timing is impeccable. I was so disgusted with a recent news release from a private company that crossed my in-box I was planning on sending something to you about just that very subject." Dail provided another example of what H.C. Hoover called "the charlatans of mining in attempts to cover the flights of their imaginations."[1]

Dail provided key "flights of imagination" statements from a press release issued by a private mining company. "[P]rivate rare earth developer [Charlatan Mining] has revealed it has discovered a billion-dollar "game-changer" for the industry in Montana: the highest-grade REE deposit in the United States. '[Charlatan Mining] has nearly 9% TREO [total rare earth oxide] (89,932 ppm), far ahead of any other domestic rare earth resource,' the company said. 'The deposit also has readings of 2.4% (23,810 ppm) combined neodymium and praseodymium… [and] has recently confirmed carbonatite mineralization at depth, below high-grade surface samples of 17.05% TREO and 16.44% TREO.' … The company is now working with an undisclosed but 'major national laboratory' to develop highly efficient, environmentally safe processes for domestically refining the rare earths at [the deposit]. "The unique aspects of the…deposit will enable the Company to make the resource available for production and delivery on an expedited basis," officials said, noting that it is assessing next steps for the property, including financing and business development. "We have confirmed that [the deposit] is the highest-grade rare-earth deposit in the United States, with a multibillion-dollar resource value." No timeline for work has yet been released.

A photograph included in the press release shows the outcrop of a coarse-grained dike, maybe three feet wide, intruding schistose rock. This photo fails to suggest a significantly sized billion-dollar deposit. The company's web site highlighted another photograph showing a four to six-inch wide seam of presumably carbonatite in an underground exposure. A volumetric estimate found on web site simply multiplied the 800 acres in 40 mining claims covering the property by an assumed one-foot thickness of the mineralization and by a tonnage factor (the density of some of the rare earth minerals, not the rock itself) to generate a billion-dollar value for the deposit. This of course does not account for the large amount of waste rock that would have to be removed to mine a one-foot-wide mineralized zone (which is what is used in the "estimate" nor does it account for any dilution that would be expected whether mined in an open pit scenario or underground.

Furthermore, no mention is made of the time and expenses necessary to compile the needed environmental baseline data; meetings with neighbors, land and environmental regulators, and other interested parties (ESG) required to obtain operating permits. These processes often take years before all required permits are obtained and operations can begin.

As noted in PE&P column 185, processing (rare earth oxide separation) for rare earth deposits is a significant problem for two major reasons. First, the rare earth elements are chemically very similar; therefore, it is difficult to separate one element (or its oxide) from the others. China does most of the world's processing. Second, large amounts of additional elements, including thorium and uranium are commonly found in bastnasite, allanite, and other REE-bearing minerals. Dealing with the resulting radioactivity presents an environmental problem. While several companies have announced plans for constructing REE processing plants, none have been successfully constructed. The REE grades required by these processing plants and the processing costs are unknown. Because the profitability of extraction of REE oxides from these plants is unknown, no estimates of mineral resources or mineral reserves can be made because there are no reasonable prospects for eventual economic extraction of the REEs.

A Problematic Valuation Case

My Ammonite Resources colleague, **Betsy M. Suppes**, brought this case to my attention. Suppes is a petroleum geologist and a Certified Mineral Appraiser. Her client is an estate whose beneficiary is an aged heir. The estate includes ownership of two parcels totaling about 100 acres that are underlain by shallow productive oil and gas strata. One of these parcels is shaped like a simplified map of Tennessee and the other is an irregularly shaped pentagon. Suppes was asked to appraise the oil and gas value of these parcels. This assignment is typical of Suppes' assignments. The parcels are in Glade Township, Warren County, northwestern Pennsylvania.

Continued on p. 32

1. Herbert C. Hoover, 1909, *Principles of Mining*: McGraw-Hill Book Co., p. 16.

Answers:

1. The answer is choice “b” or “A stone swallowed by some animals to help grind food and aid digestion.”

A gastrolith is a stomach stone or gizzard stone. The rocks are held inside the gastrointestinal tract. In some species which lack grinding teeth, the gastroliths are retained in the gizzard and utilized to crush food. The ingestion of gastroliths has been associated with certain reptiles (e.g., present-day crocodiles and alligators, as well as dinosaurs), birds and mammals (e.g., seals, etc.). Gastroliths are usually rounded and polished.

2. The answer is choice “c” or “n = 0.025.” Please refer to the table below:

Manning roughness coefficient value	Type of stream
0.04 to 0.05	Mountain streams with rocky beds.
0.035	Winding natural streams with weeds.
0.025	Natural streams with little vegetation.
0.020	Straight, unlined earth channels.
0.012	Channels with smooth concrete.

3. The answer is choice “b” or “Magnesium.”

Some cations commonly found in soils include hydrogen, sodium, potassium, ammonium, calcium, and magnesium. Please see below:

Common cation in soil	Monovalent	Divalent
Hydrogen	H^+	
Sodium	NA^+	
Potassium	K^+	
Ammonium	NH_4^+	
Calcium		Ca^{++}
Magnesium		Mg^{++}

4. The answer is choice “b” or “The Rows of atoms are displaced a fraction of an interatomic unit along the glide plane. The lattice of the displaced part of the crystal is symmetrically altered with respect to the undeformed part.”

Choice “a” depicts “translation gliding.”

Choice “c” describes “cataclastic deformation” or “cataclastic flow.”

Both, “translation gliding” and “twin gliding” are characteristic of plastic deformation.

“Cataclastic flow” involves brittle deformation and high strain occurring above the brittle-ductile transition boundary. It is associated with fault zones and impact breccias. Microfracturing along with frictional rolling, gliding and sliding of rock fragments describe the pertinent deformation style.

5. The answer is choice “d” or “6 feet (horizontal) by 4 feet (vertical).”

The equation [$x^2/9 + y^2/4 = 1$] is that of an ellipse. The general formula for this type of geometric figure is:

$$(x-h)^2/a^2 + (y-k)^2/b^2 = 1 \qquad (1)$$

Equation (1) describes an ellipse with center:

$$C_t = (h, k) \qquad (2)$$

elongated along the x axis ($a^2 > b^2$), with foci

$$f = (h \pm c, k) \qquad (3)$$

where:

$c^2 = a^2 – b^2$ (4)

The major axis of the ellipse is:

$Ma = 2a$ (5)

and the minor axis:

$Mi = 2b$ (6)

Our elliptical boudin is represented by:

$x^2/9 + y^2/4 = 1$ (7)

Based on equations (1) through (6), we calculate the following for the boudin in question:

$C_t = (h, k) = (0, 0)$ (8)

$a^2 = 9$ and $a = 3$ (9)

$b^2 = 4$ and $b = 2$ (10)

$Ma = 2a = 6$ (11)

$Mi = 2b = 4$ (12)

$c = \sqrt{(a^2 – b^2)} = \sqrt{(9-4)} = \sqrt{5}$ (13)

$f = (\pm\sqrt{5}, 0)$ (14)

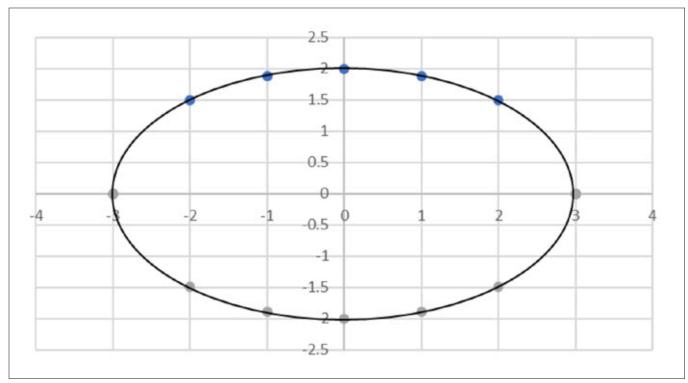
Vertices = $(\pm 3, 0)$ (15)

Covertices = $(0, \pm 2)$ (16)

Equations (11) and (12) provide the answer to our question. A graphical representation of our boudin structure is illustrated below:

Boudins of amphibolite layers (metamorphosed basalts) that were stretched within quartz schists (Norway).
Photo credits © Haakon Fossen. Permission obtained from Dr. Fossen by Robert Font. Photo from website: https://blogs.egu.eu/divisions/ts/2019/05/19/features-from-the-field-boudinage/

$x^2/9 + y^2/4 = 1$



AIPG CPG Ron Parratt Honored for SME Leadership Role

AIPG member Ron Parratt (CPG-07616) was recognized for his leadership as out-going SME President during the Society for Mining, Metallurgy & Exploration (SME) annual conference held in February 2023. During Ron's presidency, a memorandum of understanding was signed between AIPG and SME. Ron currently serves on AIPG's liaison committee with SME.

Ron pictured here (second from left) with his family.

Professional Ethics, continued from p. 29

Suppes soon learned that local customs in Warren County presented problems. Local operators drill wells of ≥1,500 feet deep on their own properties so royalty interests are uncommon. The estate's attorney's law partner represented a number of these local operators and there were conflicts of interest between the partner's clients.

The local topography is rugged with about 500 feet of vertical relief. Wells are drilled along old logging roads, ridgelines, and valley bottoms. Figure 1 shows the apparent location of the two parcels in red, the topography, and black dots marking the location of shallow oil and gas wells.

Suppes measured the well spacing of 25 wells in the vicinity of the two parcels and found that the average spacing was 430 feet or a radius of 215 feet around each well. As Suppes began examining the property locations of the two parcels discrepancies started appearing. Table 1 presents the apparent acreage data on the parcels Suppes uncovered.

Suppes also discovered that the survey descriptions of the two parcels differed from one another. Depending on the particular survey some existing wells were either located on the parcels or were located so close to the property line that production trespass was occurring. Suppes found maps showing the well locations and property boundaries prepared and stamped by a licensed surveyor that demonstrate the oil and gas trespass. In addition, survey points on these maps varied in location and the survey had placed pipes marking survey points without regard to whether pre-existing survey-point pipes existed or were used in a particular survey. Several of these professionally stamped surveys were filed with the Pennsylvania Department of Environmental Protection.

Because of the lack of agreed-upon accurate surveys of the two parcels, corresponding accurate surveys of well locations, and detailed well production records, Suppes is unable to complete this valuation assignment. The facts of the case give rise to the following ethical questions:

1. Can the appraiser complete the assignment given the problems identified?
2. Is the appraiser acting unethically by not reporting the conflict of interest within the estate's

Table 1. Acreage Data on the Two Parcels to be Valued

Pentagonally-shaped parcel		Pentagonal parcel Tennessee-shaped parcel	
Deeded acres	50	Deeded acres	58.575
County assessed acres	50	County assessed acres	57.92
Planimetered acres	37.456	Planimetered acres	58.11

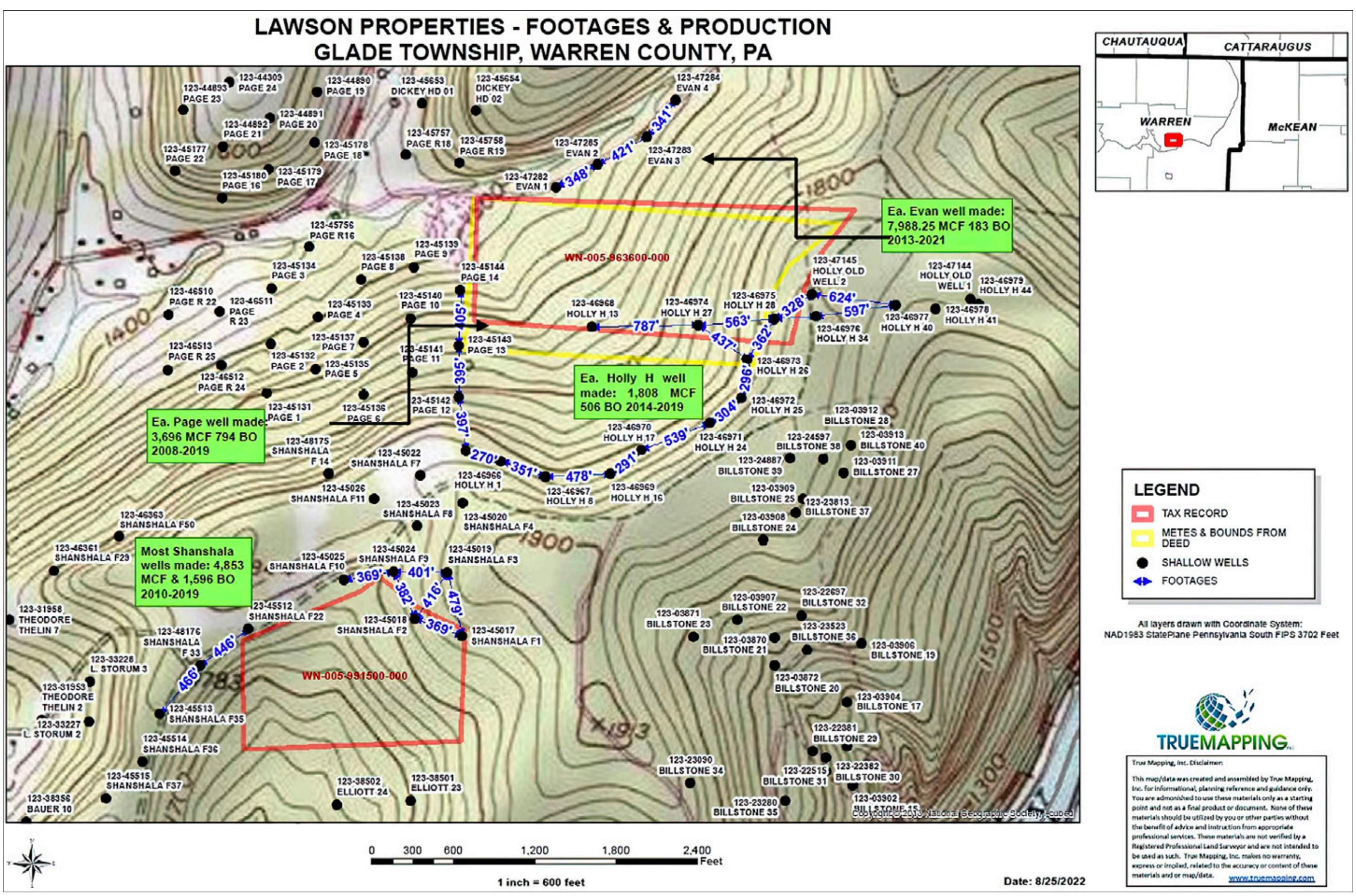


Figure 1. Location of the parcels to be valued, the topography, and the location of shallow oil and gas wells (source Betsy Suppes).

law firm (representing the estate and the operator who drilled on the estate) to the state bar?

3. Is the appraiser acting unethically by not reporting to the appropriate licensing agency:
4. The surveyor who did not follow the deed or the county assessor's office parcel outline?
5. The surveyor knowingly changed the boundary for various clients.
6. Not reporting this information to the PA DEP?
7. Can the appraiser reasonably justify their inaction by stating that they informed the heir, and their attorney (although did not point out the conflict of interest within the firm)?
8. Can the appraiser reasonably justify their inaction by stating that they don't get paid for the time spent to report on these non-ethical practices?
9. Given the foregoing problems, can an approximate valuation be made that describes the problems and resulting assumptions made?

How would you answer these questions? Please send me your thoughts.

Implicit Versus Explicit Modeling

I recently received an advertisement stating that many geologists use implicit modeling because they believe it saves time but also because of the challenge of working with explicit models. Because I'm not an expert in modeling, I asked my good friend Jim Reed of RockWare, Inc. for an explanation. Reed explained, "Implicit modeling is building the model from the XYZG borehole and surface data using an interpolation algorithm. Explicit model is hand-drawing polygons on parallel or sub-parallel cross-sections and then connecting these polygons into polyhedrons. Explicit modeling has tons of advantages such as handling very complex geology but it's much harder to use. I like the idea of using both approaches. For example, using explicit modeling to rough out the geology and then using implicit modeling to interpolate the geochemistry with geologic polyhedrons."

Contouring provides the simplest example. There are a variety of contouring algorithms that will rapidly contour gridded data, each of which differs from contours drawn using a different algorithm. This is implicit modeling. Hand drawing contours takes more work and thought and are the explicit method of contouring. The resulting contours are not necessarily more accurate than computer-drawn contours. A combination of both approaches is likely to be better than either alone.

ChatGPT and other AI Chatbots

Articles about ChatGPT and other AI chatbots have recently become common. Beata Stefanowicz wrote, "*AI chatbot* is a piece of software that simulates conversations with users using natural language processing (NLP). It operates through messaging applications and uses machine learning to provide a human-like experience. Artificial intelligence chatbots can help you increase sales, improve customer satisfaction, and save you time. You can also use them to analyze complaints, reviews, and feedback from a variety of touchpoints. They provide human-like help without the need to forward your site's visitor to the representative until a complex issue comes up. On top of that, AI bots understand user intent and learn with time about different ways to phrase questions to find the best answers for your clients." (https://www.tidio.com/blog/ai-chatbot/ March 27, 2023).

ChatGPT is currently the most widely used AI chatbot software, but other software exists or will soon be released. Clear AI chatbot software is rapidly evolving and will prove useful in a wide variety of ways. But the usefulness of an AI chatbot also can contribute to its ethical misuse. For example, it should not be used for writing term papers. This is cheating. The point of a term paper is to investigate a topic and personally write about your investigation and findings. The academic world is developing methods of detecting chatbot-written text.

> "...usefulness of an AI chatbot also can contribute to its ethical misuse."

I received the following announcement of a meeting to discuss using AI in your work. "How might AI help you in your work? AI can help…staff be more efficient, effective, and strategic in their work. By automating routine tasks, providing data-driven insights, and improving communication, AI can free up time for church staff to focus on building relationships and serving their community. (Full disclosure: AI wrote this workshop description.) Let's explore together." My friend Jim Reed of Rockworks used ChatGPT to update some of his software manuals and was surprised and pleased at how well the software worked for that purpose. He also found that ChatGPT could write computer code. Clearly, AI is increasingly being used in a wide variety of ways, mostly good but some bad.

Although I have not used ChatGPT, I have been using Grammarly, a free online writing assistant (www.grammarly.com) that reviews spelling, grammar, punctuation, clarity and usage, and related writing issues as I generate text in Word™. Grammarly is a variety of AI chatbot as defined above. I often agree with Grammarly's suggestions but not infrequently I don't. In any case, I appreciate the suggestions to improve my writing. Because I'm deciding whether to accept one of Grammarly's suggestions, the resulting text is still mine and is not a variety of cheating (unless one's writing assignment specifically forbids such use—one still has to learn to write well unaided). Various aspects of the use of AI and ChatGPT continue to be topics frequently addressed in the news and other media. Please contribute examples of your use of or encounters with AI chatbots and the ethical use thereof.

The Battle for Your Brain

I recently read *The Battle for Your Brain: defending the right to think freely in the age of neurotechnology* by Nita A. Farahany, St. Martin's Press, 2023. Headbands or ear buds that record brain wave activity are increasingly commonly used devices for a variety of purposes including relaxation, meditation, and other forms of neurofeedback. "Neurotechnology can tell us if we're wired to be conservative or liberal, whether our insomnia is as bad as we think, and if we're in love with someone or just "in lust." We can learn how we process risks and rewards and whether we're congenitally disposed to be spendthrifts or tightwads. Soon, smart football helmets will be able to diagnose concussions immediately after they occur. Neurotech devices can also track changes in our brains over time, such as the slowing down of activities in certain brain regions associated with the onset of conditions like Alzheimer's disease, schizophrenia, and dementia." Increasing numbers of companies are requiring employees to wear neurofeedback headbands that detect increasing fatigue for long-haul truckers, mine equipment operators, air traffic controllers, and others. Other devices can help epileptics be alerted to oncoming seizures while quadriplegics can type on computers using just their thoughts. This all sounds great but, as Farahany warns, the increasing sophistication of neurotechnology is a Pandora's box.

"The same neuroscience that gives us intimate access to ourselves can allow companies, governments, and all kinds of actors who don't necessarily have our best interests in mind access too. I find this terrifying as an Iranian American because nothing in the US Constitution, state and federal laws, or international treaties gives individuals even rudimentary sovereignty over their own brains. It's not going to happen tomorrow, but we are rapidly heading toward a world of brain transparency, in which scientists, doctors, governments, and companies may peer into our brains and minds at will. And I worry that in this rapidly approaching future, we will voluntarily or involuntarily surrender our last bastion of freedom: our mental privacy." This can lead to a far more frightening controller than Big Brother in Orwell's *1984*.

Warning machine operators and truckers of increasing fatigue is desirable, but the same technology can be used to measure employee output in undesirable ways. Farahany explores both the desirable, debatable, and frightening aspects of neurotechnology pointing out the largely unexplored ethical dilemmas inherent the neurotechnology's use and the need for laws protecting mental privacy. *The Battle for Your Brain* will not be the most enjoyable book you read all year, but it may be one of the most important.

President's Message continued from p.27

geologue du Quebec were present and are interested in being active participants.

My overall impression is that this group will be an important ally to AIPG's mission to promote the profession of geology and to certify professional geologists. GGPG is currently constructing a website that will show a world map with locations of geoscience professional organizations with links to the requirements and roles of each organization. Stay tuned for more information on GGPG in the future.

Going to a Conference?

AIPG members are busy, and many are attending a conference or two this year. I need members to volunteer to be an ambassador for AIPG at those conferences. AIPG arranges for a booth at a limited number of conferences, but you can volunteer to represent AIPG at any conference. What does volunteering entail? That depends on your willingness to take on various options, of course, but here are some things that you can do.

1. **Recruit.** Talk to your fellow attendees about AIPG and the benefits of membership. Give out the website address (aipg.org) liberally. Let others know about the different membership categories and how finding the best membership category fit is a simple call to headquarters or a chat with an AIPG member.

2. **Invite.** Colleagues can be invited to AIPG activities – there are plenty of virtual and in-person events, such as meetings and field trips organized by AIPG sections, our 60th anniversary conference, webinars, and next year's international field trip to Scotland. If you look at our website page for events (Community Calendar - American Institute of Professional Geologists (aipg.org)), you'll find one or two activities available most weeks.

3. **Promote.** Show your AIPG pride by wearing your AIPG lapel pin, or AIPG logo clothing. There are options for field and office attire available through the AIPG website. I also like the AIPG patches that can be sewn onto your favorite shirt, safety vest or jacket that is already hanging in your closet.

4. **Organize.** The conferences that AIPG staff attend AND where we have a booth are SME, AASG, Colorado Oil and Gas, and AEG. If you will be attending any of those conferences, then please contact the AIPG office (aipg@aipg.org or via phone 303-412-6205) to volunteer to help at the booth. For other conferences where there is no AIPG booth already arranged, see if you can organize for AIPG to have a booth without charge, then contact the AIPG office to get some promotional materials and to solicit other members to help you at the booth. We don't have sufficient budget to pay for a booth or table at additional conferences, but we are willing to work out trades such as space at our annual meeting in exchange for a space at another society's conference. Spending time at the booth is quite fun, because you get to talk to a lot of interesting people and hear what other geologists are doing. A valuable aspect of AIPG is networking and an AIPG booth is a prime location for networking!

If your company has a booth and is willing, AIPG can provide you with some materials to be available at your company booth. Displaying QR code in a plastic sheet holder has been a super way for everyone with a smart phone to access the membership registration page quickly. For some membership categories, it takes just a few moments to sign up online and registration as a member happens immediately. QR codes are very popular with students and ECPs!

I'm looking forward to attending the Michigan Section Annual Environmental Risk Management Workshop in June, and I know that other AIPG members and staff will be at conferences this year. Please stop by to say hello to your colleagues!

Best regards,

Dawn

Implementing Stealth Education in the Geosciences

(Part 5)

Getting Down to Earth!

James F. Howard PhD., CPG-2536

As defined in previous installments of this series, Stealth Education is the practice of inserting 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.***

If possible, a good Q & A session should be worked into the presentation. That can often lead into additional topics that may pique the interest of the audience. As an example, in a lecture on Coral Reef Ecosystems, I introduced the concept of sea level rise and fall due to glaciation cycles and climate change. After the presentation to a cruise ship audience, some of the audience approached the Cruise Director (my immediate ship contact) requesting a separate lecture on Climate Change, Causes and Effects. This provided an excellent opportunity for much greater expansion into the dynamics of the earth system and its interaction with climate cycles.

In order to best implement the concept of Stealth Education, the topics involved should be chosen to be as diverse as possible and able to effectively blend the topic with appropriate aspects of interest to a general audience. The example selected for the next set of editorials, Alternative Energy Sources, is a current topic and one that can be utilized in many different venues and involve multiple audience types.

When a geoscientist discusses Energy Resources, it is assumed that he or she will emphasize fossil energy sources, such as coal or petroleum or, possibly, nuclear power, depending on the character of the audience. Although these topics provide excellent avenues for introducing geoscience principles to a group, modern audiences are often interested in more widespread and controversial energy sources than those based on hydrocarbons of various types. This discussion will concentrate on alternatives associated with the development of geothermal sources and their availability in various venues.

As a reminder, always keep in mind that many, if not most members of the general public, your primary target, are probably unfamiliar with the basics of ANY given aspect of your program. I would always start with a slide illustrating the general methodology for conversion of mechanical energy to electrical energy for widespread distribution and use. Many excellent sources of visuals, particularly animations, are available on websites dedicated to secondary educational teaching support audiovisual websites or, in some cases, governmental or private information websites.

As this particular discussion is directed toward the use of geothermal sources for conversion to electrical energy, I find it useful to introduce the audience to the basics of earth's geothermal structure. This allows discussion on distribution of the thermal sources that can be tapped to provide the heat necessary to convert a fluid, usually water but not always, into steam that can be used to drive turbines and produce electrical energy.

Figure 1 is a simple diagram that provides a base for discussion of the thermal profile of the earth's interior and an overview of the general distribution of heat from the surface to the earth's

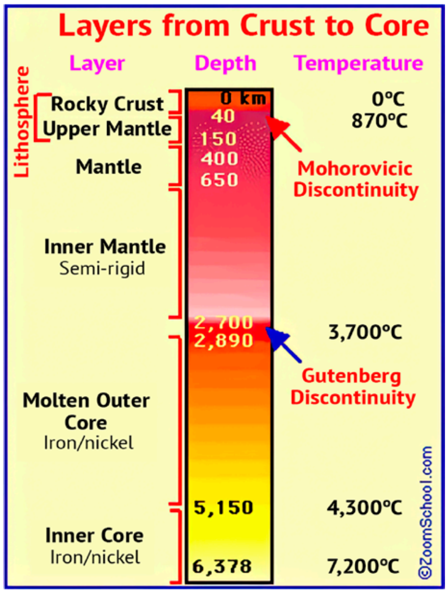


Figure 1. Thermal profile of earth. February « 2012 « My Blog (takeschoolhome.com).

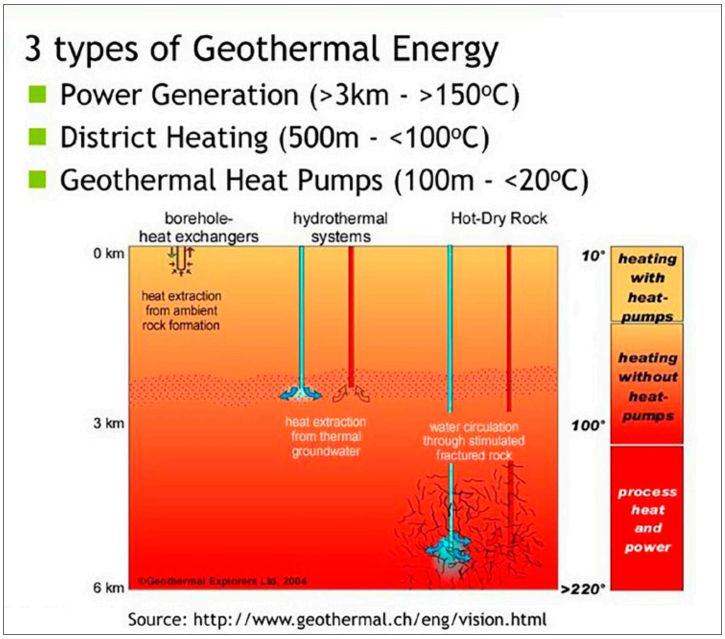


Figure 2. Modified from Government of Western Australia, Department of Mines, Industry, Regulation and Safety, Courtesy of http://www.geohermal.ch/eng/vision.html –Geothermal Explorers Ltd.

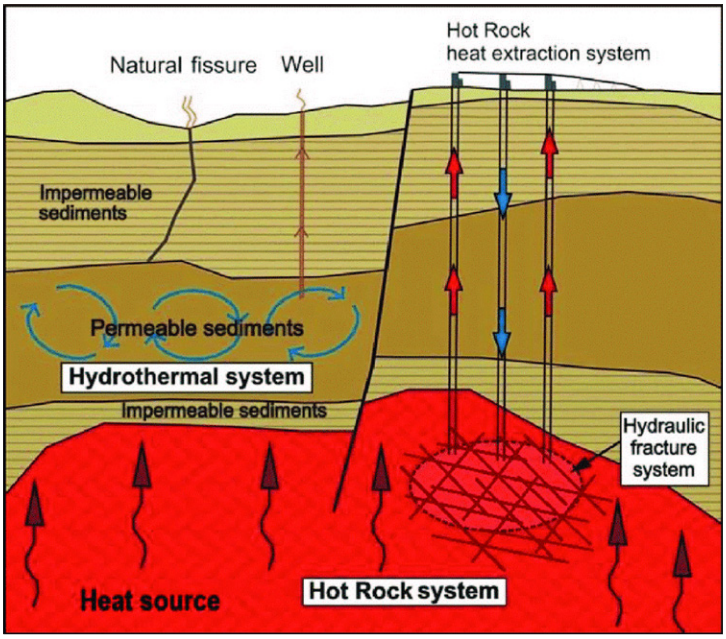


Figure 3. González, Zayre & Garcia-Zarate, Marco, (2018). Geothermal Energy as an Alternative to Reduce Atmospheric Emissions and Provide Green Energy. 10.5772/intechopen.80759.

core. This diagram, from a high school teaching blog site, is an example of the types of material available on teaching websites.

It can be used to introduce discussions on the origin of the earth, the reasons for the thermal profile and the general target zones that can serve as sources for large-scale geothermal energy development. It can also be used to spearhead a discussion of earth history and basic cosmology, depending on the audience and your assessment of what may be of particular interest to your audience.

Figure 2 provides an overview of the basic relationship between the overall thermal regime of the earth and suitability of each thermal zone with respect to providing specific sources of energy to the population of a given geographic area. It summarizes the various types of geothermal energy applications and can serve as an outline for your presentation and for more in-depth discussion of the various alternatives presently in use.

The most basic use of geothermal energy is the direct use of lower temperature steam for heating. This is primarily applicable as a heating supplement for areas where the economics and geologic conditions are favorable, e. g. Polar Regions, northerly or southerly cold temperate areas, and mountains/islands located in similar climatic conditions, such as Iceland, and regions such as islands where both low temperatures and volcanic activity are present. It can also be suitable for supplementing small commercial structures such as greenhouses, small industrial structures, public buildings, and other locations where heating alone is an applicable alternative.

Figure 3 is a simplified diagram that illustrates the sources by which geothermal energy can be accessed using modern technology. It can be used to discuss mechanisms for obtaining heat from naturally-occurring geothermal reservoirs, such as geysers and thermal springs. It can also serve as an introduction to both enhanced and unenhanced production from the zones directly overlying the magma bodies which provide long-term natural or enhanced fracture recharge of the thermal source for a surface geothermal generating plant.

This figure also provides an excellent base for discussion of magmatic sources of heat energy and can be expanded to discuss volcanism, plate tectonics, hydro-fracturing technologies and their effects and limitations on the availability of acceptable sources for the development of cost-effective geothermal energy power plants.

Figure 4 illustrates a simplified example of the process by which a geothermal power plant recovers and recirculates the source water which transports the heat from the source to an operating electrical generating station. A key element in this example is the recirculation system which allows multiple reuses of available water supplies.

This concept of recirculation can also allow expanded discussion of the positive and negative collateral effects of the development of commercial geothermal power, including expansion into overall potential environmental impacts on water resource availability, water quality impacts and beneficial as well as deleterious collateral aspects of the process.

These expanded discussions can include negative elements, such as the potential for contamination of surface and ground water resources by wastewater from the process stream, as well as positive elements, including the potential for recovery of desirable mineral resources from the process waste water, e.g. rare earths, gold, silver, and other elements associated with the late stages of magmatic segregation common to the thermal fluids and minerals in proximity to the magmatic body providing the source of the thermal energy being tapped for power.

Figure 5 illustrates the process by which the thermal fluids from the production well are utilized. Heat from the produced water converts water to steam which is then used to operate turbines which produce electrical energy for the distribution network. The steam then is transferred to cooling towers for condensation and return of the fluids to the production zone. As additional technology is developed, brines remaining after treatment by the cooling towers can then be processed for other uses such as production of fresh water, or as a source of potentially beneficial dissolved compounds and elements for use in modern industry before being reinjected. (DuChanois, R.M, et al. 2023; Capocelli, M.; et al, 2020).

If the audience is interested in engineering aspects of geothermal energy production, Figures 6, 7 and 8 illustrate some current technologies used to extract thermal energy from different types of reservoirs, specifically Dry Steam, Binary Cycle, and Flash Steam systems.

Discussions of these different types of energy extraction can provide entry points for discussions on hydrogeologic characteristics of subsurface fluids, the physical relationships between pressure and fluid character, groundwater flow and availability, permeability, and migration controls in sedimentary and igneous rocks, fracturing and the relationship with local and regional tectonic movements and other aspects controlling the availability and migration of fluids.

Dry steam plants use steam directly from a geothermal reservoir to turn generator turbines. The first geothermal power plant was built in 1904 in Tuscany, Italy, where natural steam erupts from the earth, providing a primary source of geothermal energy. Similar conditions power the Geysers Geothermal plant in northern California.

Binary-cycle power plants transfer the heat from geothermal hot water to another liquid, usually a low boiling point hydrocarbon. The heat causes the second liquid to turn to steam which then drives a generator turbine producing electricity for the distribution network. The process water is then returned directly to the reservoir for reheating and reuse.

Flash steam plants utilize heated water under high-pressure from deep inside the earth and convert it to steam at surface pressures. The steam then drives generator turbines. When the steam cools, it condenses to water and

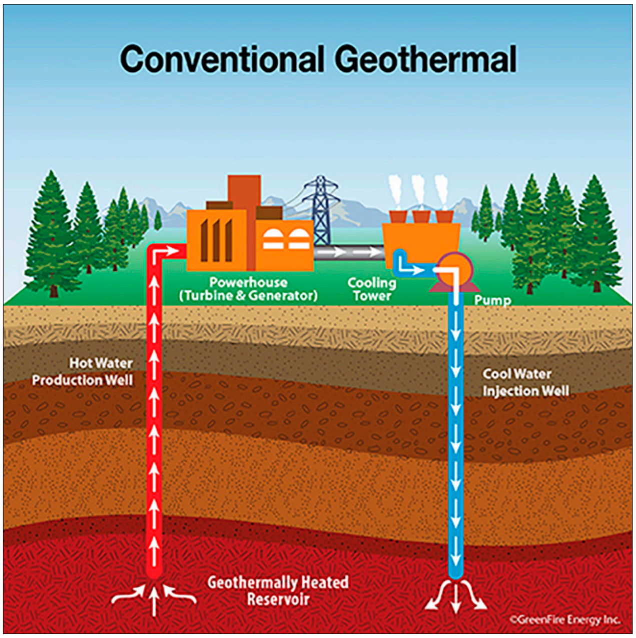


Figure 4. Greenfire Energy webpage.

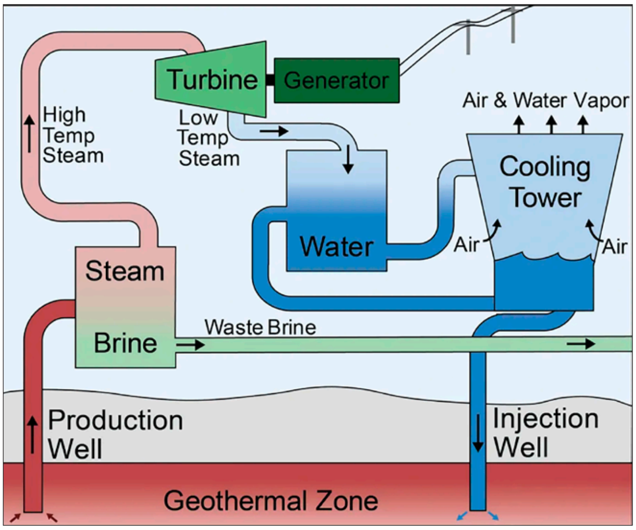


Figure 5. Generalized Diagram of interaction between a geothermal source and a commercial power generating system. University of Michigan geothermal energy fact-sheet.

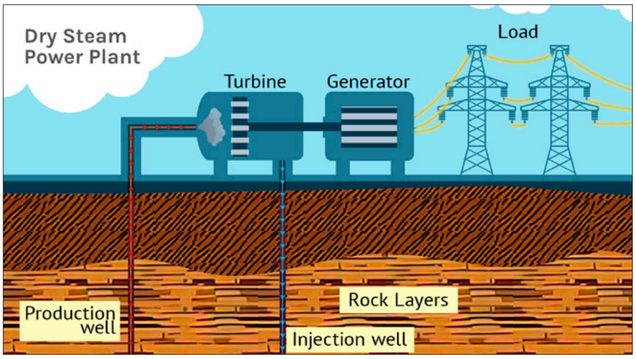


Figure 6. Simplified diagram of Dry Steam Process for Geothermal Production of Electrical Energy - US DEPARTMENT OF ENERGY-Geothermal Technologies Office - Electricity Generation. https://www.energy.gov/eere/geothermal/geothermal-technologies-office

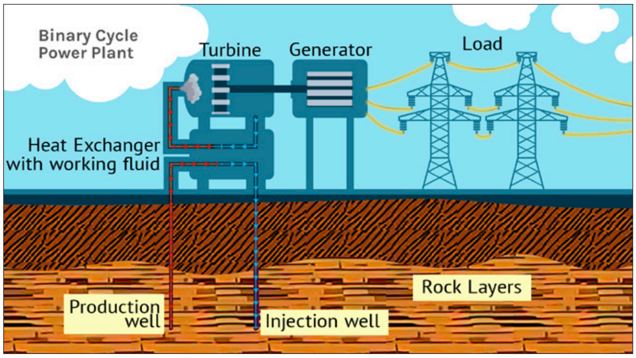


Figure 7. Simplified diagram of Binary Cycle Steam Process for Geothermal Production of Electrical Energy- US DEPARTMENT OF ENERGY-Geothermal Technologies Office - Electricity Generation. https://www.energy.gov/eere/geothermal/geothermal-technologies-office

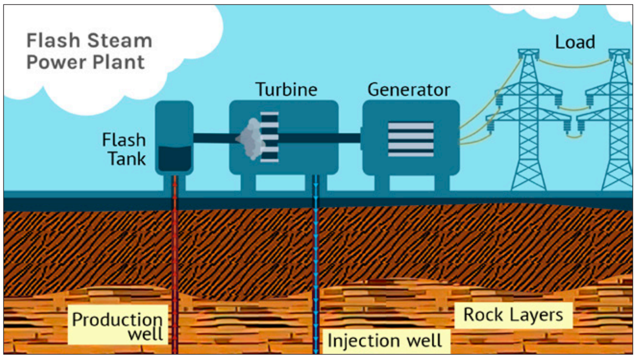


Figure 8. Simplified diagram of Flash Steam Process for Geothermal Production of Electrical Energy US DEPARTMENT OF ENERGY-Geothermal Technologies Office - Electricity Generation. https://www.energy.gov/eere/geothermal/geothermal-technologies-office

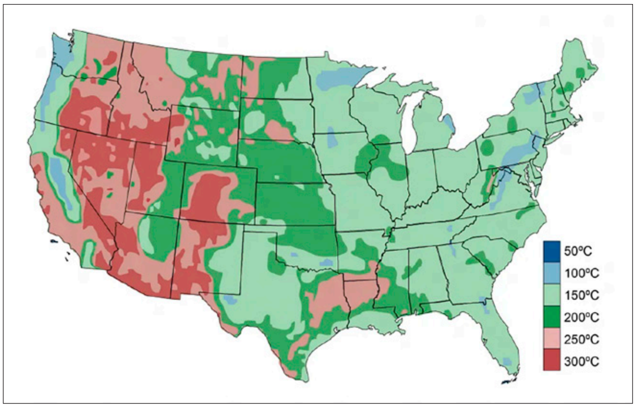


Figure 9. US Geothermal Resources at 10 km depth - Center for Sustainable Systems, University of Michigan. 2021. "Geothermal Energy Factsheet." Pub. No. CSS10-10.

is injected back into the ground to be reused. Most existing geothermal power plants are flash steam plants.

In discussions of the operating principles of these technologies, introduction of basic principles such as Boyle's Law, hydraulic fracturing as appropriate to tight reservoirs overlying magmatic sources, mineral resource recovery from spent brines, magmatic differentiation and mineral segregation, volcanism, plate tectonics and relationships to seismic activity, as well as identification of optimum site suitability for geothermal generating plants can be expanded as time, character of the audience and venue dictate.

According to the Federal Energy Management Program (FEMP), Dry steam power plants use geothermal steam of 150°C (302°F) or more, whereas flash steam power plants require relatively high-temperature geothermal resources at about 180°C (356°F). Binary-cycle, or organic Rankine cycle, power plants use lower temperature geothermal resources around 100°C (212°F), which is a major advantage in areas where only lower temperature resources are available

With respect to general availability of geothermal resources discussed above, according to Dyman and Cook, 1998, the deepest vertical well drilled on land in the U.S. is the Lone Star No. 1 Bertha Rogers, which was completed in 1974 in the Ordovician Arbuckle Formation as a wildcat well to a depth of 31,441 feet (9,583 m) in Beckham County, Oklahoma., in the Anadarko basin. This report provides a first approximation of the technically feasible depth range of available sources of usable geothermal energy which can be developed in the United States.

Comparing figure 9 with the FEMP criteria, it quickly becomes obvious that existing drilling technology is capable of supporting development of commercial geothermal generating plants in large areas of the United States. Discussions on identifying optimal locations placement of commercial geothermal energy production can be useful in introducing factors controlling the distribution of thermal energy in the subsurface. The topics of plate tectonics, magma presence and origin, volcanic activity, geysers, thermal springs and threats associated with areas such as Yellowstone, the Cascades, Mount Rainier, Mount St. Helens and other similar phenomena can easily be inserted into the discussion, depending on the interests and geographic location of the audience.

This editorial has been limited to those facets of geothermal energy production that are suitable for commercial development. If appropriate or desired by the presenter, expansion of the subject into the area of temperatures less than 100° centigrade where light industrial, commercial or residential applications such as groundwater geothermal heat pumps or direct heating can be used as an expansion or as a separate topic.

In those applications, the earth is primarily used as transient storage for non-commercial heating and cooling processes and, therefore, are much more limited in areal scope and applicability. If you choose to do so, I heartily recommend using the information and graphics available on the subject in the United States Energy Information Agency (USEIA) website.

It is extremely important to remember that the purpose of a Stealth Education Program is not to preach about the vital importance of a knowledge of the earth system in modern life. Its purpose is to utilize an entertainment venue in which important elements of our discipline can be presented to an audience to broaden their awareness and background. Hopefully, this could trigger them to incorporate some of the applicable concepts into their decision-making process in voting, public participation programs and, even, God forbid, the political decision-making process at appropriate levels.

References

Summary of Deep Oil and Gas Wells in the United States Through 1998, Thaddeus S. Dyman and Troy A. Cook pubs.usgs.gov/dds/dds-067/CHB.pdf.

González, Zayre & Garcia-Zarate, Marco. (2018). Geothermal Energy as an Alternative to Reduce Atmospheric Emissions and Provide Green Energy. 10.5772/intechopen.80759.

Thermal profile of earth February « 2012 « My Blog (takeschoolhome.com).

University of Michigan geothermal energy factsheet https://css.umich.edu/publications/factsheets/energy/geothermal

University of Michigan Sustainable Systems – geothermal energy factsheet.

US Department of Energy - Geothermal Technologies Office - Electricity Generation.

Geothermal Electric Technology by U.S. Department of Energy Federal Energy Management Program (FEMP) Updated: 11-15-2016.

DuChanois, R.M., Cooper, N.J., Lee, B. et al. Prospects of metal recovery from wastewater and brine. Nat Water 1, 37–46 (2023). https://doi.org/10.1038/s44221-022-00006-z.

Capocelli, M.; Moliterni, E.; Piemonte, V.; De Falco, M. Reuse of Waste Geothermal Brine: Process, Thermodynamic and Economic Analysis. Water 2020, 12, 316. https://doi.org/10.3390/w12020316.

Tales from the Field

Pete Dohms, CPG-7141

This particular recollection was triggered by two articles in the 2023 Student Issue of *TPG*. Bill Williams had an article titled, “A Tale of Discovery” in which he described the usefulness of field techniques not taught in universities. In Dawn Garcia’s column, she described how differing talents exhibited by geologists enter into the evaluation of candidates for CPG status.

This took me back to the winter through spring of 1980. For the previous six years, my company and I had been doing mineral exploration along a series of polymetallic veins in the historic Silver (Red Cloud) Mining District of, what was still at that time, Yuma County, Arizona. Given the complex mineralogy of the district, with pilot testing suggesting potential economic concentrations of silver, lead, zinc, fluorspar and barite, drilling and sampling had blocked out over 10 separate vein-type deposits. These were scattered like beads on a string along three sub-parallel, generally north-trending vein systems. Bench-scale metallurgical testing had suggested possible economic recoveries of silver, lead, zinc, fluorspar and barite. Bulk sampling and pilot-scale metallurgical testing were in order. I had the great, good fortune of managing the bulk-sampling work.

Many weeks of bulk sampling, both underground in old mine workings, and above-ground along exposures of the veins, had been completed by our contract miners. A small crew of local laborers had brought the broken ore to staging areas, where it was hauled to Yuma, to a local aggregate mining operation with an industrial-sized jaw crusher. The ore from each location had been carefully segregated and was to be separately crushed to 2-inch minus, then loaded into separate trucks for hauling to the testing lab in Tucson.

The jaw crusher was mounted at the top of a structure, fed by a conveyor belt onto which the broken ore was placed using a front-end loader. I was stationed at the top of the structure to direct operations, and make sure that the procedure went smoothly. It was fortunate that I had been furnished a 20-pound steel wrecking bar, because quite a few of the pieces of ore coming up the conveyor needed substantial persuasion before they would fit into the jaws. Late spring in Yuma, Arizona is warm, and naturally there was no shade at the top of the crusher. The ore, having a moisture content approaching zero, was exceedingly dusty. At the end of the day, I was covered in brown dust, streaked with sweat, and when I poured water over my head, mud ran off.

None of this, of course, had been taught at Michigan Tech (it was some years after my graduation that an underground lab for mining engineering students was built within the famous Quincy Copper Mine, located near campus). But the experience illustrates the points made by Bill Williams and Dawn Garcia. No university can possibly teach all of the field techniques that a geologist might encounter during a career. And, yes, the geologists who become CPG candidates certainly must exhibit a wide variety of talents.

Place-Based Education in Geoscience

Rasoul Sorkhabi, Ph.D., CPG-11981

Dr. Rasoul Sorkhabi is a professor at the University of Utah's Energy & Geoscience Institute, Salt Lake City.
Email: rsorkhabi@egi.utah.edu

Geology, the science of Earth, by definition is a place-dependent science. Earth refers to the planet as well as its parts. Geologic knowledge results from observations and investigations of materials and processes of Earth – rocks, fossils, mountains, basins, earthquakes, volcanic eruptions and so forth. Geology students usually do fieldwork as part of their graduation. Moreover, various regions can be used as real cases (natural settings) to teach and learn geology (Sorkhabi, 2023). However, "place-based education" (PBE) (Elder, 1998; Smith 2002; Sobel, 2004) or "place-conscious education" (Gruenewald, 2003), discussed in this article, has a different meaning, pedagogy, and methodology. We must first distinguish between physical space, which is everywhere, and "place" which is a spatial, special and social construct by humans and has thus significance and relationship – "a sense of place" – for its inhabitants. As several authors (Tuan, 1977; Altman and Low, 1992; Ryden, 1993; Schama, 1995; Feld and Basso, 1996; Lippard, 1997) have discussed in detail, a place is filled with meaning, identity, value, memory, feelings and experience for its people. There is an enormous amount of research and literature on how to empirically measure the sense of place, psychological attachments and physical dependence people have to their habitats (such as forests), and how these can be used for ecosystem management, environmental preservation, sustainable development, tourism, and education in social and environmental science. Place-based geoscience education integrates the "sense of place" theory as applied to specific areas and populations with the traditional (thematic) geologic education.

The "New Old" Method of Education

What is place-based education (PBE)? David Sobel, an environmental teacher and author, defined it as follows: "Place-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science and other subjects across the curriculum" (Sobel, 2004). According to David Gruenewald of Washington State University, "place-conscious education aims to work against the isolation of schooling's discourse and practices from the living world outside the increasingly placeless institution of schooling" (Gruenewald, 2003).

Although the PBE theory and methods have rapidly developed in the past three decades, the concept itself is not entirely new and was discussed by various thinkers and scholar in the past centuries. Jean-Jacques Rousseau in *Emile or On Education* (1763) highlighted the importance of interaction with nature and real life in children's education than a heavy emphasis on abstract bookish knowledge. John Dewey in his book *School and Society* (1899), wrote: "From the standpoint of the child, the great waste in the school comes from his inability to utilize the experiences he gets outside the school in any complete and freeway within the school itself; while, on the other hand, he is unable to apply in daily life what he is learning at school. That is the isolation of the school, its isolation from life. When the child gets into the schoolroom he has to put out of his mind a large part of the ideas, interests, and activities that predominate in his home and neighborhood. So, the school, being unable to utilize this everyday experience, sets painfully to work, on another tack and by a variety of means, to arouse in the child an interest in school studies." Dewey created the University of Chicago Lab School to advance his educational ideas.

In a sense, place-based education, largely conducted in a physical, societal and family setting intimate to students, was the common practice before emergence of modern schools. This method of traditional education is particularly visible in tribal societies.

It Began at Diné College

As far as place-based geology education is concerned, one of the pioneering examples comes from the Diné College in Tsaile, Arizona, a public tribal college which serves the 27,000-square-mile Navajo Nation. In the 1990s, Steven Semken (now at Arizona State University) designed a course on Indigenous Physical Geology (Semken and Morgan, 1997; Dubiel et al., 1997) in response to the college's Board of Regents mandate that the instructors should incorporate the Navajo tribe's culture into the curriculum. Following "ethnogeology" (Murray, 1997; Semken and Morgan, 1997), Semken used native Navajo terms and concepts to relate geoscience subjects and learning to the tribal students: For instance, "Tsé na'alkaah" (geology), "Dzil" (sacred mountain), Tsézhin ("the rock that is black" for volcanoes and volcanic rocks of the Colorado Plateau), and so forth. Over the years, Semken and colleagues have advanced their methodology of PBE in geology (Semken, 2005; Semken and Freeman, 2008; Ward et al., 2014; Semken et al., 2017).

In the mid-1990s, Kent Kirkby joined the University of Minnesota's Department of Earth Science and was assigned to a design a large, entry-level geoscience course. Kirkby met

Semken and learned about his "Indigenous Physical Geology" course. Kirkby decided to adopt a similar approach to his geoscience course; he, however, faced two challenges: The place-based geology course at Diné College was offered to a relatively small number of tribal students, while the Earth Science 1001 course at the University of Minnesota targeted a large number of students coming from various backgrounds. Kirkby had to design a place-based geology education course in an urban and diverse environment (Kirby, 2014). To do this, Kirkby incorporated elements of the local geology and history of the Upper Midwest into the course, both its lectures and laboratory exercises. Because large universities are located in metropolitan settings and diverse populations, PBE in universities will have to advance innovative methods to use the sense of place theory in geoscience education. Russell-Ciardi (2006), Miele and Powell (2010), and Powell (2011) have discussed some aspects and solutions of PBE in urban environments, including the "city as a lab" concept.

How It Works

Semken (2005) suggests five characteristics of PBE in geology: (1) Its content focuses explicitly on the geologic and other natural attributes of a place. (2) It integrates, or at least acknowledges, the diverse meanings that place holds for the instructor, the students, and the community. (3) It teaches by authentic experiences in that place or in an environment that strongly evokes that place. (4) It promotes and supports ecologically and culturally sustainable living in that place. (5) It enriches the sense of place for students and instructor alike.

Gregory Smith of Lewis & Clark College in Portland, Oregon, discussed five thematic components that can be adopted to different settings of PBE. These include: (1) Culture; (2) nature and the environment; (3) real-world problem solving (identification of real issues to investigate); (4) internship and entrepreneurship opportunities for students; and (5) induction of students into the intellectual and decision-making processes of the community (Smith, 2005).

Anthony Deringer of Texas State University in San Marcos discussed how PBE helps to strengthen mindfulness and attentiveness in students by promoting critical thinking and problem-solving skills, community engagement, environmental justice, and social justice (Deringer, 1997).

Masterson et al. (2017) proposed that the "sense of place"-based education strengthens the stewardship (responsible management of natural resources and environment) and the capacity of communities and institutions to respond and adapt to social and ecological changes.

Although place-based geoscience education uses the local landscape, environment, resources, culture, and community, it should not imply that the course is partial, incomplete, or below global standards. In fact, a syllabus in place-based geology education must cover the contents of the mainstream geoscience textbooks such as those by Tarbuck et al. (2019), Marshak (2022), and Reynolds and Johnson (2022). The PBE course should also encompass all the learning outcomes of a normal geoscience course as identified by Anderson et al. (2001): (1) Factual knowledge (e.g., minerals, rocks, fossils, structural geology); (2) conceptual knowledge (e.g., plate tectonics, biogeochemical cycles); (3) procedural knowledge or skillsets (e.g., scientific method, geological mapping); and (5) metacognitive knowledge (e.g., problem-solving, professional society, and social responsibility).

While PBE programs share certain requirements and characteristics, geoscience by its very nature can make special contributions to PBE. Firstly, geology by studying the materials, processes and history of Planet Earth as a whole brings a "global sense" to the "local sense" of place. This is particularly important in our age of global village, globalization, shared environmental problems, integrated world economy, and international science (Heise, 2008). Place-based geoscience education thus inspires and empowers students to think globally and act locally. In other words, just as the traditional schooling and education has been criticized to be isolated from the place and real life, a rigid focus on PBE may lead to isolation of a place or people from the rest of the world. Place-based geoscience education, while retaining the uniqueness and resources of a given place or population, also demonstrates how various parts, places and environments are inter-related at various levels and via natural processes and biogeochemical cycles.

Secondly, place-based geoscience education strengthens the sense of place by teaching students about the geologic history and resources of their enviros. Stedman (2003) argued that the sense of a place is not simply social construct by its people but that the place itself plays an active role in the intensity and degree of this sense. By revealing how a region formed through the geologic time, how it was shaped by tectonic and geomorphic processes, and how the region provides life-support resources to people, geoscience education amplifies the sense of place for its inhabitants and outside world alike.

The Sense of Place in Geoscience Education

PBE and the "sense of place education" (SOPE) programs have gained much attention and popularity in recent decades. Although they are not full-fledged mainstream programs in schools and colleges, teachers and education programmers have found it useful to incorporate elements of PBE and SOPE in their curriculums. Moreover, several case studies of geoscience PBE among the native peoples in the USA are available; these include cases in the Navajo Nation, Arizona (Semken and Morgan, 1997; Dubiel et al., 1997; Semken, 2005); Native American tribes of the Great Plains (Palmer et al., 2009); Myaamia tribe of Oklahoma (McCoy et al., 2011), Flathead Indian Reservation in Montana (Johnson et al., 2014), Crow Indian Reservation (Cohn et al., 2014), and native Hawaiians (Gibson and Puniwai, 2006; Lemus et al., 2014).

There is a huge (and growing) volume of literature available on the theory, methodologies and case evaluation of PBE, and geoscience teachers will find much practical information from these sources (e.g., Smith and Gruenewald, 2014; Demarest, 2014; Anderson, 2017; Yamamur and Kotch, 2018; Langran and DeWitt, 2020). The Orion Society has been a supporter of PBE that focuses on the natural environment. They have published several seminal studies (under the Natural Literary Series), including *Stories in the Land: A Place-Based Environmental Anthology* (1998), *Beyond Ecophobia: Reclaiming the Heart in Nature Education* (1999), *Into the Field: A Guide to Locally Focused Teaching* (1999), and *Place-Based Education: Connecting, Classrooms and Communities* (2004, 2005). In 2014, the *Journal of Geoscience Education* published by the US National Association of Geoscience Teachers, brought out two special issues on "Teaching Geoscience in the

Context of Culture and Place" (volume 62, issues 1 and 2). PBE and SOPE offer new pedagogical tools in geoscience education.

References

Altman, I., and Low, S.M., eds. (1992) *Place Attachment*. New York: Plenum Press, 314 p.

Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., and Wittrock, M.C. (2001) *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman, 352 p.

Anderson, S.K. (2017) *Bringing School to Life: Place-Based Education Across the Curriculum*. Lanham, MD: Rowman & Littlefield Publishers, 200 p.

Cohn, T.C., Swanson, E., Whiteman Runs Him, G., Hugs, D., Stevens, L., and Flamm, D. (2014) Placing ourselves on a digital Earth: Sense of place geoscience education in Crow country. *Journal of Geoscience Education*, 62: 203–216.

Demarest, A.B. (2014) *Place-Based Curriculum Design: Exceeding Standards through Local Investigations*. Abingdon-on-Thames: Routledge, 172 p.

Deringer, S.A. (1997) Mindful place-based education: mapping the literature. *Journal of Experimental Education*, 40 (4): 333-346.

Dubiel, R. F., Hasiotis, S. T., and Semken, S. C. (1997) Hands-on geology for Navajo Nation teachers. *Journal of Geoscience Education*, 45: 113-116.

Edler, J. (1998) Stories in the Land: A Place-Based Incremental Education Anthology. Great Barrington, MA: The Orion Society, 127 p.

Feld, S., and Basso, K.H., eds. (1996) *Senses of Place*. Santa Fé, New Mexico: School of American Research Press, 293 p.

Gibson, B.A., and Puniwai, N. (2006) Developing an archetype for integrating Native Hawaiian traditional knowledge with Earth system science education. *Journal of Geoscience Education*, 54:287–294.

Gruenewald, D.A. (2003) Foundations of place: a multidisciplinary framework for place conscious education. *American Educational Research Journal*, 40: 619-654.

Heise, U.K. (2008) *Sense of Place and Sense of Planet: The Environmental Imagination of the Global*. Oxford University Press, 264 p.

Johnson, A.N., Sievert, R., Durglo, M., Finley, V., Adams, L., and Hofmann, M.H. (2014) Indigenous knowledge and geoscience on the Flathead Indian Reservation, northwest Montana: Implications for place-based and culturally congruent education. *Journal of Geoscience Education*, 62:187–202.

Kirkby, K. C. (2014). Place in the city: Place-based learning in a large urban undergraduate geoscience program. *Journal of Geoscience Education*, 62(2): 177-186.

Langran, E., and DeWitt, J. (2020) *Navigating Place-Based Learning: Mapping for a Better World*. London: Palgrave Macmillan, 182 p.

Lemus, J.D., Seraphin, K.D., Coopersmith, A., and Correa, C.K.V. (2014) Infusing traditional knowledge and ways of knowing into science communication courses at the University of Hawaiʻi. *Journal of Geoscience Education*, 62: 5–10.

Lippard, L.R. (1997) The Lure of the Local: Senses of Place in a Multicentered Society. New York, New Press, 325 p.

Marshak, S. (2022) Earth: Portrait of a Planet, 7th ed. New York: W.W. Norton, 1040 p.

McCoy, T., Ironstrack, G., Baldwin, D., Strack, A.J., and Olm, W. (2011) *Asiihkiwi neehi kiisikwi myaamionki: Earth and sky, the place of the Myaamiaki*. Miami, OK: Miami Tribe of Oklahoma, 87 p.

Miele, E.A., and Powell, W.G. (2010) Science and the city: Community cultural and natural resources at the core of a place-based science teacher preparation program. *Journal of College Science Teaching*, 40:40–44.

Murray, J. (1997) Ethnogeology and its implications for the aboriginal geoscience curriculum: *Journal of Geoscience Education*, 45: 117-121.

Palmer, M.H., Elmore, R.D., Watson, M.J., Kloesel, K., and Palmer, K. (2009) Xoa:dau to Maunkaui: Integrating indigenous knowledge into an undergraduate Earth systems science course. *Journal of Geoscience Education*, 57:137-144.

Powell, W. (2011) City-as-lab: Place-based education at the heart of an urban geoscience curriculum. *In the Trenches*, 1: 5–6.

Reynolds, S., and Johnson, J. (2018) Exploring Earth Science, 3rd ed. New York: McGraw-Hill, 736 p.

Russell-Ciardi, M. (2016) Place-based education in an urban environment. *Museum International*, 58(3): 71-77.

Ryden, K.C. (1993) *Mapping the Invisible Landscape: Folklore, Writing, and the Sense of Place*. Iowa City, University of Iowa Press, 326 p.

Schama, S. (1995) *Landscape and Memory*. New York, Vintage Books, 652 p.

Semken, S. (2005). Sense of place and place-based introductory geoscience teaching for American Indian and Alaska Native undergraduates. *Journal of Geoscience Education*, 53(2), 149-157.

Semken, S. C., and Morgan, F. (1997). Navajo pedagogy and Earth systems. *Journal of Geoscience Education*, 45: 109-112.

Semken, S., and Freeman, C. B. (2008). Sense of place in the practice and assessment of place-based science teaching. *Science Education*, 92(6): 1042-1057.

Semken, S., Ward, E. G., Moosavi, S., & Chinn, P. W. (2017). Place-based education in geoscience: Theory, research, practice, and assessment. *Journal of Geoscience Education*, 65(4): 542-562.

Smith, G.A., and Gruenewald, D.A. (eds.) (2014) Place-based Education in the Global Age: Local Diversity. Abingdon-on-Thames: Routledge, 408 p.

Smith, S. (2015). A sense of place: Place, culture and tourism. *Tourism Recreation Research*, 40 (2): 220-233.

Sobel, D. (2004) *Place-Based Education: Connecting Classrooms and Communities. Great Barrington*, Massachusetts, The Orion Society, 109 p.

Sorkhabi, R. (2023) All geology is regional geology: Case-based education in geoscience. *The Professional Geologist*, 60 (2): 58-61.

Stedman, R C. (2003) Is it really just a social construction?: The contribution of the physical environment to sense of place. *Society & Natural Resources* 16 (8): 671-685.

Tarbuck, E.J., Lutgens, F.K., and Tasa, D.G. (2019) Earth: An Introduction to Physical Geology, 13th ed. New York: Pearson, 784 p.

Tuan, Y-F. (1977) Space and Place: *The Perspective of Experience*. Minneapolis: University of Minnesota Press, 235 p.

Ward, E. M. G., Semken, S., and Libarkin, J. C. (2014). The design of place-based, culturally informed geoscience assessment. *Journal of Geoscience Education*, 62(1): 86-103.

Yamamura, E.K., and Kotch, K. (2018) *Place-Based Community Engagement in Higher Education: A Strategy to Transform Universities and Communities*. Sterling, VA: Stylus Publishing, 176 p.

Three of the Many Benefits of Staying an AIPG Member

Brigitte Petras, ECP-0851

What keeps AIPG members interested after 60 years and counting? AIPG has many resources and opportunities, especially for students and early career professionals, and some may not truly realize what is available. As the environmental and energy landscape evolves, it's important to be aware of the great resources accessible to folks. In this digital age, it can be hard to decipher the significant resources that are out there, so I have compiled some of the many benefits that AIPG provides below.

National Networking Opportunities with a Variety of Geologists

As a student, I didn't realize how great it is to connect with other geoscience professionals until I attended my first quarterly meeting with the AIPG Ohio Section. Not only was the technical talk inspiring but meeting other geologists and learning what they do in their everyday jobs was truly eye-opening as a new geology student. Even as I attend conferences and meetings today, I am still so inspired by learning more about our profession and our professionals. Here are some additional benefits of AIPG networking:

- ✓ Listen to insightful talks and webinars
- ✓ Gain professional support and guidance
- ✓ Obtain visibility
- ✓ Invite opportunities
- ✓ Inspire creative thinking
- ✓ Create long-lasting professional relationships

Professional Development

Developing yourself as a professional can be furthered through professional organizations such as AIPG. Some of these opportunities include the following: AIPG's Student Early Career Professional Webinars (which will continue in the Fall), sharing project results in state or national meetings, serving as a technical session chair (email me if you're interested in chairing at the 2023 National Meeting), or serving on a section or national committee. AIPG also offers the CPG credential, and guidelines and tips on how to achieve geology certifications and licensures. The AIPG Mentorship program also enables professional development for both mentors and mentees (and you can sign up today!). Additionally, the Geoscience Online Learning Initiative (GOLI) by the American Geosciences Institute, started in cooperation with AIPG, has online courses for geologists.

Other Technical Opportunities

AIPG's Lunch and Earn Webinar Series provides hour-long continuing education opportunities for AIPG members (and non-members). Besides these opportunities, other technical opportunities include attending AIPG conferences and field trips. These conferences involve environmental geology, hydrogeology, economic geology, and so much more. These technical opportunities can expand current knowledge of a field of geology and could also help others transition into a different field through the range of technical breadth that AIPG members have. Refer to the Members Only resource page on our website to see past technical webinars.

Overall, AIPG is a scientific community of many different geologists that have been dedicated to advocating for the profession of geology and continue to provide spectacular resources for students and early career professionals. Take advantage of AIPG's opportunities to advance and enhance your career!

Brigitte with AIPG National President Dawn Garcia in Tucson after presenting at the University of Arizona.

Trip to the Crater of Diamonds State Park

Murfreesboro, Arkansas

Allan R. Blaske, CPG-10529

Editors Note: This article was originally published in the January 2021 edition of Geologically Speaking, the Michigan Section publication.

Introduction

What does a geologist do when stuck in northeast Texas for a work assignment with nothing to do? You find something geologically interesting to explore! Unfortunately, northeast Texas does not offer anything of geologic interest (sorry, but it is true!). I found myself in this situation in November 2020 and knew exactly where I was going to spend my day off. I have always wanted to visit this location but have never been to this part of the United States. It is not really on the way to anything, but since I was within a three-hour drive, I figured I might not ever be any closer.

You have probably heard the stories on the news about someone finding a diamond at an Arkansas park. Every few years someone finds a large one and the story makes a brief appearance on a national news outlet. Most recently, in September 2020, a 9-carat brown diamond was found, the size of a small marble!

The Crater of Diamonds State Park is located in southwest Arkansas, just to the southeast of the town of Murfreesboro, Pike County, in Arkansas (Figure 1). The park is the world's only diamond-bearing site open to the public. For $10, you can dig for diamonds – and keep what you find! The park is located approximately 40 miles north of interstate highway 30, 60 to the northeast of Texarkana, Arkansas, and approximately 100 miles southwest of Little Rock, Arkansas (Figure 2). The park features a 37.5-acre plowed field where you can search for diamonds. The park is over 900 acres, and other amenities include a visitor center, diamond discovery center, walking trails, picnic sites, a campground, gift shop, café, and even a water park (Figure 3). At the visitor center, you can view real diamonds found in the park and interact with exhibits illustrating the area's unique history and geology. At the Diamond Discovery Center, you can learn more about rocks and minerals found at the park and how to search for diamonds using various techniques. Park staff provide identification of rocks and minerals found at the park, as well as diamond mining demonstrations and other interpretive programs.

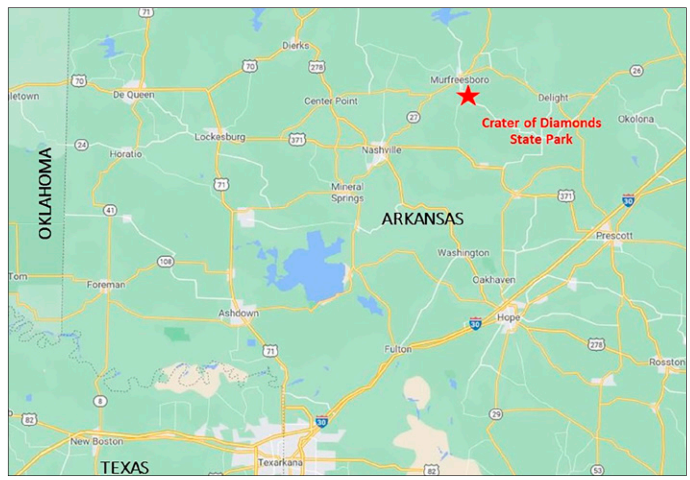


Figure 2. Location of Murfreesboro and Crater of Diamonds State Park. (modified from Google maps).

Figure 1. Sign at Entrance to Crater of Diamonds State Park.

History

The first diamond was found in 1906 by John Huddleston, a farmer who owned a portion of the diamond-bearing crater at that time. Soon after the first diamond was found, a "diamond rush" created a boomtown atmosphere around Murfreesboro. After 1906, several attempts at commercial diamond mining failed. The only significant yields came from the original surface layer, where erosion over a long period of time had

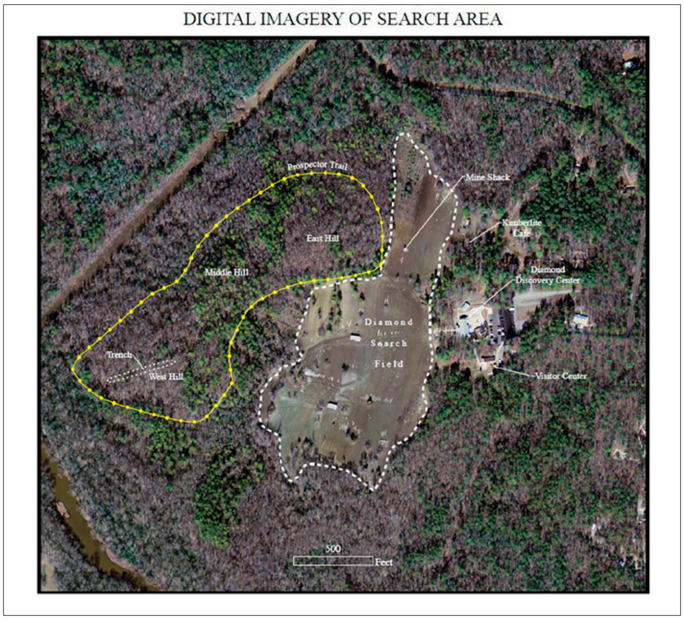


Figure 3. Aerial view of Crater of Diamonds State Park.
(From Hanson, W. D., Howard, J. M., and Clardy, B. F., 2007).

concentrated diamonds. During the Second World War, the U.S. government took over the mine and granted a contract to extract diamonds. Diamonds were found, but the mine was not successful. From 1951 to 1972, the crater hosted several private tourist attractions. In 1972 the property was sold to the State of Arkansas for $750,000. The tourist operation continued as the centerpiece of Crater of Diamonds State Park. In the 1990s, a consortium of diamond companies was allowed exploration rights at the park, but studies indicated that the deposit is sub-economic. Figure 4 shows a historic mine shaft structure from previous operations.

Geology

Crater of Diamonds State Park is just south of the Ouachita Mountains and along the northern margin of the West Gulf Coastal Plain. The oldest rock unit in the area surrounding the park is the Pennsylvanian-age Jackfork Sandstone. The sandstone beds dip steeply to the south. Overlying

Figure 4. Historic mine shaft building from the Ozark Diamond Mine in the diamond search field.

the sandstone are Cretaceous sedimentary rocks, including limestones with some shale, sandstone, and gypsum. They represent sediments that were deposited in shallow water on the northern margin of the Cretaceous seas. These rocks dip gently to the south and have been eroded by local rivers and streams. Figure 5 is a geologic map of the area around the park.

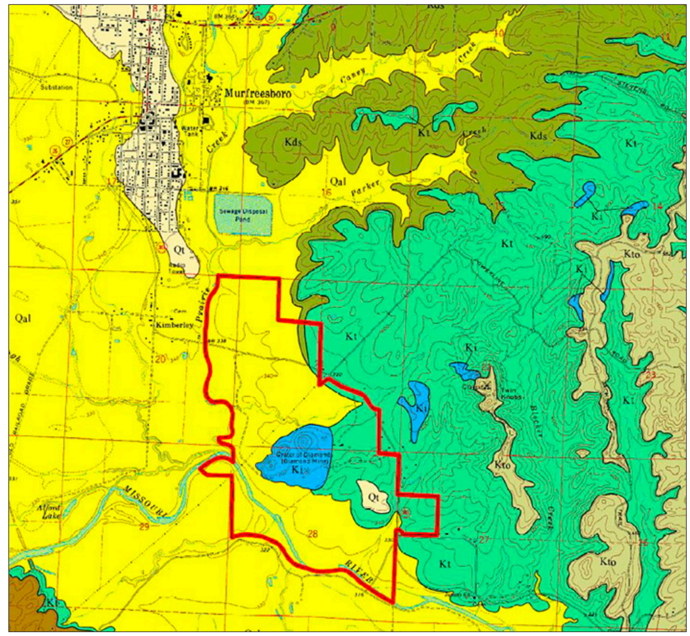


Figure 5. Geologic map. State park outlined in red. Lamproite diatreme bodies are represented in blue. Green colors represent Cretaceous sedimentary rocks, and yellow is quaternary alluvium.
(modified from Hanson, W. D., Howard, J. M., and Clardy, B. F., 2007).

Along the coastal margin, about 100 million years ago, several explosive volcanic eruptions occurred, resulting in the emplacement of diamond-bearing rocks known as the Prairie Creek Diatreme. Other, smaller diatremes of similar origin and composition are present in the area surrounding park.

The rock within the diatreme is a lamproite. Lamproite is an ultrapotassic and somewhat aluminum-poor mantle-derived volcanic rock, which includes forsteritic olivine, phlogopite, richterite, leucite, sanidine, diopside, and a variety of rare potassium-, barium-, titanium-, and zirconium-rich oxides and silicates. Lamproites form from partially melted mantle at depths greater than 93 miles. The volcanic eruption brought xenoliths and xenocryst diamonds from the peridotite or eclogite mantle regions where diamonds form.

The lamproite within the Prairie Creek Diatreme have been divided into several rock types, based on textural and depositional differences. These include magmatic lamproite, pyroclastic lamproite, and maar epiclastics. Figures 6a and 6b are a map and cross section of the diatreme.

The magmatic lamproite was originally termed peridotite by early investigators and later hypabyssal olivine lamproite and pyroxene (diopside) madupitic lamproite by recent workers. The rock is a magmatic non-explosive phase material. The rock consists of crystals and crystal fragments of olivine, in various stages of alteration to serpentine, set in a fine matrix of poikilitic phlogopite, diopside, magnetite, and perovskite. Magmatic lamproite may contain xenoliths of rocks from the

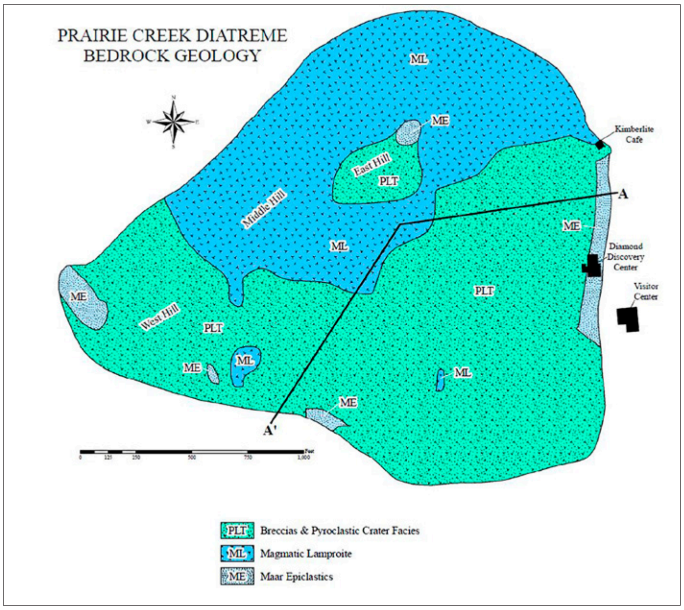


Figure 6a. Plan map of the lamproite diatreme, showing various volcanic units.
(From Hanson, W. D., Howard, J. M., and Clardy, B. F., 2007).

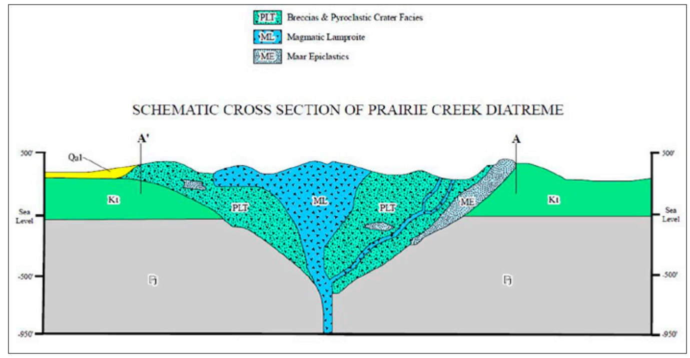


Figure 6b. Cross-sectional representation of the lamproite diatreme, showing various volcanic units.
(From Hanson, W. D., Howard, J. M., and Clardy, B. F., 2007).

mantle and crust, brought along by its rapid movement to the earth's surface. The magmatic lamproite contains only very few micro-diamonds.

The pyroclastic lamproite was originally termed kimberlite by early workers simply because it contained diamonds. Pyroclastic lamproite is further subdivided into two field identifiable types: lamproite lapilli tuff and lamproite breccia tuff. These units are the source of the diamonds now found in the soil. These rocks weather rapidly because most of the minerals composing them formed at great depth and are unstable at surface temperatures and pressures. The weathered material (now soil) is a gray to green-gray clay. The lamproite lapilli tuff is fine-grained ash that was formed by the initial explosion and settled as air fall material. Phlogopite mica is present in all samples, often a major component. The lamproite breccia tuff is composed of fragments of lamproite and other rocks that were both shattered during rapid transport to the surface and the initial near surface explosive emplacement event. Olivine was a major component, now mostly altered to serpentine. Some breccia fragments of lamproite still contain glassy olivine crystals, only having marginal alteration. In hand specimen, the rock is dark brownish with scattered yellow, tan, or whitish spots of serpentine after olivine set in a fine-grained matrix.

The maar epiclastic rocks were originally described as quartz-bearing tuffs. They formed by admixture of uncemented Cretaceous sands and clays with the lamproite lapilli and breccia tuff units.

Diamonds

Diamonds originated in the mantle as part of the early formation and crystallization of the earth and were brought to the surface by the explosive eruption of the lamproite. Mineral inclusions within the diamonds indicate an age of approximately three billion years. The formation of the pipe itself has been dated from local stratigraphy as upper Early Cretaceous (approximately 106 million years). Most diamonds found at the park have suffered some dissolution by the lamproite matrix and transporting fluids, and perhaps even breakage and dissolution effects. This is due to the fact that diamonds are not stable at pressures and temperatures other than those in the mantle where they formed. The lamproite body is uneconomical for large-scale mining. However, the rocks within the diatreme have been weathered to a depth of 40 feet or more, and this weathering has somewhat concentrated the diamonds in the upper portions of the pipe (now soil), where they can be found by visitors to the park.

Searching for Diamonds

More than 33,000 diamonds have been found by park visitors since the Crater of Diamonds became a state park in 1972, including the 40.23-carat Uncle Sam, the largest diamond ever unearthed in the U.S. This equates to more than 600 finds per year. Most diamonds found are the size of a match head, or about 0.2 carats. Diamonds found in the park are generally white, brown, and yellow (Figure 7). The search area is plowed periodically to help loosen the surface soil and promote diamond finds (Figure 8).

Figure 7. Diamonds from Crater of Diamonds State Park. Yes, these were found in the park! Diamonds found at the park and historic displays can be seen at the Visitor Center.
(Photo from Crater of Diamonds State Park website).

Figure 8. Diamond search field. Note the furrowed surface from periodic plowing, and the washing pavilion in the center distance. Hopeful diamond seekers already searching!

Several techniques can be used to locate diamonds. Some people slowly wander the plowed surface, searching for diamonds laying on the surface. This technique works best after the field has been plowed and after recent rains. Searchers look in low areas and small ravines where gravel accumulates after rains.

Screen sets are available for rental at the park, or you can purchase from private vendors outside the park or bring your own. I brought my own double-screen setup – an upper screen (1/4-inch mesh) to remove large rocks, debris, and maybe a huge diamond, and a lower screen (window screen) to wash the gravel. You can bring also shovels, pails, wagons, and other tools, but no power tools are allowed. Many people also use a saruca, a small, round screen used to concentrate the heavy minerals.

Some use the dry screening technique, where you simply sift soil from the field through your screen set. Most people, however, use the wet screening technique. The park contains two pavilions which contain water-filled troughs and tables. You simply dig up material from the field, and screen it through your screen set, using the water to remove the fine silt and clay soil. With the proper technique, gravel can be washed and graded in the lower screen so that the heavier mineral grains are concentrated to the center of the screen. The screen is then flipped onto a table, and if lucky, a diamond will be in the center of the gravel pile (Figure 9). If you were not lucky enough to find a diamond in your screened gravel, you can take up to five gallons of screened material home with you so that you can continue your search.

Where do you dig to find a diamond within the 37 ½ -acre search field? It is completely random! There are makers in the field where large, historic diamonds have been found. But previous finds are no indication of future finds. Because the surface material in the field is deeply weathered bedrock and has been repeatedly plowed, the diamonds are randomly distributed through the field. Some search for areas with more abundant gravel which has been washed by rainwater, but others dig holes several feet deep, thinking that "this is the spot"! The only predictor of success is a lot of hard work (dig and screen lots of material) and a good bit of luck!

Figure 9. Screened and washed gravel. Are there any diamonds in here?

Conclusion

It was a perfect fall day (sunny and 70 degrees). Unfortunately, I did not find a diamond during my brief visit (about five hours) to the park (and no one sifting around me did either). But I sifted about a dozen buckets of soil and brought home about four gallons of sifted gravel to continue the search! (I just know there is a diamond in there somewhere!). I learned something new about the unique lamproite rocks which originated in the mantle (how cool is that?!), crossed something off my bucket list, and had a great time! I highly suggest a visit if you are ever in this part of the United States!

References

Hanson, W. D., Howard, J. M., and Clardy, B. F., 2007, Geology of the Crater of Diamonds State Park and Vicinity, Geologic Map State Park Series, DGM-SPS-003, Arkansas Geological Survey

Howard, J. M. and Hanson, W. D., 2008, Geology of the Crater of Diamonds State Park and Vicinity, Pike County Arkansas; Arkansas Geological Survey, State Park Series 03 (SPS-03)

Crater of Diamonds State Park Website: https://www.arkansasstateparks.com/parks/crater-diamonds-state-park

Crater of Diamonds State Park Wikipedia Website: https://en.wikipedia.org/wiki/Crater_of_Diamonds_State_Park

Ancient Concretions Support Plants at Lake Shore

Paul F. Hudak, Department of Geography and the Environment, University of North Texas

Introduction

Found in sedimentary rock formations, concretions are often misinterpreted as fossils or meteorites. Concretions form inside sediment shortly after deposition, as minerals precipitate from solution, sometimes as successive layers around a nucleus such as a granule, plant remnant, or small shell (Todd, 1903). Curved bedding planes form as concretions grow within and compacting sediment around them. Fully developed concretions take on various shapes, from semi-spherical to highly irregular, and vary in size from microscopic to more than a meter (Todd, 1903). Others have noted the role of concretions in preserving fossils and separating fluid reservoirs (Marshall and Pirrie, 2013). This study documents the capability of weathered concretions to help support new plant life.

Study Area and Observations

Numerous concretions were observed in the eroding surface of the Upper Cretaceous Woodbine Formation at the northeastern shore of Lewisville Lake in north-central Texas. The study area is located about 18 km east of Denton, Texas near U.S. Highway 380 (Figure 1). Lewisville Lake supplies water to local municipalities, while also providing storage for flood control and supporting various types of recreation.

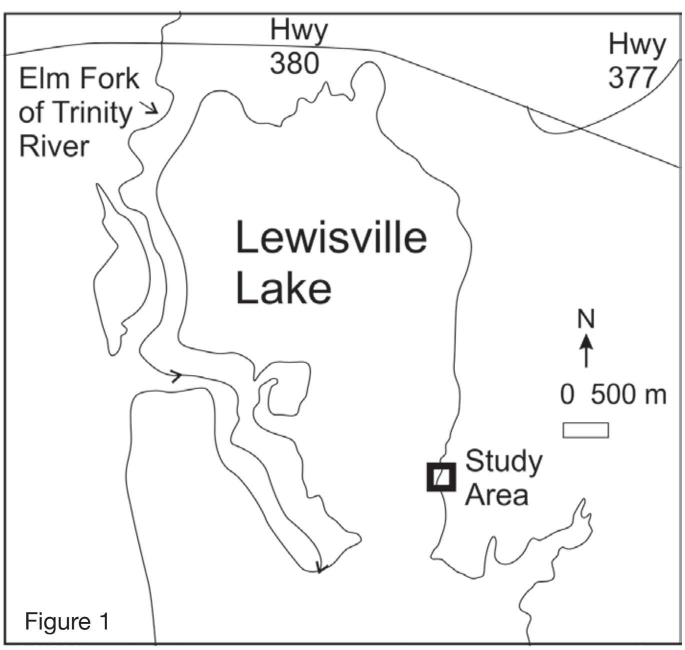


Figure 1

The Woodbine Formation consists of ferruginous sand, sandstone, clay, and shale, with scattered and discontinuous seams of lignite, gypsum, and volcanic ash, deposited in a deltaic setting (Winton, 1925). Friable sandstone and clay are predominant constituents of the Woodbine in the study area. A thin blanket of terrace deposits comprising sand, gravel, and clay overlies the Woodbine in the area. Waves have extensively eroded and reworked the terrace deposits.

Woodbine concretions formed as sediment accumulated in an organic-rich, deltaic swamp that covered the study area approximately 100 million years ago (Winton, 1925). In this oxygen-deficient environment, bacteria altered iron to precipitate siderite at a rock-biofilm boundary (Wells, 2000). Thereafter, groundwater and weathering altered siderite to precipitate hematite and goethite; these minerals and quartz are now widespread in the concretions (Wells, 2000). Mineral replacement, accompanied by volume reduction, shrinkage, and dissolution, formed the hollow space found inside many concretions today.

Typically, concretions are harder and more resistant to weathering than surrounding rock, thus protruding outward in eroding outcrops (Marshall and Pirrie, 2013). In the exposed Woodbine Formation, concretions often form small hummocks, between which sediment and moisture accumulate to nurture seeds and support plants (Figure 2). Sediment and water also


Figure 2

accumulate within broken concretions, typically within spaces between adjacent concentric layers, to further support plant growth (Figure 3). Protected from wind, micro-environments


Figure 3

within and between concretions are ideal for seed germination. Still cemented, bowl-shaped layers within concretions delay infiltration, thereby making water available to plant seeds and seedlings. Eventually, roots propagate through cracks inside concretions, or into sediment between concretions, and anchor into more stable underlying sand and clay (Figure 4).


Figure 4

For example, concretion micro-environments have supported extensive buttonbush (*Cephalanthus occidentalis L.*) in the study area. Mature shrubs in the area range up to 16 cm in diameter and 3.4 m in height. Often used to stabilize shorelines, buttonbush is remarkably resilient to wind and wave action (Figure 5). Dense root masses bind sediment to slow denudation and unwanted lake sedimentation. When leaves are present in the spring, summer, and fall, button bush canopies absorb and dissipate wind energy to help protect land behind them.

Buttonbush typically blooms from June through September and produces fruit in September and October (Wennerberg, 2004). In the fall, the button-shaped fruit dries out and scatters its seeds, some of which germinate to form new shrubs. In addition to stabilizing the shoreline, buttonbush provides


Figure 5

food and habitat for various birds, deer, and insects (LBJWC, 2023). Buttonbush provides nectar to bees, butterflies, moths, and hummingbirds (Wennerberg, 2004), while also serving as larval host to various moths (Wheeler, 2017).

Conclusion

Often underappreciated, Woodbine concretions are yet intriguing in their intricate forms and the wonder they inspire. Their journey commences in dark, saturated subterranean environments and ends on weathered land. When revealed, concretions tell us about the geologic past, in addition to harboring plants that support terrestrial ecosystems.

References

LBJWC (Lady Bird Johnson Wildflower Center). 2023. Plant Database. Lady Bird Johnson Wildflower Center, Austin, Texas. Available from: https://www.wildflower.org/plants/result.php?id_plant=ceoc2

Marshall, J. D. and Pirrie, D. 2013. Carbonate concretions—explained. Geology Today, 29(2), 53-62.

Todd, J. E. 1903. Concretions and their geological effects. *Bulletin of the Geological Society of America*, 14, 353-368.

Wells, S. 2000. Iron Concretion Formation and Diagenesis in the Upper Cretaceous Woodbine Formation of North-Central Texas. M.S. Thesis. University of Texas at Arlington, Arlington, Texas.

Wennerberg, S. 2004. Common Buttonbush (*Cephalanthus occidentalis L.*). Natural Resources Conservation Service, United States Department of Agriculture. Available from: https://plants.usda.gov/DocumentLibrary/plantguide/pdf/pg_ceoc2.pdf

Wheeler, J. 2017. Planting for Pollinators: Buttonbush. Xerces Society for Invertebrate Conservation, Portland, Oregon. Available from: https://xerces.org/blog/planting-for-pollinators-button-bush#:~:text=In%20addition%20to%20its%20attractiveness,walnut%20moth%20(Citheronia%20regalis)

Winton, W. M. 1925. The Geology of Denton County. Bureau of Economic Geology, University of Texas, Bulletin 2544, 1-114.

Foundation of the AIPG

Annual Silent Auction

Annual Meeting Welcome Reception
Radisson Hotel Cincinnati Riverfront
Sunday, September 17, 2023
6:00 – 8:30 pm

The Foundation of the American Institute of Professional Geologists will hold a silent auction at the AIPG annual meeting Welcome Reception on Sunday, September 17th starting at 6 pm at the conference headquarters hotel in Covington, KY. We hope you will consider a donation to the silent auction to raise funds in support of the Foundation for AIPG programs, scholarships, internships, and various initiatives. We also encourage you to consider bidding on items at the auction. Additional information and donation forms are provided on the AIPG web site: aipg.org/foundation.

Please contact Mike Lawless or Larry Weber, trustees of the Foundation, if you have any questions about the silent auction, or to advise them of donated items being sent in advance:

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Mike Lawless

Michael D. Lawless, CPG, PG
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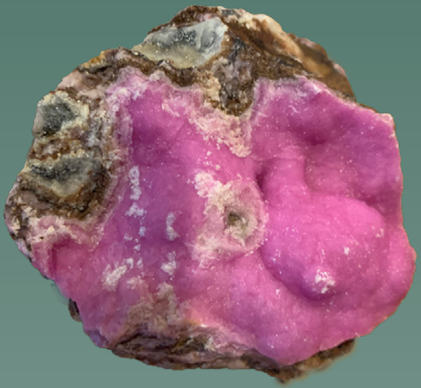

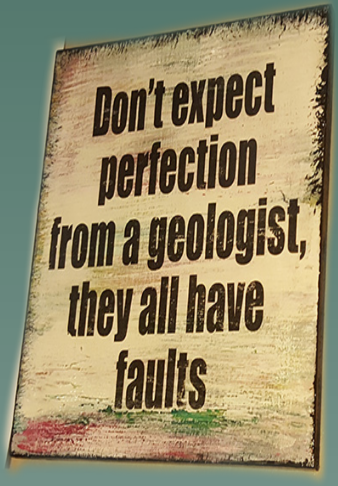

Example previous silent auction items.

AIPG MEMBERSHIP TOTALS		
	As of 5/2/2022	5/1/2023
CPG/Active	2,252	2,152
CPG Emeritus Member	596	610
Honorary Member	18	19
Professional Member	695	710
Professional Member/Non-Practicing	45	45
Early Career Professional	206	208
Associate Member	44	46
Student Adjunct	925	866
TOTALS	**4,781**	**4,656**

Comments on proposed rule: Modernization of Property Disclosures for Mining Registrants

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

Critical Minerals

As technology continues to advance, the need for critical minerals to support these advances grows. What approaches and techniques are used in the exploration, mining, and processing of critical minerals? Are there new technologies used in these activities? How will geoscientists be involved in the future and what will their role be? AIPG is seeking articles about critical minerals including advancements in technology for which the minerals are needed and the efforts taken to locate, extract, and process them. Please send your article to me at aipg@aipg.org

Adam Heft, CPG-10265, *Editor*

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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JAN.FEB.MAR. - November 1, 2023

APR.MAY.JUN. - February 1, 2023

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