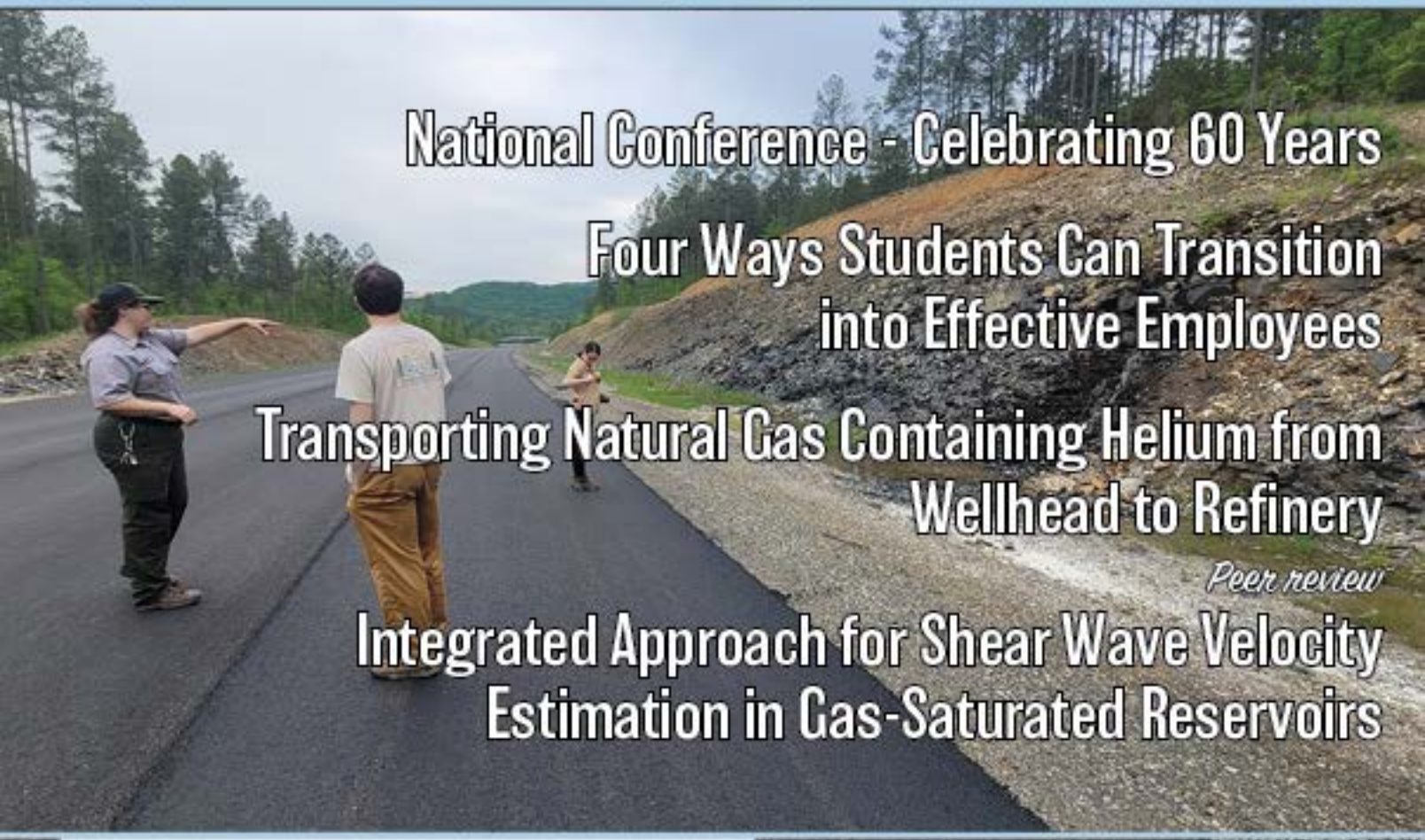
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THE PROFESSIONAL GEOLOGIST

VOLUME 60 NUMBER 2 STUDENT EDITION APR.MAY.JUN 2023



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On the Cover: 2022 Photo Contest Environmental Impact Winner: *Western Michigan University's Geology club observes an anthropogenic disconnect in the recharge zone of Hot Springs National Park. The most important resource within Hot Springs National Park is its water, which penetrates deep into the earth via highly fractured, porous, sedimentary rock. Equally important, are the recharge zones within the area that direct and funnel water into the spring system. In this image, we see how shale within the recharge zone serves as a conduit for flow. A break in this conduit results in a decrease of water flowing to the Hot Springs. This new road cut, through the Arkansas Novaculite formation, was created by the Arkansas Department of Transportation (ADOT) to connect U.S. Highway 70 and State Highways 5 and 7. The Arkansas Novaculite formation consists of novaculite, shale, and chert formed during the Devonian. It's easy to look at an image like this and place the blame on ADOT. The story is much more convoluted; it represents the importance of communication and serves as a direct result of a disconnect in communication.*

Photo taken by: Donovan Vitale, SA-11158, Michigan Section, Western Michigan University Student Chapter.

AIPG National Executive Committee

PRESIDENT - Dawn Garcia, CPG
Stantec
O: (520) 545-7603, Arizona Section
dawnhgarciacpg@gmail.com

PRESIDENT-ELECT - Shanna Schmitt, CPG
Minnesota Pollution Control Agency
O: (651) 757-2697, Minnesota Section
shanna.schmitt@state.mn.us

PAST PRESIDENT - Matthew J. Rhoades, CPG
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rhoadesgeo1@gmail.com

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SECRETARY - John Sorrell, CPG
Sorrell Consulting, LLC
O: (312) 288-3823, New Mexico Section
geodejohn@gmail.com

TREASURER - Mark Schaaf, CPG
Kleinfelder
O: (410) 850-0785, Capitol Section
mschaaf@kleinfelder.com

EDITOR - Adam W. Heft, CPG
WSP
O: (517) 886-7400, Michigan Section
adam.heft@wsp.com

EARLY CAREER PROFESSIONAL - Brigitte Petras, ECP
Battelle Memorial Institute
O: (330) 559-1812, Ohio Section
petras@battelle.org

ADVISORY BOARD REPRESENTATIVES

Robert Andrews, CPG
City of Columbus - Department of Public Utilities
O: (614) 645-3227, Ohio Section
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William Brab, CPG
AST Environmental, Inc.
O: (859) 846-4900, Kentucky Section
billbrab@gmail.com

Andrew Jones, MEM
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O: (502) 471-7553, Colorado Section
andrew.jones.geo@gmail.com

Mehmet Pehlivan, MEM
Delta Group
O: (714) 719-6854, California Section
mpehlivan@yahoo.com

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

EXECUTIVE DIRECTOR - Aaron W. Johnson, MEM - awj@aipg.org
ASSISTANT DIRECTOR - Wendy J. Davidson - wjd@aipg.org
PROFESSIONAL SERVICES MGR - Cathy L. Duran - cld@aipg.org
MEMBERSHIP SERVICES MGR - Dorothy K. Combs- dkc@aipg.org
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OFFICE ASSISTANT - Kathy Glivar - officeadmin2@aipg.org
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AIPG Publication Policy, October 4, 2010. AIPG encourages submission of articles and editorials for publication in *TPG* on topics related to the science and profession of geology. Submittals shall be of interest to the members of AIPG, other professional geologists, and others interested in the earth sciences. Articles and editorials may be noted as follows at the discretion of the Editor, "The opinions, positions and conclusions presented herein are those of the author and do not necessarily reflect the opinions, positions or conclusions of the American Institute of Professional Geologists." All materials submitted for publication, including author opinions contained therein, shall include accurate and appropriate references. The Editor has the authority to solicit, edit, accept, or reject articles and editorials and other written material for publication. The Executive Committee has the authority if it so chooses to act on any particular case to support or overrule actions of the Editor regarding the solicitation, editing, acceptance, or rejection of any particular article, editorial, or other written material for publication.

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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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What Makes a Professional?

Adam W. Heft, CPG-10265

Hello fellow Professionals! I hope everyone had a great Holiday season, and now that 2022 is in the rearview mirror you are looking forward to a new season of projects, or if you are enjoying retirement, awaiting your next trip or visit with family and friends.

This year, the Apr/May/Jun edition of *TPG* is the Student Edition, and it is packed full of articles written by and/or for, students. Dig through this edition to find the little gems hidden inside. Our peer-review article by **Joshua Ademilola, SA-11421**, a graduate student, is on Shear Wave Estimation in Gas Saturated Reservoirs; be sure to check it out! **Robert Carvalho, CPG-10588**, provides a piece on Four Ways Students Can Transition into Effective Employees. Although this edition is the Student Edition, please note that students are welcome (and encouraged!) to submit articles at any time. Doing so is a great way to show your prospective employers your writing skills and your motivation to go above and beyond what is expected of you as a student; doing so may well help land you your top job choice.

Ok; I have a bit of a confession to make. My last column indicated that this Student Edition would also include the student scholarship essays. I got a bit ahead of myself there because those are included in the *NEXT* edition, not this one. Consequently, I made the decision that next year we'll move the Student Edition back one more issue to become the Jul/Aug/Sep edition which will include the essays. I'm hoping that we'll have enough articles by and for students for that issue that it will truly be the Student Edition.

This edition also includes the long-awaited 60th Anniversary National Conference information. Start planning to attend now; there are a lot of activities for individuals in all fields of geology. You are also welcome to attend the National Executive Committee meeting and see how the organization's leadership works. Perhaps you will decide after attending that you would like to become involved in the governance of our organization. Showing up and meeting others is a first step. And speaking of which, election information for our candidates is also included in this edition – be sure to read their statements and **VOTE** for your candidate of choice for each of the positions.

So, what makes a professional? There are a number of different definitions that come up when you search online for what constitutes a professional. The accaglobal.com definition says that "to most people, acting like a professional means working and behaving in such a way that others think of them as competent, reliable and respectful." Mindtools.com lists eight characteristics of professionalism, which include: competence, knowledge, conscientiousness, integrity, respect, emotional intelligence, appropriateness, and confidence; two of these, along with ethics, form the triad upon which AIPG is based. A History of AIPG 1963-2003 defines a professional geologist on page 10 as "A person qualified to apply the principles of geology or its subdivisions to economic, industrial or engineering problems, by having high standards of training, experience and personal integrity."

Something that many of us have found is that for people (or companies) to take us seriously or be considered a professional, one needs to have initials behind their name. Doctors have M.D., engineers have P.E., lawyers have J.D., and so on, while we geologists have P.G., LPG, RG, or CPG. Some specialties of geoscientist have other initials, but it amounts to the same idea.

Back in the early 1960s, most geologists had no professional recognition, but other professions had long since established theirs. As a result, our profession was left behind, and others, particularly engineers, were written into laws allowing them to do work that geologists were better qualified to do, but were not recognized as professionals. AIPG was formed to help rectify this situation, although many states have since enacted licensure required for geologists to practice in those states.

> **"Certification by AIPG on the other hand, specifically requires in addition to competence and knowledge, integrity and ethics as well. "**

But does holding a professional geologist license in a particular state make that individual a professional? Looking back at the list of characteristics that defines a professional, one could contend the answer to the question is "no". The only characteristics that licensure ensures is competence, and by extension, knowledge. Certification by AIPG on the other hand, specifically requires in addition to competence and knowledge,

Continued on p. 9

Not The Whole Story

The Kids

The article "Geoscience Education and Energy Transition" which appeared in the October-November-December 2022 issue of *The Professional Geologist* does not address what needs to be done to make geology/earth science (geology) a part of grade school education, nor what needs to be done in order to make the general public aware of the roles that geologists play in the functioning of nations around the world, commerce, public health, public welfare and the environment.

First, professional geologists and teachers specializing in geology or earth science need to get together in a conference dedicated to geology education and attend workshops which focus on how geology can be presented to students at various grade levels. A concise curriculum and plan of instruction would need to be drawn up which can be presented to local school administrators, local politicians, and state politicians. The curriculum and plan would have to be in language that a non-scientist can understand and would have to contain, at the very least, the five above roles that involve geologists and the teaching of geology in an academic fashion (the knowledge of the science). The curriculum and plan should be crafted in the form of a bill – some type of permanent educational legislation. The bill would go through the usual political approval process which may take years, but this is the path we must follow in order to establish geology as a permanent part of any curriculum.

The teaching of geology should follow the stepped method of teaching computer science. Just as teachers of computer science first start by introducing children to the various pieces of computer hardware, geology teachers would start by performing show and tell and explaining what a rock is, what is sand and what are mountains, et cetera. Yes, the children of this age are not too young to learn at least this much information – you should have seen how a two-and-a-half-year-old I know played games on her dad's smart phone once he turned it on. Following this introduction in preschool or kindergarten, instruction for increasingly higher grades should be accompanied by the introduction of more information of increasing complexity and additional geologic concepts (e.g. geologic time, mountain building, continental drift, evolution of life). Finally, by the time the student completes twelfth grade, he or she should have a reasonable understanding of the roles of a geologist/earth scientist and can continue their education in an informal fashion or go on to major in geology.

One issue that the reader is probably aware of is how to install geology in a grade school curriculum when, at least in high school, the average college bound student is scheduled to take one year each of general science, biology, chemistry, and physics. My solution is to make general science a half year course and to have it followed by geology in the spring semester. In college, physical geology is usually a one semester course, as is historical geology. It is tough to squeeze so much information into one semester, but this may be the best solution for geology instruction. Otherwise, the administration of the school system, the teachers' union, school boards and parent associations may not be able to grasp how to accommodate this extra item of required education. Incorporating geology into grades one to six and junior high school curriculums could follow the same half year schedule. However, the lower grades typically do not include full years of science, but, instead, concentrate on the "three Rs" (reading, writing and arithmetic). Given this situation, it may be easier to schedule geology instruction as lower grade school curriculums are less structured.

Getting the geology legislation passed may seem like a near impossibility, but there exists a possible source of assistance in this matter. This is the body of professional engineers and engineering educators. If we were to get them "on board" I believe it would benefit geology education. How would we do this? Specifically, we would involve the various engineering societies and organizations and work with them to get a general engineering curriculum included in the pre-school and grade school curriculums. General engineering would constitute a half year program which would follow a half year program for physics. One course prepares the student for the other. Would general engineering be taught to preschoolers and kindergarten students? It already is! Kids play with Lego blocks, wooden block sets and construction vehicles in sand boxes.

Challenges exist for implementing the geology curriculum. One very large one is that the number of available trained teachers seems to be shrinking. This has resulted in schools cutting back on the number of courses they will teach. Also, compared to non-science teachers, science teachers comprise only a small part of the teaching staff nationwide. How this compares to teaching systems in other countries is unknown to the writer. Though, in many other countries, science and engineering seem to be traditionally included in grade school curriculums to some extent. Another issue is whether local school systems have enough money to hire qualified science teachers. Budgets are always tight and school systems will usually ensure that at least the basic courses are taught. Lastly, the cooperation of politicians is problematic. Catering to voters with an agenda, the occurrence of election years, political alliances, availability of funding and a sense of "If I do this for you, what's in it for me?" get in the way of passing any legislation.

Another challenge is incorporating geology in the STEM programs that are popular in the more advanced grade school instruction schedules. I have yet to come across a STEM program that introduces students to other sciences (e.g., geology, meteorology, oceanography, biochemistry). Again, persistent geology advocacy is necessary for success. Informative presentations must be made to those individuals in each school system who have either the authority and/or control the money for funding the various curriculums. This requires a very coordinated effort and careful planning with the help of fellow geologists.

The Adults

Following the above, we should turn our attention to how we can educate the adult public. This is an educational environment without a concrete format. Worse than that, each adult is completely free to choose or not choose to become scientifically educated – or at least made aware of the various subjects. It's like being in a greased pig wrestling contest. Just when you think you have their attention, they slip away.

The challenge exists not just with adults who have stopped their education after graduating high school, but also with

college educated individuals who have never had an interest in science. Doctors, dentists, and optometrists are exceptions, but their training is very focused and so they do not come into contact with geological information. So how do you educate a group of people who are distracted by family life, community events, work, interpersonal relationships of all natures, personal finances, personal health, and the struggle to get by day to day?

There is no single solution which will work for everyone – I'm sure the reader is aware of this. Aside from the above distractions, you are considering people of widely varying incomes, ethnic backgrounds, living standards, social habits, community associations, residence locations (rural, suburban, urban), daily personal energy levels and more. However, if you focus on these issues, your brain will fry and smoke will come out of your ears! You are also making the challenge much more difficult than it needs to be. What you should do is look for the common denominator – human behavior. One should use common sense and tailor the geological presentation to the specific group.

When it comes to human behavior, we are fortunate to be scientists. This is because we will need to conduct research regarding who we are about to present to. What are their likes, dislikes, flashpoint subjects, education level, attention span, are they attending a larger event and just want to be entertained or do they want to relax and not have to think about anything serious? You do not want to present evolution to a religiously conservative community. Not only will the audience become hostile, but the bible thumping preacher will consider you a threat to his authority and sabotage your earnest intellectual endeavors. You also have to know what will attract an audience. The successful presenter is not just an educator, but also a salesperson. Some salespeople I have encountered throughout my life are too pushy or too animated in their presentations. Geology requires a more nuanced approach. One should look approachable (a familiar manner of dress accompanied by mannerisms that are also familiar to the targeted group), show a small smile when looked at, maybe say hello and do not act like you are trying to sell someone something (even though that is the idea). It is better to let the person come to you rather than you approach them. This is less threatening given your position as a stranger. If you are attending an open school administrator meeting, teachers' or parents' conference or a local meeting, then setting up a booth might be the right idea.

If you have been to a large geological conference, then you already know what a booth should look like. The ideal geology booth should be colorful, but not in a fashion that might mislead the viewer into thinking you represent another group or organization. Colors are attractive and make the booth stand out. Posters explaining briefly what geology is about are helpful. Sometimes what is written on a poster makes the viewer think a little and results in questions they wish to ask about geology (a trick to get them to approach you). Once they arrive at the booth, that is the time to introduce yourself, your purpose for being at the meeting and providing information in a congenial manner. You can even answer the questions they have!

Make sure to have simple, but informative pamphlets on hand to give out. Also, show the school principal, parent, or teacher some examples of the latest versions of age-appropriate geology textbooks. Let them sit down with one and skim through it. Hopefully, the person is interested in having geology taught in their school. Ask them what they think of geology as part of the school curriculum. Offer your business card with an email address that you are willing to share. (What? You do not have a business card? Shame on you! Go out and spend a little money and buy a sleeve of 100 cards or more.) Network with school administrators, teachers, and parents. Find out when and where other meetings will take place and attend all of them. Granted this is a lot of work. Maybe get other geologists you know to help out.

Alternative methods of spreading geologic information include television, the computer, and the smart phone. Many people collapse in front of the television after work and rely on this infamous machine to supply them with all of the "true" information their laziness requires – a really bad idea and I am sure there are many readers who do the same. The better public programs are the documentaries. Documentaries are well received by the public, are shown regularly on the public television channels, and are streamed on the computer and the smart phone, though I think the smart phone format is too small to have a significant emotional impact. These formats are as convenient and lazy as it gets. All of the sources can be viewed very passively in the comfort of wherever you are. Also, televisions are everywhere there is electricity, but paying for reception in poor mountainous areas such as Appalachia is a problem.

Documentaries are not cheap to make. They also have to be marketed to public television channels, broad band providers and streaming services. Therein lies a mine field of concerns regarding the content that may become part of a geology documentary. One must be aware that getting a documentarian to produce the program and getting a broadcast channel, broadband provider or streaming service to accept the film may be difficult, if not impossible, when factual information regarding climate change, fossil fuel exploration and use, mining and animal status (think animals that have been deemed by environmental activists as possibly becoming extinct) are included. If someone objects to just one little item in the project, then this can permanently cancel every effort to make the documentary. However, this is subject for another article.

So, documentaries are expensive. They are also very effective at presenting information to a wide viewing audience. This is all the more reason to try this approach for making geology a known subject. The expense could be managed by including a number of geological associations and institutions as partners in the production of a series of films which would present geological information in the form of one educational module per film. How many films would be in the series? This would have to be worked out, but it could not be too many as the audience will lose interest with information overload. A working group of geologists would have to develop (flesh out) each module. Once this plan is on paper, then it would have to be presented to the owner/president of a documentary film producing company. If he or she accepts the project, then the hard work begins to more fully develop the ideas that were put on paper by the working group. Producing a documentary is, as in the words of the famous producer Ken Burns, the act of telling a story. The work involved in writing this story, filming, editing, rewriting and so forth is too complex to present here. Suffice it to say that it would be at least several years until

the final iteration of the film series would be completed and ready for viewing by the public.

I can only say that this may be the only real way for geology to be made a part of the educational culture of America. Even if students do become educated by attending approved geology courses in grade school, it would be many years until they would reach a point of some understanding of the subject and are familiar with the roles of geologists. By and large, geologists seem to be a reserved group of individuals, as most scientists are. We do not typically seek fame and fortune, but just desire to continue with our daily lives. The public can see biology around them in the form of the animals and plants that intersect their lives. Chemistry is obvious to them in the form of the drugs they take and the goods they buy and bake. Meteorology presents itself as the weather that surrounds us each day. Though physics is hard to recognize in the daily lives of ordinary citizens. However, geology, I have to say, is even more obscure. We fill up our cars everyday with gasoline or diesel fuel, burn fuel oil to keep warm and burn gas for cooking and heating, but the public never makes the connection that these substances were once crude oil and natural gas that came from deep in the ground!

As a closing comment, let me state the following. Geology includes the study of climate cycles, natural air, water and soil pollution, the formation of metal deposits, the formation of coal, oil and natural gas, natural cycles of extinction, gases exhausted by volcanoes, weather changes brought on by the sun's varying luminosity, volcanic eruptions, and Milankovitch cycles, naturally varying atmospheric carbon dioxide concentrations and more. In the age of wokism (hyper political correctness), many individuals in positions of power and authority, the media and those on the editorial boards of journals and publication companies adhere to the idea of anthropogenic global warming (climate change). They greatly influence others such as teachers, parents, and the general public. As such, few individuals dare step outside the approved agenda for fear of retribution, either as a loss of their job and income or for fear of being ostracized.

Therein lies the problem with teaching geology to students or the public. You cannot teach geology without teaching the above special subjects. Geologists cannot acquiesce to others and exclude the subspecialities that are not "approved." However, one risks fierce protests, retribution, civil disobedience that disrupts teaching, being fired (even if you just express that you do not adhere to the climate change religion), serious threatening via social media and by phone and angry people showing up where you live. Free speech is being threatened worldwide. It seems to be particularly bad in America, Great Britain, most of Europe and Australia – at least from what I have read. I used to work for a state environmental agency in a supervisory position and the people around me knew that I did not believe in anthropogenic global warming. However, I was careful not to get into loud and extended arguments!

Too much time has passed without advocating broadly for our profession and so geology has languished in obscurity. It is partly our fault due to our inaction. Something has to change!

Raphael Ketani, PG, CPG-9003

Sunnyside, NY

To the Editor:

In the January edition of the *TPG*, Peter Dohms expressed his skepticism about the "Ruling Theory of Anthropogenic Warming", because "climate activists" may have not considered alternative hypotheses. I laud Mr. Dohms skepticism, but my initial response is to question whether alternative hypotheses have already been considered and subsequently rejected, not by activists, but by the research community? The answer to that is yes.

Has Mr. Dohms considered that research published by government agencies such as NOAA, and NASA, as well as in peer-reviewed journals, are not being authored by alarmists, but by scientists who are simply presenting the analyses of data they have collected? It's a question I addressed at length in a *TPG* op-ed I wrote 15 years ago (Koenigsberg, 2008). My observation then was that it was the latter, not the former. That view has not changed.

Predictions of anthropogenic greenhouse gas (GHG) induced warming are not new. Svante Arrhenius (Arrhenius, 1896) predicted it 127 years ago, based on data far more sparse than available today. Modern research and observations support Arrhenius's predictions, given that GHG concentrations today are at levels not seen since the Pliocene and increasing at a rate much faster than occurred during the runup to the Paleocene Eocene Thermal Maximum 56 million years ago (McInerney and Wing, 2011).

Scientific theories represent the best explanation for the facts as we know them today. Good theories have testable predictions. Modern climatologists, many of whom started out their careers as geologists, have made predictions which are now observable phenomena, such as the melting of major ice sheets (Alley, 2000) and increasing strength of hurricanes (Knutson et al, 2010).

The only thing they got wrong is the speed with which these predictions are becoming reality.

Andrew Koenigsberg, PG, CPG-7973

References:

Alley, Richard (2000), "The Two Mile Time Machine", Princeton University Press, Princeton, NJ.

Arrhenius, Svante (1896). "On the influence of carbonic acid in the air upon the temperature of the ground". *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Scienc*e. 41 (251): 237–276. https://doi.org/10.1080/14786449608620846.

Koenigsberg, Andrew (2008), "Discussion of Anthropogenic Climate Change in Recent Issues of *TPG*", *The Professional Geologist*, Volume 45, Number 5.

Thank you Brigitte Petras and *TPG* Editor Adam Heft for the January-February-March 2023 *TPG* article on *Legacy Lead (Pb) In Urban Soils: An Ongoing Source of Exposure.*

I have a footnote to add concerning lead in our communities. General aviation continues to make extensive use of piston-engine aircraft (PEA), the majority of which have been using leaded aviation gas all along, their operators and owners having been granted, decades ago, an exception from environmental and public health regulations prohibiting the use of leaded gas.

Leaded aviation gas is a significant source of lead here in the U.S. The U.S. EPA reports that "In 2017, approximately 470 tons of lead were emitted by engines in piston-powered aircraft (PEA), which constituted 70 percent of the annual emissions of lead to air in that year. Lead is emitted at and near thousands of airports..." (Federal Register, 2022).

Over the past several years, I have developed an increasing awareness, together with a public and environmental health concern regarding PEA lead emissions. When one has lived near an airport, in my case the Cherry Capitol airport in Traverse City, that hosts one or more flight school operations, one cannot avoid PEA noise, which is a proxy for lead emissions. In the case of the Cherry Capitol Airport, the primary source of lead emissions is from the State of Michigan's Northwestern Michigan College's (NMC) flight school. I thus developed a personal awareness for PEA lead emissions and the associated exposures, and I assembled my own set of information pertinent to NMC's flight school PEA operations and leaded aviation gas use.

NMC has a fleet of piston-engine-aircraft that mainly conduct touch-and-go flight operations (circuits), which number in the thousands per year, over the eastern portions of Traverse City. These touch-and-go circuits consist of takeoff, gaining minimal requisite elevation and circling back to the airport, landing, and then repeat. The plane may not even stop on the runway depending on air traffic conditions at the airport - hence the term touch-and-go. In the course of a given day, there could be three planes at a time, and hundreds of operations. These repetitive flight patterns are generally, but not entirely, over areas of Traverse City that offer affordable housing, which takes the associated lead exposures into the realm of an environmental injustice.

Touch-and-go flights take place in fair-weather, low-wind-speed low-elevation (generally less than 1,000-1,500 ft) conditions, with higher throttle settings. The relatively low flight elevations during the touch-and-go circuit result in emissions below the elevations where significant atmospheric mixing would normally occur.

During the entirety of these piston-engine aircraft operations, touch-and-go or otherwise, fine particulate lead, roughly 10 nanometers in size, is being emitted to the atmosphere (Griffith, 2020). These extremely small lead particles, considerably smaller than the lead particulates associated with automotive combustion of leaded gasoline, are especially problematic for children due to their relatively high rate of respiration, and the relative ease with which such small particles, once inhaled, can enter their bloodstreams, brains, organs and bones.

In the case of NMC, these emissions and the associated surreptitious, invisible, tasteless, odorless lead exposures have been ongoing for nearly 55 years. In the past, higher lead levels were used in aviation gas. Today, 100LL (meaning 100 octane, "low-lead") aviation gas is the norm. However, LL is a descriptor that conceals the fact that 100LL contains 0.56 grams of lead per liter.

In 2019, NMC used nearly 65,000 gallons of 100LL. This translates to approximately 300 lbs/yr of lead emissions, or approximately 16,000 lbs over the past 55 years. The vast majority of this lead has likely been emitted in repeated flight paths over residential areas, including several schools, one with programs for autistic children.

There is considerable evidence (Zahran et al., 2017) that, for a group of Michigan airports, including Cherry Capitol Airport, near-airport children's blood lead levels are elevated over what they would otherwise be. Zahran et al. (2022) recently presented similar findings for the Reid-Hillview airport in Santa Clara County, California, stating that:

Across an ensemble of tests, we find that the blood lead levels (BLLs) of sampled children increase in proximity to RHV, are higher among children east and predominantly downwind of the airport and increase with the volume of PEA traffic and quantities of avgas sold at the airport. The BLLs of airport-proximate children are especially responsive to an increase in PEA traffic, increasing by about 0.72 μg/dL under periods of maximum PEA traffic.

Additional perspective is provided by two studies that addressed air quality using modeling and field air lead measurements completed by the Town of Middleton, Wisconsin, and concerning a similar general aviation airport setting: Middleton Wisconsin Municipal Airport – Morey Field (C29) Field.

The first is a March 18, 2022, air quality modeling study by Trinity Consultants of the Morey Field vicinity. This Town of Middleton-funded study yielded estimates, based on the widely accepted and widely used EPA air quality modeling software AERMOD, of the maximum monthly ambient air quality lead concentrations (mass per unit volume) at ground level associated with PEA operations at the airport. The second is a companion September 15, 2022, Town of Middleton-funded field lead investigation study by Trinity Consultants. The field air sampling results for lead demonstrated and documented a good agreement between the AERMOD simulation results and actual ground level ambient air lead concentrations measured in the field.

Also, the Town of Middleton arranged for a USGS groundwater quality study, including measurement of lead isotopic ratios. Preliminary results (Town of Middleton, 2022) show that lead in groundwater samples from six near-airport residential water supply wells have lead isotopic ratios very similar to the lead isotopic ratio of the 100LL aviation gas sold at Morey Field.

There is no question of the linkages between PEA lead emissions, ground level lead exposures, and near-airport children's blood lead levels. The studies that have been done and published have application to thousands of general aviation settings across the U.S. It is not necessary to replicate these studies at each and every general aviation setting where leaded aviation gas has been used for decades and continues to be used. The geospatial scale of the impact is staggering, as is the magnitude of the public health impact, as is the economic cost – as determined by Zahran et al. (2013). From a public health perspective, the bottom line on lead exposure from the Centers for Disease Control (CDC) is that: "No safe blood lead level in children has been identified. Even low levels of lead in blood have been shown to negatively affect a child's intelligence, ability to pay attention, and academic achievement." (https://www.cdc.gov/nceh/lead/prevention/health-effects.htm, accessed January 11, 2023).

Of great relevance to this matter of aviation-lead impacts on public and environmental health is the historic role of the geologist Clair Patterson, who some may know for his pioneering role, with George Tilton, in developing the uranium-lead dating method. Patterson encountered environmentally-related lead contamination in the 1940's and he went on to develop expertise in lead sources related to anthropogenic, activities. He campaigned for several decades against the lead poisoning that resulted from human releases of lead, principally from leaded gasoline combustion in internal combustion engines, into the environment. Patterson was vilified, blacklisted, and ostracized but he persisted and eventually, as a direct result of his dedicated efforts and the contributions of others, lead was phased out of gasoline used in cars and trucks. Note that general aviation piston-engine aircraft were exempted from that action and extensive use of leaded aviation gas continued and continues at the present time. See Gary Arndt's *How Lead Was Discovered to Be in Everything* (https://everything-everywhere.com/how-lead-was-discovered-to-be-in-everything/.

There is cause for guarded optimism as the EPA on October 17, 2022, published (Federal Register, 2022) Proposed Rules and opened a 90-day public comment period for its *Proposed Rule: Proposed Finding that Lead Emissions from Aircraft Engines that Operate on Leaded Fuel Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare*. Optimism is guarded because the general aviation sector "captured" the federal regulatory system as concerns leaded fuel use, lead emissions and the associated lead exposures decades ago and to this day still thwart's our regulatory system's ability to protect public and environmental health from degradation by piston-engine aircraft lead emissions and the associated lead exposures.

Charlie Schlinger, Ph.D., R.G., P.E., CPG-09554
Michigan

References

Federal Register, 2022, Vol. 87, No. 199, Monday, October 17, 2022, Proposed Rules, pages 62753-62781.

Griffith, J.D., 2020, Electron microscopic characterization of exhaust particles containing lead dibromide beads expelled from aircraft burning leaded gasoline, Atmospheric Pollution Research 11, 1481–1486.

Town of Middleton, WI, 2022a, Screening Level Assessment of Ambient Lead Concentrations Around the Middleton Wisconsin Municipal Airport – Morey Field (C29). https://middleton.civicweb.net/document/43209/.

Town of Middleton, WI, 2022b, Measurement of Ambient Lead Concentrations Around the Middleton Wisconsin Municipal Airport – Morey Field (C29). https://middleton.civicweb.net/document/43210/.

Town of Middleton, Wisconsin, 2022c, December 19, 2022 Town Meeting information, Town of Middleton website, accessed January 23, 2023, https://town.middleton.wi.us/vertical/Sites/%7B97A50AAB-3824-4833-ACEA-EF2B9A14C856%7D/uploads/USGS_Morey_Airport_Presentation.pdf.

Zahran, S., Keyes, C., Lanphear, B., 2022, Leaded aviation gasoline exposure risk and child blood lead levels, PNAS Nexus, Volume 2, Issue 1, pages 1-11. https://doi.org/10.1093/pnasnexus/pgac285.

Zahran, S., Iverson, T., McElmurry, S.P., and Weiler, S., 2017, The Effect of Leaded Aviation Gasoline on Blood Lead in Children, JAERE vol. 6 no. 2, pp. 575-610.

Editor's Note: Our policy is that when a Letter to the Editor is submitted in response to a published article, only one response/rebuttal to that letter will be published. Further responses will not be published and should be sent directly to the author if a debate is desired. As a reminder, articles whose main topic is any aspect of anthropogenic-caused climate change will also not be considered for publication in keeping with the past decision of the Executive Committee.

To the Editor:

The Jan-Mar 2023 Issue of *TPG* (pg. 4) contains a letter by Peter Dohms, CPG-07131 that suggests that the Method of Multiple Working Hypothesis (MMWH) has not been considered with regards to the causes of climate warming. His example of an alternate hypothesis is the fact there were fewer sunspots during the Maunder Minimum when the Little Ice Age occurred. He states that at the present time there is a peak of sun spots and solar flares coinciding with recently observed Northern Hemisphere warming. Peter says he will be skeptic of the Ruling Theory of Anthropogenic Global Warming until such phenomena as the variable radiation from the sun is eliminated as a major cause for the observed warming.

There is considerable on-going research on these topics and in an effort to address the concerns of Peter and others;[1] some results are described here. Concerning solar radiation variation and the recent warmer temperatures, Figure 1 indicates that the solar radiation is only a small part of the increase temperatures.

Some have linked the Little Ice Age and the Maunder Minimum's temporary cooling effect to decreased solar activity, but the Little Ice Age was also likely influenced by volcanic activity and ocean circulation shifts.[2,3]

The greenhouse effect is well proven by physics[4] and the carbon dioxide emissions from fossil fuels and industry has increased to 40 billion metric tons per year or more during the

1. https://en.wikipedia.org/wiki/Climate_change_denial#cite_note-Matthews_153%E2%80%93168-8
2. https://www.swsc-journal.org/articles/swsc/full_html/2017/01/swsc170014/swsc170014.html
3. https://www.science.org/content/article/gulf-stream-slowed-during-little-ice-age
4. https://scied.ucar.edu/learning-zone/how-climate-works/greenhouse-effect

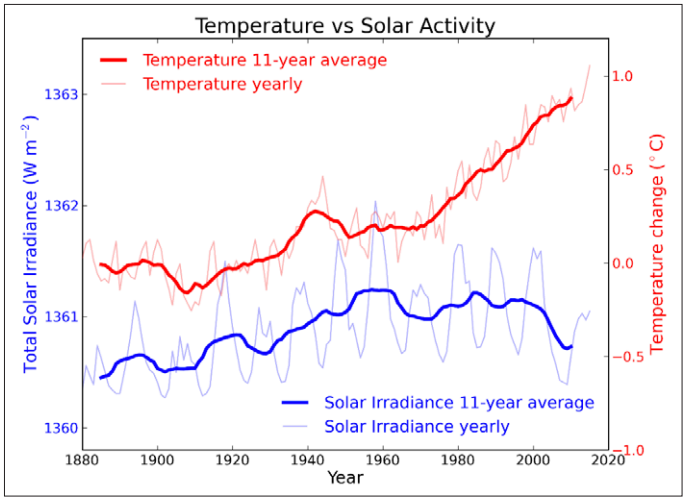


Figure 1. Annual global temperature change (thin light red) with 11 year moving average of temperature (thick dark red). Temperature from NASA GISS. Annual Total Solar Irradiance (thin light blue) with 11 year moving average of TSI (thick dark blue). TSI from 1880 to 1978 from Krivova et al 2007. TSI from 1979 to 2015 from the World Radiation Center (see their PMOD index page for data updates). Plots of the most recent solar irradiance can be found at the Laboratory for Atmospheric and Space Physics LISIRD site. This Figure is from skeptialscience.com/solar-activity-sunspots-globalwarming.htm. A similar figure is at https//climate.nasa.gov with a credit to NASA/JPL-Caltech.

industrial age.[5] Carbon dioxide, a powerful green house gas increased by 50% in the global atmosphere[6] as well as other greenhouse gases.[4]

Many studies suggest that higher amounts of these gases will occur and therefore a much higher greenhouse effect[7] could be reached in the future. Many of us are worried that we are not moving fast enough to reduce these gases and other emissions.[8]

Frederick E. Simms Ph.D., CPG-10292

5. https://ourworldindata.org/emissions-by-fuel
6. https://www.weforum.org/agenda/2021/03/met-office-atmospheric-co2-industrial-levels-environment-climate-change/#:~:text=Carbon%20dioxide%20(CO2)%20in%20the,fuels%20during%20the%20industrial%20revolution.
7. https://public.wmo.int/en/media/press-release/more-bad-news-planet-greenhouse-gas-levels-hit-new-highs
8. https://www.nature.com/articles/d41586-022-00585-7

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Editor's Corner, continued from p. 3

integrity and ethics as well. By extension, and because our certification mandates that we only practice and hold ourselves out to be experts in our specialty field(s), appropriateness also comes into play, as does confidence. Because of this our CPGs are respected by many in and out of their specialty fields; some are renowned nationally and internationally.

There are at least two other characteristics that I think professionals also share. The first is a drive to better oneself and their knowledge of changes to their profession. Learning doesn't stop when you graduate. Someone, somewhere is always pushing the boundaries of what is possible, or discovers something that can be applied to what you do. Knowing the latest advances in technology enables us to better serve our clients or win new clients whose projects were not being well served by those they were working with.

The second is to always keep one's word. Saying you'll do something, but then doing something different (or nothing) is a mark of insincerity, and it doesn't take people long to realize this and decide they cannot rely on you. So always be sure to "walk the talk" in any kind of business dealing.

Those are my thoughts; do you have any other characteristics of a professional you'd add to the list? What do you think?

Dawn Garcia Honored for Building Collaborative Relationship between AIPG and SME



The Society for Mining, Metallurgy & Exploration (SME) president Ronald Parratt (CPG-07616) has recognized Dawn Garcia (CPG-08313) for "her persistence and enthusiasm that were instrumental in establishing a memorandum of understanding between SME and the American Institute of Professional Geologists (AIPG). This agreement establishes a collaborative relationship for programming economic and exploration geology at SME's MINEXCHANGE annual meetings and at the AIPG annual meetings. Garcia's enthusiasm and leadership were critical in bringing this partnership to Fruition." Dawn will receive a SME Presidential Citation during the SME Annual Conference in February 2023. Dawn approached SME with the proposition of collaboration and worked with AIPG and SME while she was president-elect to formalize the agreement and to organize a technical session for the 2023 SME Annual Conference, which she will co-chair with Deanna Wolfe (MEM-3086).

Dawn is a hydrogeologist and licensed professional geologist with more than 35 years of experience. She has worked in characterization, remediation and reclamation projects, and public disclosure reporting. She has visited hundreds of mineral development projects and mining operations.

She has a long history of service to the profession of geology and the mining industry. She has been an invited speaker at workshops, has been a presenter of technical papers at numerous technical conferences, and has taught a short course on mine closure at the University of Guanajuato (Mexico).

She has served as the geologist member of the Arizona Board of Technical Registration by appointment of the governor. She received the Martin Van Couvering Memorial Service to the Institute Award from AIPG in 2021 for distinguished service to the profession of geology. She currently serves as the 2023 president of AIPG. She served on the SME Arizona Conference executive board for over a decade.

Annual National Conference Agenda

Covington, Kentucky

AIPG 2023

September 15-19, 2023

FRIDAY, SEPTEMBER 15	8:00 am - Noon	Environmental Refresher Training - Asbestos Inspector *(additional fee required) Lunch on your own.*
	1:00 pm - 6:00 pm	**Field Trip:** Exploring Ancient Worlds at the Cincinnati Museum of Natural History & Science - Tour led by Museum's Paleontologist and includes OMNIMAX Theatre Future Feature *(additional fee required)*
SATURDAY, SEPTEMBER 16	8:00 am - Noon & 1:00 pm - 5:00 pm	Environmental Refresher Training - Lead Inspector, Asbestos Inspector, OSHA Refreshers *(additional fee required)*
	8:00 am - 4:30 pm	AIPG Executive Committee Business Meeting / AIPG Advisory Committee Meetings
	8:00 am - 5:00 pm	Student & Early Career Professional Workshop & Activities (includes lunch)
	9:00 am - 5:00 pm	Spouse/Guest Field Trips (on your own)
	4:30 pm - 5:30 pm	Foundation of the AIPG Meeting
	5:00 pm - 9:00 pm	Student Welcome Reception, Speed Networking & Trivia Game Night
SUNDAY, SEPTEMBER 17	7:30 am - 5:00 pm	**Field Trip:** Karst Geology of the Mitchell Plateau, South-Central Indiana *(additional fee required)*
	8:00 am - 5:00 pm	**Field Trip:** Significance of Pleistocene Fluvial Systems and Glaciations on the Landscape Evolution of Northern Kentucky *(additional fee required)*
	8:00 am - 5:00 pm	**Field Trip:** Upper Ordovician and Lower Silurian Facies, Cycles, and Sequences in Southern Ohio: A Field Guide and Core Workshop *(additional fee required)*
	10:00 am - 4:00 pm	Exhibitor and Poster Set Up at Hotel
	10:30 am - 2:00 pm	Boat Trip: Dixieland Jazz Brunch Cruise - Foundation of the AIPG Fundraiser *(additional fee required)*
	1:00 am - 5:00 pm	Distillery Visit & Tasting *(on your own)*
	6:30 am - 8:30 pm	Exhibitor Welcome Reception & Foundation Silent Auction
MONDAY, SEPTEMBER 18	7:00 am - 7:50 pm	Section Representative Meeting
	7:00 am - 7:50 pm	Past Presidents Breakfast & Gleaning of Wisdom for Future (by invitation)
	8:00 am - 8:30 pm	Opening Welcomes from 2023 National Officers and Local Dignitaries
	8:00 am - 4:30 pm	**Field Trip:** Industrial Mineral Production and Quarry Operations in Northern Kentucky *(additional fee required)*
	8:00 am - 5:00 pm	**Field Trip:** Exploring the Type Cincinnatian Series (Upper Ordovician) and its World-Famous Fossils at Hueston Woods State Park, Oxford, Ohio *(additional fee required)*
	8:30 am - 10:20 am	State Survey Presentations (IN, OH, KY) '**State Geological Features & Survey Research Findings, Resources, Practical Applications for All States and Nations**'
	10:30 am - 11:40 am	State Survey Panel Discussion - '**How can States Work Together to Solve Current Geoscience Challenges Nationally and Globally**'
	1:30 pm - 3:00 pm	Workshop: **Cultivating a Sense of Belonging - conversations about gender, race, and ethnicity** with Nye Jones, WSP

All events are open to registrants (with the exception of daily registrations). Events with additional fees are noted.

MONDAY, SEPTEMBER 18	1:00 pm - 5:00 pm	Technical Presentations
	6:00 pm - 9:00 pm	Awards Dinner 'Diamonds and Denim' at the Newport Aquarium *(additional fee required)*
TUESDAY, SEPTEMBER 19	8:00 am - 9:00 am	Opening Welcomes - 2024 National Officers & National/International Dignitaries
	8:00 am - 5:00 pm	**Field Trip:** Revisiting the Wisconsin Depositional History of the Southernmost Extent of the Scioto Sublobe, Ohio *(additional fee required)*
	8:00 am - 5:00 pm	**Field Trip:** Organic-Rich Gas Shales and Related Rocks Near the Devonian-Mississippian Boundary, Northeastern Kentucky *(additional fee required)*
	9:00 am - 10:30 am	Panel: **Prioritizing Diversity in the Geosciences, and Why it's Good for Business** - panelists share their experiences led by Nye Jones, WSP
	9:00 am - 5:00 pm	Technical Presentations

All events are open to registrants (with the exception of daily registrations). Events with additional fees are noted.

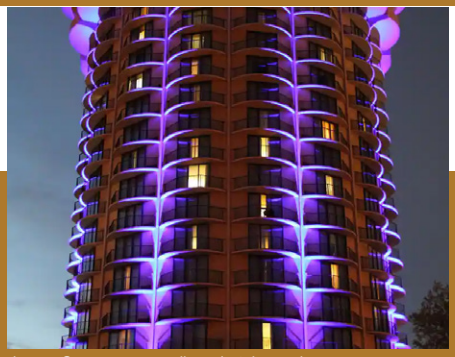


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Field TRIPS

FRIDAY, SEPTEMBER 15

Exploring Ancient Worlds at the Cincinnati Museum of Natural History and Science

Leader: Chris Lilek, CPG
1:00 pm - 6:00 pm

The Museum of Natural History and Science at Cincinnati Museum Center offers a world of science, history and nature through interactive exhibits and amazing artifacts. Guests can reach their own "ah-ha" moment through creative thinking and problem-solving skills. With something for all ages, there's always more to explore in the Museum of Natural History & Science. The tour will be led by the Museum Paleontologist and includes an OMNIMAX Theater Future Feature.



Photo courtesy of the Museum of Natural History and Science.

SUNDAY, SEPTEMBER 17

Karst Geology of the Mitchell Plateau, South-Central Indiana

Leaders: Donald K. Lumm, Ph.D., CPG, Craig McCammack, CPG
7:30 am - 5:00 pm

The Mitchell Plateau is an iconic karst landscape in south-central Indiana developed in Valmeyeran (Middle Mississippian) carbonates. Sinkholes, karst valleys, disappearing streams, and caves are well developed in the region. Field trip stops will include various karst topographic features developed on prime farmland, a road cut of the typical strata, and a guided tour of Marengo Cave, a U.S. National Landmark. Hiking boots are recommended for soft or wet soil.



Crystal Cave, photo courtesy of Marengo Caverns.

Significance of Pleistocene Fluvial Systems and Glaciations on the Landscape Evolution of Northern Kentucky

Leader: William Andrews
8:00 am - 5:00 pm

Attendees will visit various excellent and significant examples of Pleistocene fluvial features and deposits in Boone County, Kentucky. Regional glaciations influenced the development of fluvial, lacustrine, and outwash/drift deposits along the Ohio River and tributaries as the valley developed and evolved through the Quaternary. Anticipated stops include Boone Cliffs State Nature Preserve, Split Rock Conservation Park, and Big Bone Lick State Park. There will be moderate walking on this trip. Wear closed-toe shoes and dress appropriately for the weather.

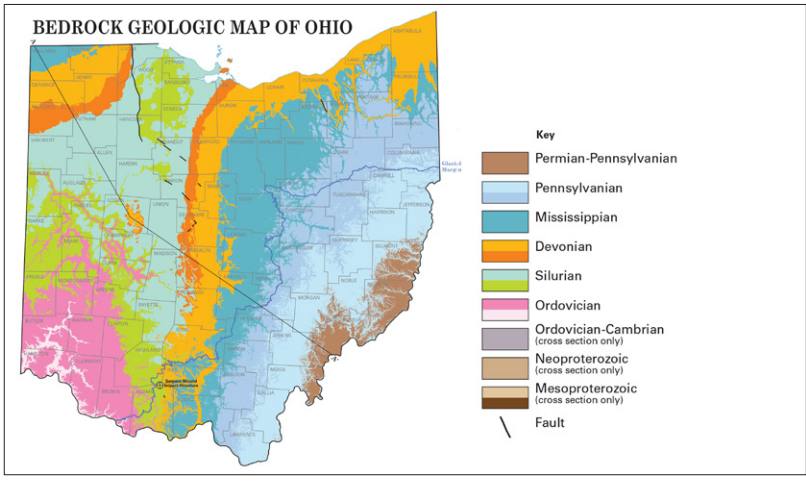


Photo courtesy of William Andrews.

Upper Ordovician and Lower Silurian Facies, Cycles, and Sequences in Southern Ohio: A Field Guide and Core Workshop

Leaders: Dr. Carlton Brett, Christopher B. Waid, Cole Farnam
8:00 am - 5:00 pm

This will be a single-day workshop combining field and subsurface study of new reinterpreted uppermost Ordovician to lower Silurian successions. Facies include gray and red shales, fossiliferous limestones and dolostones, patch reefs, and minor ironstones. The focus is on methodology of correlation and sequence/ paleoenvironmental interpretation in mixed siliciclastic-carbonate successions using litho- and bio-facies, gamma ray logs, and chemostratigraphy. Closed-toe shoes are suggested along with layered clothing for weather changes.



Ohio Division of Geological Survey, 2006, Bedrock geologic map of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map BG-1.

MONDAY, SEPTEMBER 18

Industrial Mineral Production and Quarry Operations in Northern Kentucky

Leader: Donald K. Lumm, Ph.D., CPG
8:00 am - 4:30 pm

Sand and gravel and limestone are the principal industrial mineral commodities produced from active quarries in northern Kentucky, part of the greater Cincinnati region. Participants on this field trip will visit an active sand and gravel quarry developed in Wisconsinan (Quaternary) glacial outwash on the Ohio River, and a limestone quarry developed in the Lexington Limestone (Middle Ordovician). A roadcut(s) of the local Middle and Upper Ordovician bedrock exposed in the region will be reviewed.

Stockpile sample collecting! Bring your hard hat if you can and wear boots.



Sand and gravel are principal industrial minerals.

Exploring the Type Cincinnatian Series (Upper Ordovician) and its World-Famous Fossils at Hueston Woods State Park

Leader: Mark E. Peter
8:00 am - 5:00 pm

Join Ohio Geological Survey paleontologist Mark Peter and Survey geologists for a day trip to view formations of the Richmond Group in the North American type Cincinnatian Series (Upper Ordovician) and collect marine invertebrate fossils at Hueston Woods State Park in College Corner, Ohio. The morning program will include a visit to the Karl E. Limper Geology Museum on the Miami University campus in Oxford, Ohio, where participants will view locally derived specimens of rare and exceptionally well-preserved Cincinnatian fossils. After lunch in the state park, participants will receive an introduction to the local geology and paleontology and will have an opportunity to collect fossils.

Recommend closed-toed shoes, preferably waterproof; sun protection; water; and rain jacket, if appropriate; will be walking on uneven ground in stream exposures.

Limited to 30 participants. Please note that normally, collection of natural objects from Ohio's state parks is prohibited; however, fossils at Hueston Woods are so plentiful that park managers have allowed collecting fossils for personal, non-commercial use (but no collecting is allowed from the nature preserve area).



Photo Courtesy of Mark E. Peter, ODNR Division of Geological Survey.



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Join us on the Dixieland Jazz Brunch River Cruise!
Sunday, September 17, 2023 from 10:30 am - 2:00 pm
This event is a fundraiser for the Foundation of the AIPG.

TUESDAY, SEPTEMBER 19

Revisiting the Wisconsin Depositional History of the Southernmost Extent of the Scioto Sublobe, Ohio

Leaders: Andy Nash, Thomas Valachovics, Tyler Norris
8:00 am - 5:00 pm

This field trip traces the movement of the Scioto Sublobe after the Last Glacial Maximum (LGM) through Clinton and Fayette counties. Field trip participants will view stratigraphic evidence for glacial processes at natural and man-made outcrops. Analytical results from recent mapping projects will be discussed at field trip stops to provide further context to the interpreted glacial history. Wear closed toed shoes for a visit to a limestone quarry. All other necessary PPE will be provided by the Ohio Geological Survey.

Every effort was made to select accessible field trip stops, however some stops require mild to moderate walking.

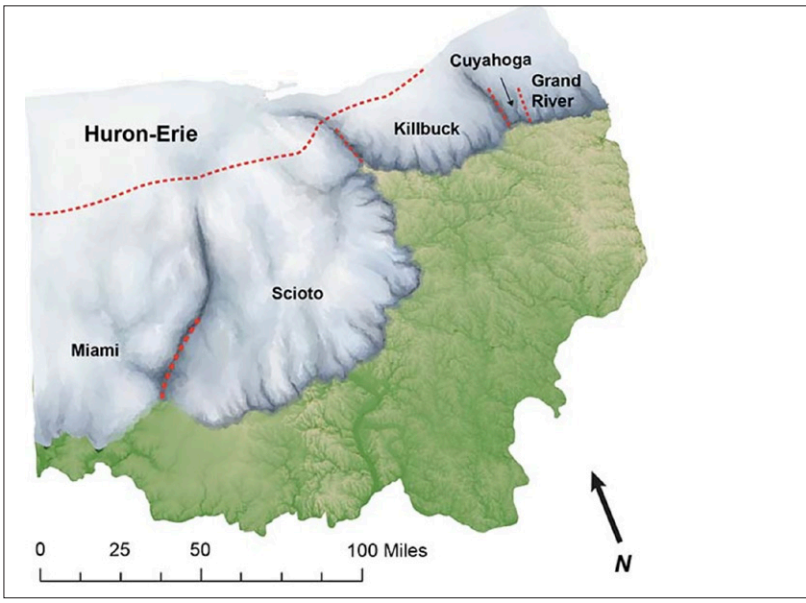


Photo source: Ohio Department of Natural Resources.

Organic-Rich Gas Shales and Related Rocks Near the Devonian-Mississippian Boundary, Northeastern Kentucky

Leaders: Frank R. Ettensohn, CPG, R. Tim Lewis, Charles E. Mason, CPG, Geoff Clayton
8:00 am - 5:00 pm

This trip will examine classic exposures of Devonian-Mississippian, organic-rich, gas shales in northeastern Kentucky, including the Ohio and Sunbury shales, and associated deltaic sediments from the Bedford Shale and Borden Formation. Important stratigraphic intervals, including the Three Lick Bed, Silurian – Devonian boundary, Protosalvinia zone, and Devonian – Mississippian boundary, as well as a Late Devonian dropstone in the upper Ohio Shale, will be examined. Wear layers for variable weather conditions and roadside geology.



Photo courtesy of Frank R. Ettensohn, CPG.

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Four Ways Students Can Transition into Effective Employees

Robert Carvalho, P.G. CPG-10588, CEO/President at EAI, Inc.
https://www.eaienviro.com/

Abstract

Students often leave school with a lot of knowledge but without a clear path to becoming effective and successful employees. This article outlines some of the ways to approach the new job experience in order to excel, learn, and be of great value to your employer for a successful career.

Keywords: Students, recent graduates, employer expectations, advice for recent graduates, career advice, work advice.

So, you've graduated from college and you have all the tools you need for the workplace, right? If you're like most students, the transition from the expectations and daily requirements of school are different than those of your employer. For decades, EAI has hired student interns to support our work in environmental contracting. During that time, we've learned some insights that support our intern's successes, and they've shared tools that have helped them excel in their roles with EAI. Here we'll share the top four tips to help students move successfully into technical careers.

1. Start with Professionalism

Professionalism starts with a great attitude. One of the easiest ways to learn and grow is to listen attentively and take notes so that you can recall important details. Learning to ask critical questions of your manager during meetings is important, but so is learning to find answers to questions and being resourceful. Most managers and CEOs are very busy and have lots of competing priorities they need to attend to. Make your time with them more effective by doing your research and planning beforehand, including preparing a list of questions you have in advance.

2. Be Open to Learning

EAI appreciated student interns Shea Bontempo, project engineer, and Dylan Inguardi, project manager, from Stevens Institute for joining our team in 2022. They provide some insights they learned while on the job.

Shea says designing shop drawings at EAI has allowed him to gain a confident grasp on AutoCAD, how to read and understand blueprints, and a better understanding of the building construction process. He hopes to play his part in cleaning up the planet when he graduates with his master's.



Dylan Inguardi, Project Manager, and
Shea Bontempo, Project Engineer from Stevens Institute.

Continued on p. 24

Developing an Integrated Approach for Shear Wave Velocity Estimation in Gas-Saturated Reservoirs

Ademilola, J.A.*[1], SA-11421; Adeoti, L.[1]; Adeogun, O.Y.[1]; Obafemi, S.[1]; Wei Ren[2], and Yakubu, D.A.[3]

Abstract

Shear wave (S-wave) velocity estimation from Castagna's equation is often inadequate in gas-saturated reservoirs. For example, at our study site examined here (Joshzoic Field, Niger Delta), the calculation of S-wave velocity from Castagna's equation suggests that reservoirs are water-bearing, whereas neutron and density logs indicate that the reservoirs are gas-bearing. As a result, we integrated Fluid Replacement Modeling (FRM) with water saturation (S_W) values from each gas-saturated reservoir in the Joshzoic Field, to properly re-evaluate the S-wave velocity for gas sand. Wireline log signatures were employed to identify hydrocarbon-bearing reservoirs and compute S_W values. FRM and rock physics crossplots were used to re-evaluate S-wave velocity and identify gas-bearing reservoirs. The Poisson's ratios of the three reservoirs calculated from the S-wave derived from Castagna's equation range from 0.30–0.33, indicating that the reservoirs are water-bearing, whereas the neutron and density log signature of the three reservoirs (Sand A, Sand B, and Sand C) analyzed in this study show that the reservoirs are gas-bearing. Further investigation via rock physics crossplots after FRM with the S_W value of each reservoir shows anomalous zones that are plotted away from the wet background trend. The three gas-filled reservoirs are characterized by a high value of P-impedance and Mu-Rho with a low value of V_P/V_S ratio, Poisson's ratio, and Lambda-Rho, suggesting that the reservoirs are saturated with gas (which agrees with the neutron and density log signature). This study demonstrates, by developing a new integrated approach to determine S-wave velocity in gas-saturated reservoirs, the inadequacy of Castagna's equation in evaluating S-wave velocity in gas-bearing reservoirs.

Keywords: Fluid Replacement Modeling, rock physics, Castagna's equation, Lambda-Rho, Poisson's ratio, crossplots, wet trend.

Introduction

Seismic velocity sensitivity to pore pressure, lithofacies, porosity, saturation, and pore fluid type is essential when estimating the transformations from seismic data to rock properties (Avseth *et al.*, 2010). Reflection correlated with porosity, lithology, fluid saturation, and geomechanical parameters can be used for a seismic amplitude inversion (Frazer *et al.*, 2008).

There have been various studies for the evaluation of S-wave velocity by Gassmann, 1951; Pickett, 1963; Domenico, 1984; Castagna *et al.*, 1985; Han, 1989; Krief *et al.*, 1990; Greenberg

1. Department of Geosciences, University of Lagos, Nigeria.
2. College of Forestry, Northwest A&F University, Yangling, China.
3. Department of Urban and Regional Planning, Osun State University, Nigeria.2.

* Corresponding author: joshua.ademilola@yahoo.com

and Castagna, 1992; Murphy *et al.*, 1993; Bastos *et al.*, 1998; Rezaee *et al.*, 2007; Wang and Peng 2019, and Zhang *et al.* 2022, but none of these equations are valid for gas-saturated reservoirs. In reservoir characterization studies for developing oil and gas fields, shear wave velocity often plays a key role. However, some hydrocarbon-bearing reservoirs may lack shear wave velocity information (Rezaee *et al.*, 2007). This can cause limitations in the evaluation of a prospect, and even in the interpretation of seismic data (Rezaee *et al.*, 2007).

In the area of study at the Joshzoic Field, Niger Delta, shear wave velocity information was not acquired. Furthermore, no suitable equation has been found to be adequate for the evaluation of shear wave velocity in the area of study. As a result, Castagna's equation (which is only valid for wet case scenarios) has been used erroneously for the estimation of shear wave velocity in gas-saturated reservoirs. Thus, this paper has developed an approach of integrating Fluid Replacement Modeling (FRM) with a water saturation value from each gas-saturated reservoir in the Joshzoic Field in order to properly predict the S-wave velocity for gas-saturated reservoirs.

Location and Geology of the Study Area

The Niger Delta is located at the Gulf of Guinea within the Niger Delta Province (Klett *et al.*, 1997). The delta has prograded, forming depobelts from the Eocene to the Present. These depobelts are the most active part of the Niger Delta basin (Doust and Omatsola, 1990).

Onshore, the Niger Delta Province includes the geology of southwestern Cameroon and southern Nigeria (Tuttle et al., 1999), as shown in Figure 1. The Benin flank has a hinge line that is trending in the East-Northeast direction at the Southern part of the basement massif of West Africa (Tuttle et al., 1999). The Cameroon volcanic line and the transform-fault passive margin of West Africa define the offshore boundary

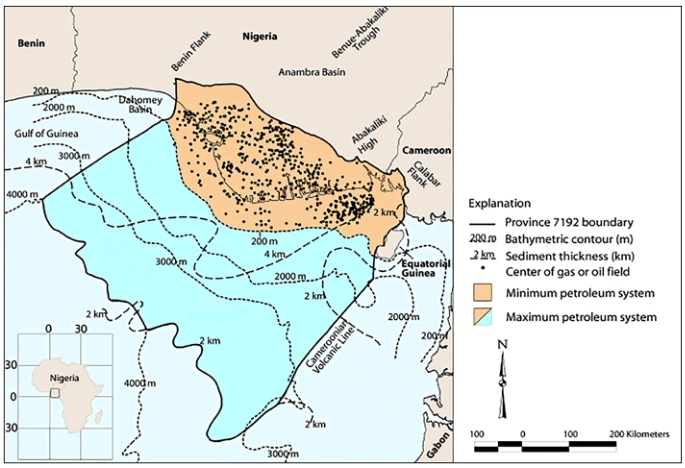


Figure 1. Map of the Niger Delta Province showing structural features. Data from Petroconsultants, 1996 (Tuttle et al., 1999).

to the east and to the west, respectively (Tuttle *et al.*, 1999). The province has an area of about 300,000 km^2. This area includes the petroleum system of the Tertiary Niger Delta (Tuttle *et al.*, 1999).

The Niger Delta is largely identified as a classical shale province (Wu and Bally, 2000), and one of the world's largest regressive deltas (Doust and Omatsola 1990). The modern Niger Delta is classified as a mixture of fluvial deltaic, tidal, and wave depositional systems. Wave action reworked the delta along the coast with channel ridges, back-barrier lagoons, and barrier islands (Avbovbo, 1978).

Previous studies in the Niger Delta by Evamy *et al.* (1978), Ekweozor and Okoye (1980), and Doust and Omatsola (1990) have suggested that the source rock may be the interbedded

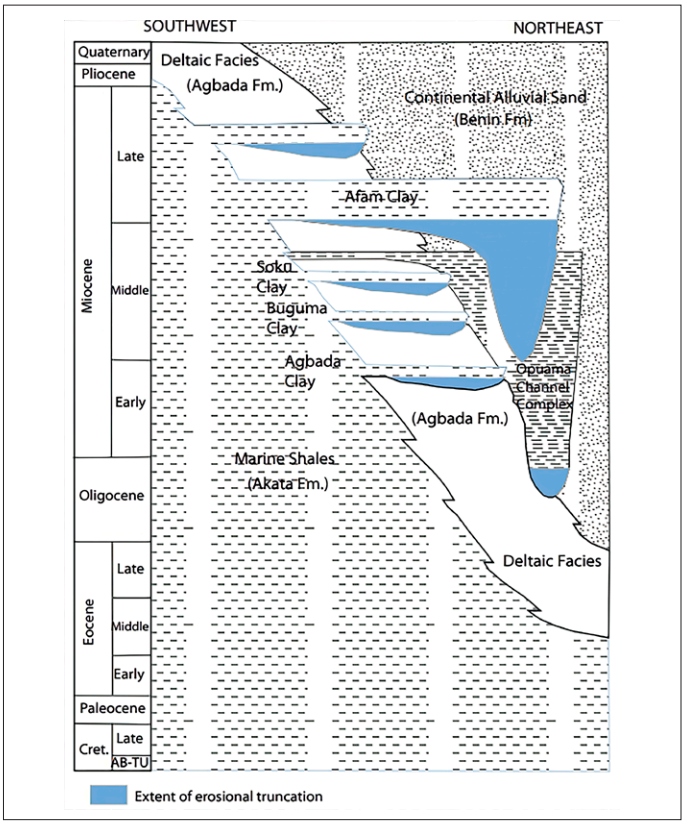


Figure 2. Stratigraphic column of the Niger Delta identifying the three lithostratigraphy Formations of the Niger Delta. Modified by Turtle et al., 1999 from Shannon and Naylor 1989 and Doust and Omatsola 1990.

shale within the Agbada Formation as shown in Figure 2, the Cretaceous shale, and the marine Akata Formation. Due to the great depth of the Cretaceous shale, it has not been drilled below the delta, thus, there is no existing data on its potential to generate hydrocarbons (Doust and Omatsola, 1990). Reservoirs in the Niger Delta are stacked, with thicknesses ranging from less than 15 m to greater than 45 m and were deposited from the Eocene to Pliocene (Evamy *et al.*, 1978). In the distal and proximal lobe complexes of the offshore Niger Delta, 3D reservoir facies modeling shows vertical and spatial changes in the turbidite channel sand facies within turbidite lobe sands and turbidite channel facies (Obafemi *et al.*, 2022). The most common traps in the hydrocarbon fields of the Niger Delta are structural traps (Tuttle *et al.*, 1999). These traps were developed when the Agbada paralic sequence underwent synsedimentary deformation (Evamy *et al.*, 1978; Stacher, 1995). Stratigraphic traps have the same primacy as structural traps on the flank of the basin (Beka and Oti, 1995). This oil

window can be found within the Lower Agbada Formation and the Upper Akata Formation in the northwestern part of the Delta (Tuttle et al., 1999). In the northern part of the Delta, the first well was drilled near a tar seep in 1908 by the German Nigerian Bitumen Corporation (Frost, 1997), but it was not until the late 1950s that oil was explored for in large quantity (Tuttle *et al.*, 1999).

Materials and Methods

The data for this study consist of composite suites of well logs containing caliper, gamma, sonic, resistivity, volume of shale, water saturation, and P-wave velocity with check shot data from one well. This well reached a depth of about 4,121 m (TVD). This well is located at a latitude of 5°44'53"N and longitude of 5°55'34"E.

Well-log analysis for lithology identification was carried out using the gamma-ray log. In addition, hydrocarbon-bearing sand was discriminated from non-hydrocarbon-bearing sand using the resistivity log. Hydrocarbon-bearing reservoirs were identified both qualitatively and quantitatively. The qualitative analysis involves scanning the well-logs for hydrocarbon reservoir signatures such as low gamma ray, high resistivity, and neutron and density log signature with low density and neutron. This led to the identification of three gas-bearing reservoirs.

Rock physics analysis was carried out to estimate shear wave, Poisson's ratio, V_p/V_s ratio, shear impedance, lambda-Rho, and Mu-Rho. The available suite of well-log data does not contain shear wave velocity (V_s) information. As a result, the Castagna *et al.* (1985) equation, which is valid for wet case scenarios, was effectively employed to generate a V_s log from which the V_p/V_s ratio was estimated. However, from qualitative analysis of the neutron and density log, the interpreted reservoirs (Sand A, Sand B, and Sand C) are not 100% saturated with water. As a result, using the Gassmann (1951) equation, fluid replacement modeling (FRM) was done for effective re-calculation of shear wave velocity within the reservoirs of interest.

Results and Discussion

The petrophysical evaluation of the reservoirs of interest (Table 1 on page 20) shows that Sand A, Sand B, and Sand C have water saturation values of 59%, 31%, and 54%, respectively. Figure 3 is the crossplot of acoustic impedance against V_p/V_s ratio, showing no anomalous deviation from the wet background trend. Conversely, the cross-over of neutron and density logs (Figures 4 through 6) indicates that the study

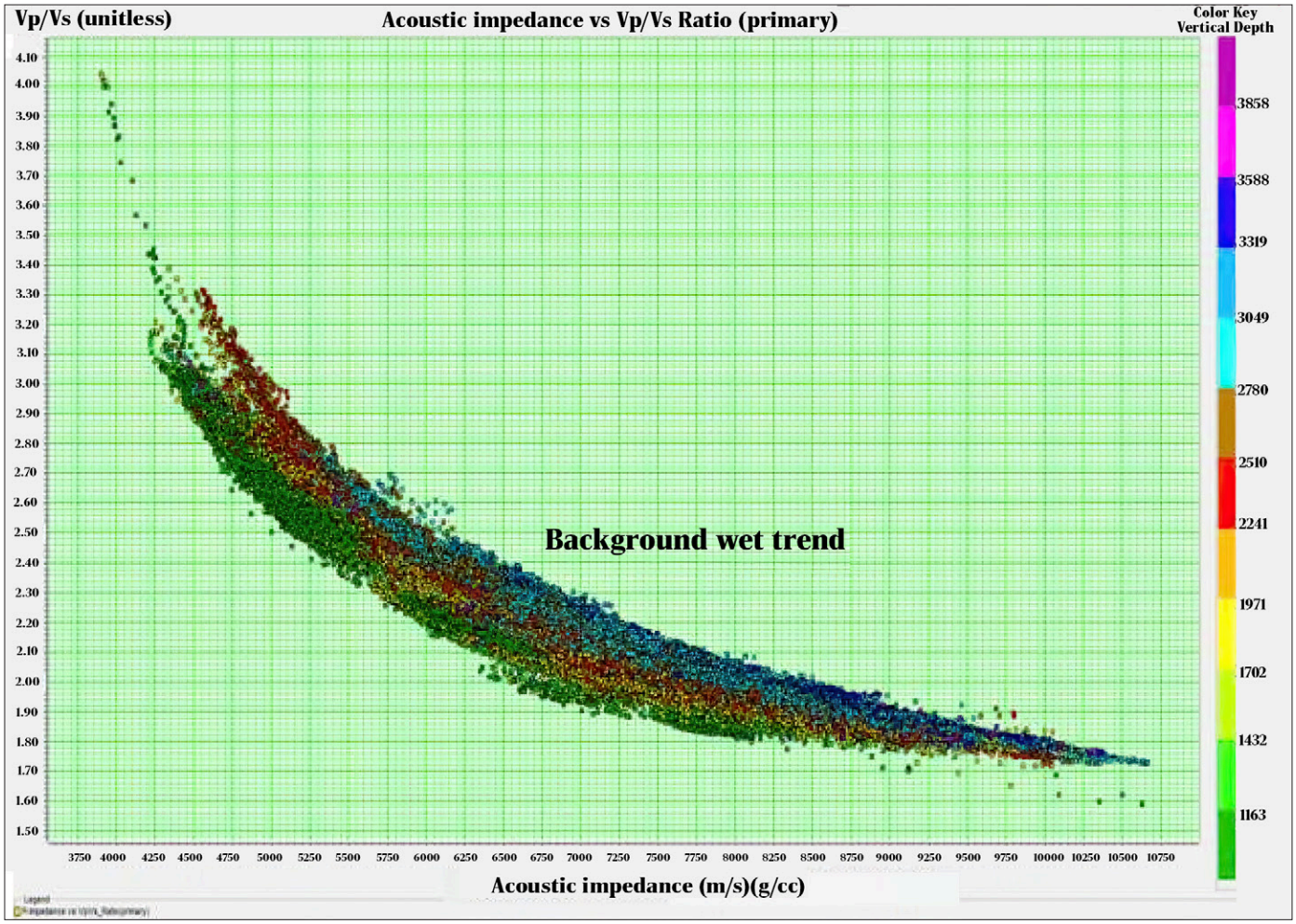


Figure 3. Cross-plot of V_p-V_s ratio against acoustic impedance for wet case, color-coded with depth, showing no deviation from the wet background trend.

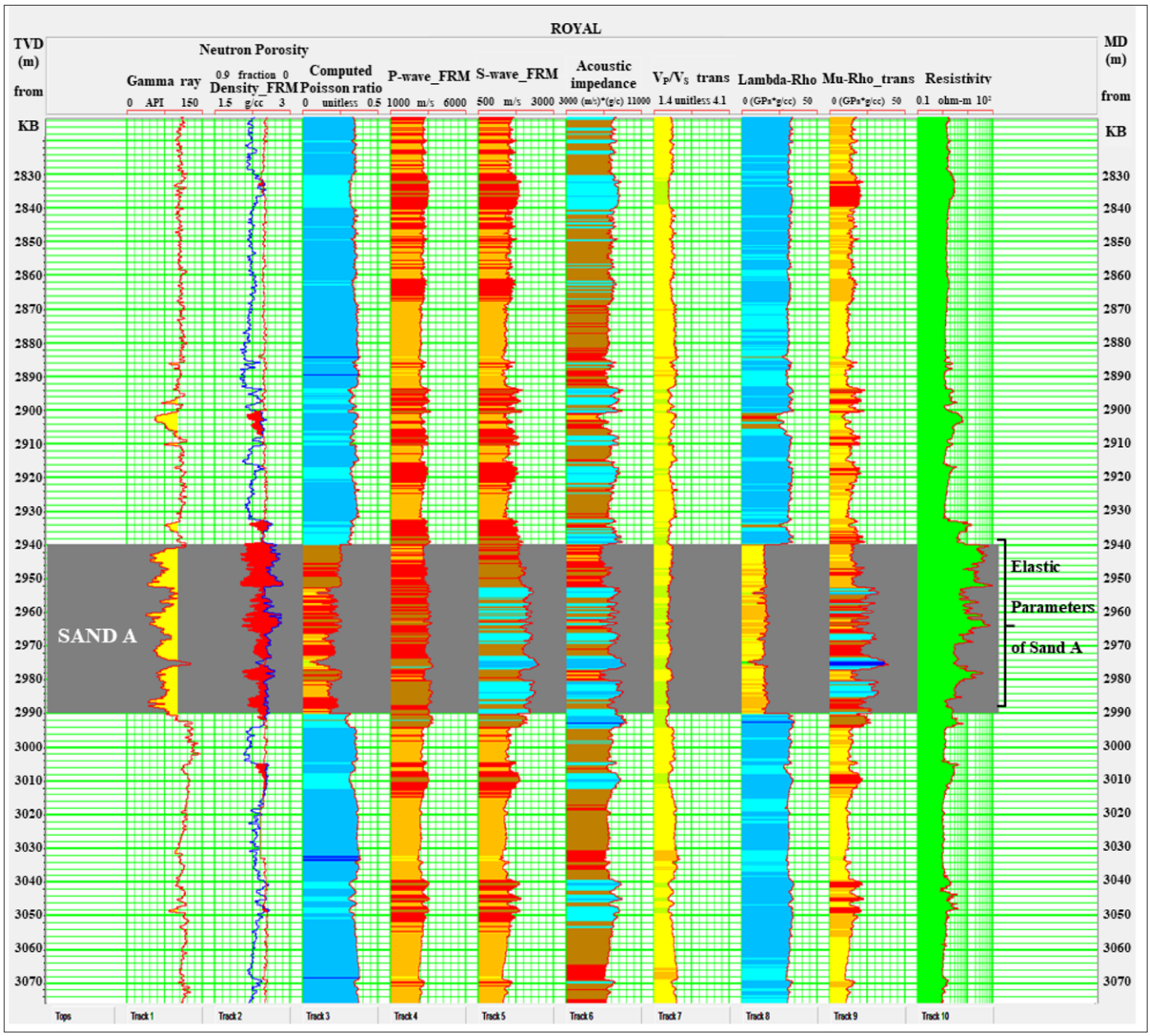


Figure 4: Rock physics model display for Sand A with Fluid Replacement Model of 58.7% water saturation.

intervals (Sands A, B, and C) are gas-saturated. This suggests that Castagna's equation is inadequate for shear wave velocity calculation in the study area. Figures 4 through 6 are the rock physics model display of Sands A, B, and C with fluid replacement modeling of 59%, 31%, and 54%, respectively. They show the re-evaluated shear wave velocity and other rock physics parameters at each reservoir interval. After comparing Castagna's equation-derived rock physics parameters and FRM-derived rock physics parameters, the rock physics results show the inadequacy of Castagna's equation in the evaluation of shear wave velocity, as shown in Tables 2 through 4 on pages 20-21. The Castagna's equation-derived rock physics parameters in Tables 2 through 4 show high Poisson's ratios, high Vp/Vs ratios, and high Lambda-Rho, indicating that the study intervals (Sand A, B, and C) are brine-filled. However, the neutron and density log signatures (low density and neutron) within the study intervals in the rock physics model (displayed in Figures 4 through 6) shows that the study intervals are gas-filled. FRM-derived rock physics parameters (shown in Tables 2 through 4) also indicate that the intervals are gas-filled, with low Poisson's ratios, V_p/V_s ratios, and Lambda-Rho. Figures 7 through 9 show the effect of FRM on the crossplot of V_p/V_s ratio against P-impedance for Sands A, B, and C, color-coded with depth. This reveals an anomalous zone that plotted away from the wet background trend. The anomalous zones in Figures 7 through 9 are interpreted as gas sand with a low V_p/V_s ratio which plotted within the depth range of reservoir Sands A, B, and C.

Conclusions

The rock physics crossplots after Fluid Replacement Modeling with water saturation values from the petrophys-

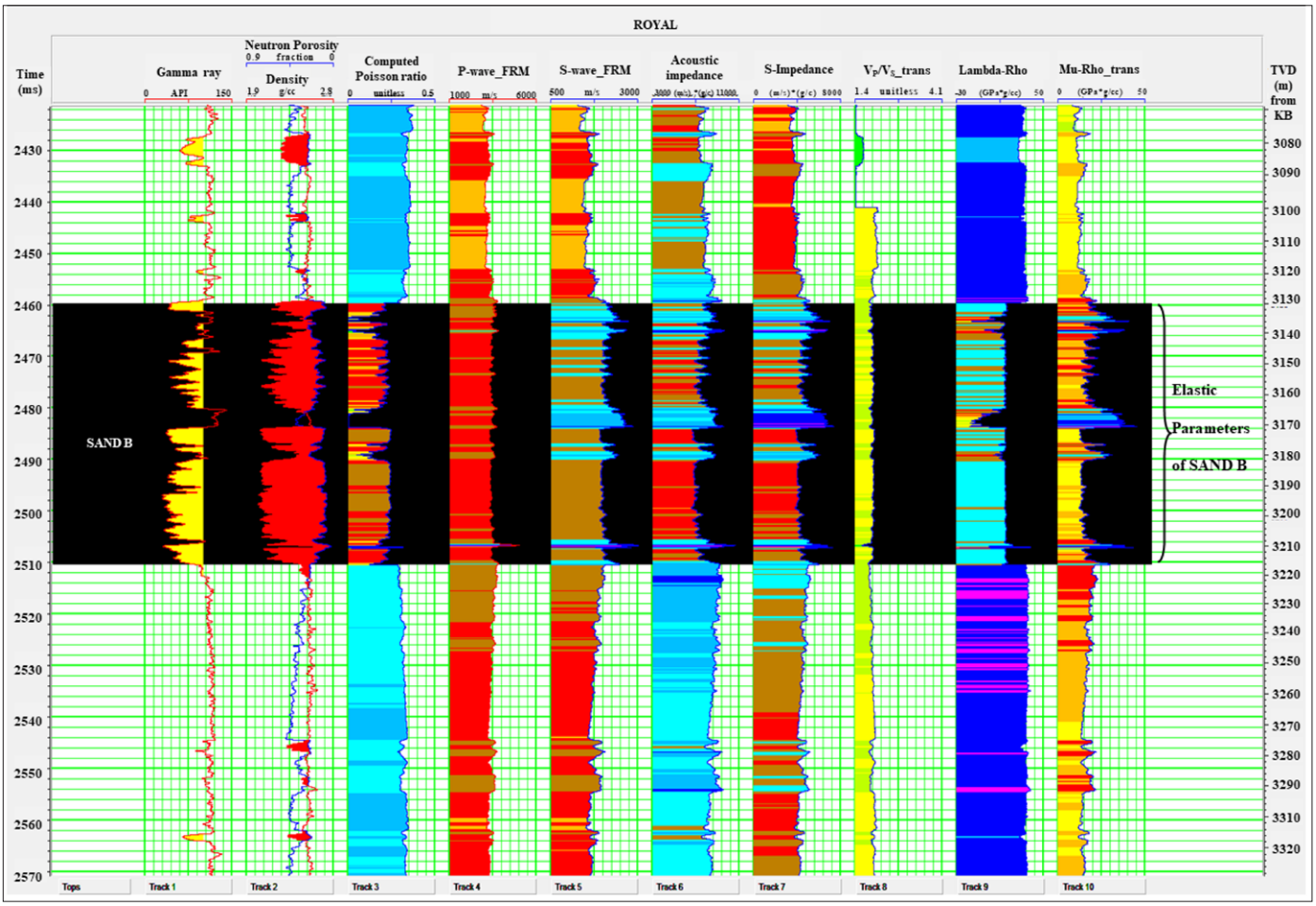


Figure 5: Rock Physics model display for Sand B with Fluid Replacement Model of 30.6% water saturation.

Table 1. Wireline petrophysical evaluation of Sands A, B, and C

Reservoir	Top (SSTVD)	Base (SSTVD)	Thickness (m)	(S_w)
Sand A	2940	2990	50	0.59
Sand B	3130	3217	87	0.31
Sand C	3393	3510	117	0.54

Table 2. Demonstration of the inadequacy of Castagna's equation for Sand A

Elastic Parameters of Sand A	Castagna's equation-derived parameters	FRM-derived parameters
S-wave velocity (m/s)	1780	2118
Poisson ratio	0.31	0.17
Vp/Vs ratio	1.91	1.61
Shear impedance (m/s*g/cc)	3916	4766
Lambda-Rho	25	11
Mu-Rho	15	23

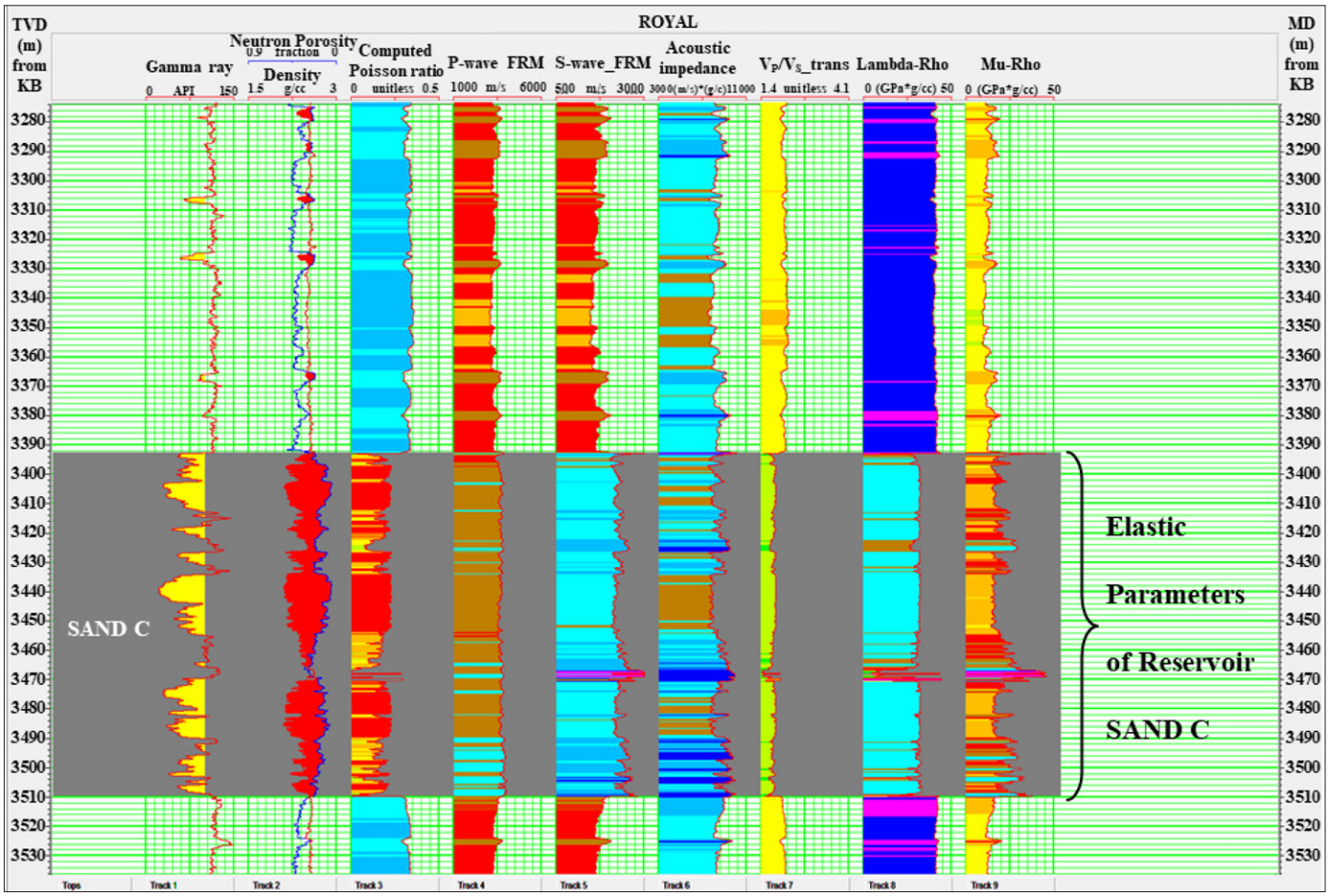


Figure 6. Rock Physics model display for Sand C with Fluid Replacement Model of 54% water saturation.

Table 3. Demonstration of the inadequacy of Castagna's equation for Sand B

Elastic Parameters of Sand A	Castagna's equation-derived parameters	FRM-derived parameters
S-wave velocity (m/s)	1735	2177
Poisson ratio	0.33	0.15
Vp/Vs ratio	1.97	1.57
Shear impedance (m/s*g/cc)	3938	5007
Lambda-Rho	29	11
Mu-Rho	16	25

Table 4. Demonstration of the inadequacy of Castagna's equation for Sand C

Elastic Parameters of Sand A	Castagna's equation-derived parameters	FRM-derived parameters
S-wave velocity (m/s)	1949	2352
Poisson ratio	0.30	0.14
Vp/Vs ratio	1.87	1.56
Shear impedance (m/s*g/cc)	4424	5433
Lambda-Rho	29	12
Mu-Rho	20	30

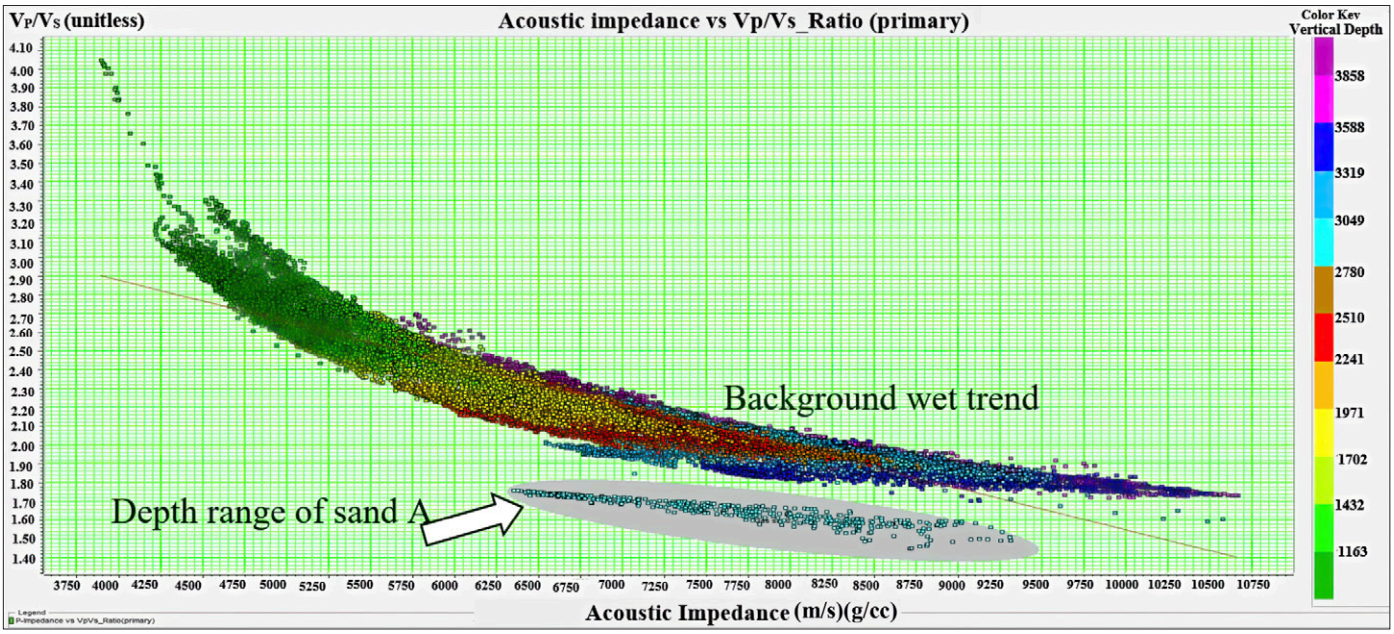


Figure 7. Cross-plot of V_p/V_s ratio against acoustic impedance in Sand A for 58.7% water saturation, color-coded according to depth, showing good deviation from the wet background trend.

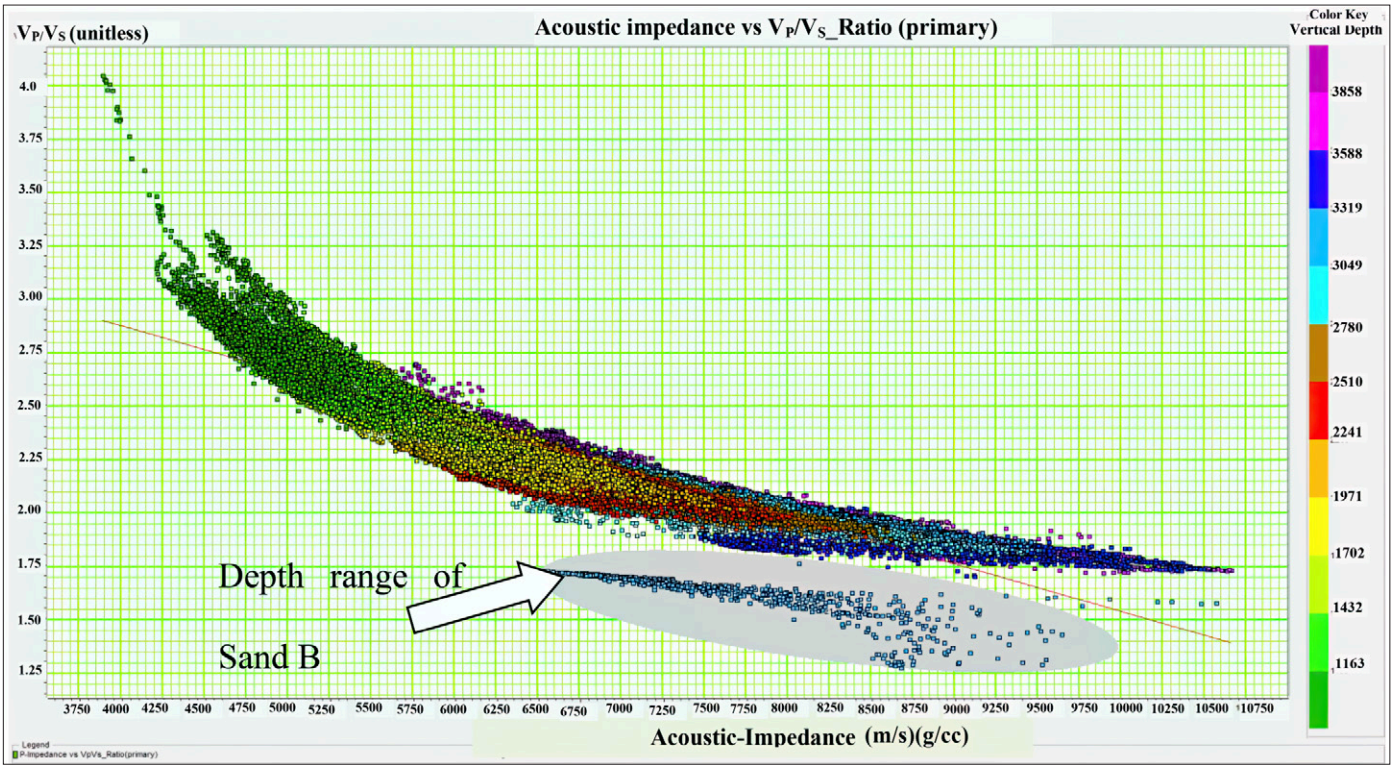


Figure 8. Cross-plot of V_p/V_s ratio against acoustic impedance in Sand B for 30.6% water saturation, color-coded according to depth, showing good deviation from the wet background trend.

ics results of each reservoir show an anomalous zone that plotted away from the wet background trend. A high value of P-impedance and Mu-Rho paired with a low value of the V_p/V_s ratio and Lambda-Rho characterize the three reservoir sands, suggesting that the reservoirs are saturated with gas. The study has demonstrated the inadequacy of Castagna's equa-

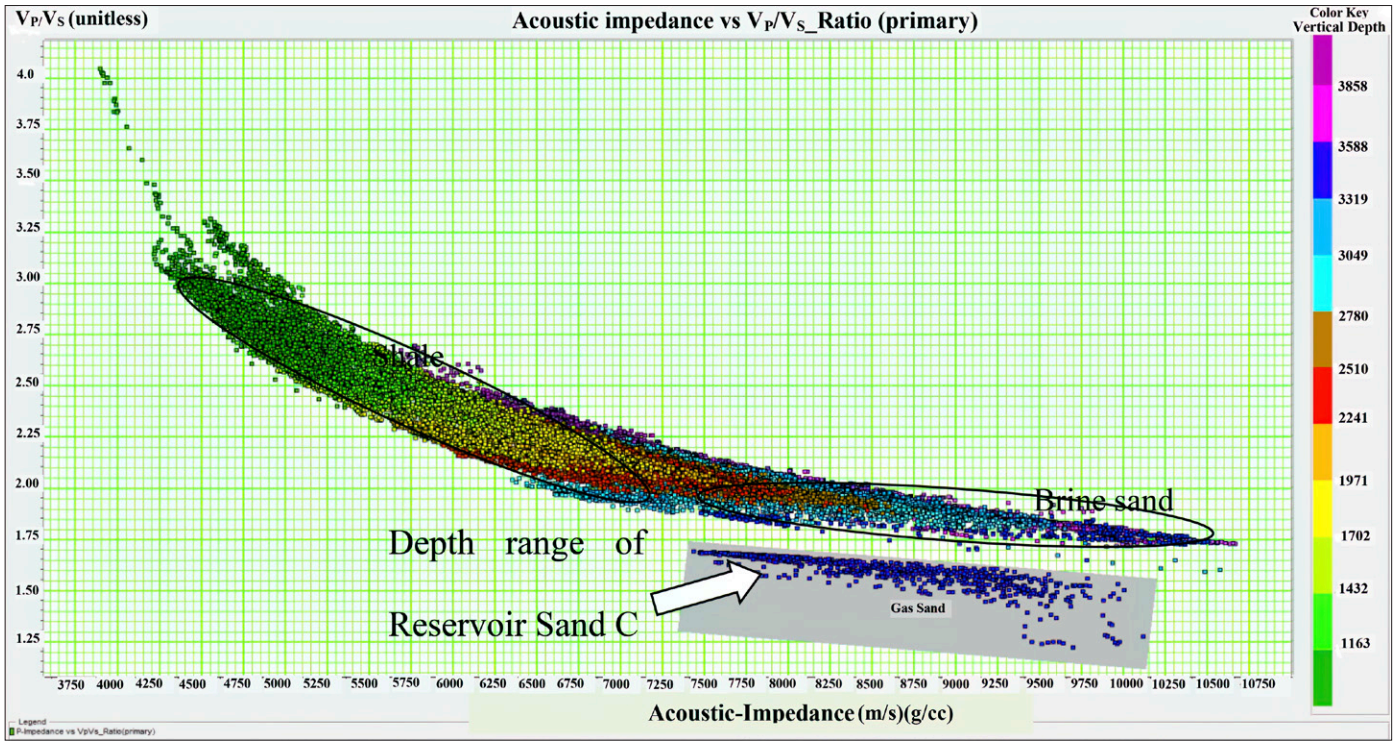


Figure 9. Cross-plot of V_p/V_s ratio against acoustic impedance in Sand C for 54% water saturation, color-coded according to depth, showing good deviation from the wet background trend.

tion in the estimation of shear wave velocity in gas-bearing reservoirs and developed an integrated approach for calculating elastic rock parameters in gas-saturated reservoirs. This will help proper reservoir characterization of the reservoirs based on its elastic rock properties for adequate fluid identification in the study area.

References

Avbovbo, A. A., (1978). Tertiary lithostratigraphy of Niger Delta. *American Association of Petroleum Geologists Bulletin*, 62, 295-300.

Aveseth, P., Mukerji, T. and Mavko, G. (2010). Quantitative Seismic Interpretation. Applying Rock Physics Tools to reduce Interpretation Risk. Cambridge University Press, Cambridge, UK.

Bastos, A.C., Dillon, L.D., Vasquez, G.F., Soares, J.A., (1998). Core derived acoustic, porosity and permeability correlation for computation pseudo-logs. Geol. Soc. London, Spec. Publ. 136, 141–146.

Beka, F. T., and Oti, M. N. (1995). The distal offshore Niger Delta: frontier prospects of a mature petroleum province, *in*, Oti, M.N., and Postma, G., eds., Geology of Deltas: Rotterdam, A.A. Balkema, p. 237-241.

Castagna, J.P., Batzle, M.L. and Eastwood, R.L. (1985). Relationships between compressional-wave and shear-wave velocities in clastic silicate rocks, *Geophysics*, 50, 571-581.

Domenico, S.N., (1984). Rock lithology and porosity determination from shear and compressional velocity. *Geophysics* 49, 1188–1195.

Doust, H., and Omatsola, E., (1990). Niger Delta, *in*, Edwards, J. D., and Santogrossi, P.A., eds., Divergent/passive Margin Basins, AAPG Memoir 48: Tulsa, American Association of Petroleum Geologists, 239-248.

Ekweozor, C.M., and Okoye, N.V. (1980). Petroleum source-bed evaluation of Tertiary Niger Delta. American Association of Petroleum Geologists Bulletin, 64, 1251-1259.

Evamy, B.D., Haremboure, J., Kamerling, P., Knaap, W.A., Molloy, F.A., and Rowlands, P.H., (1978). Hydrocarbon habitat of Tertiary Niger Delta: *American Association of Petroleum Geologists Bulletin*, v. 62, p. 1-39.

Frazer, G., Anders Bruum, Jose, C.A., Anthony Cooke, Dennis Cooke, Darren Salter P., Robert G, Dominic Lowden, Steve H., Huseyin O., Stephen P., Francisco G.P., Jorg H., Stefano V., Andreas R., and Ron R. (2008). Seismic Inversion, Reading between the lines. *Spring*, 43-63.

Frost, B.R. (1997). A Cretaceous Niger Delta Petroleum System, *in*, Extended Abstracts, AAPG/ABGP Hedberg Research Symposium, Petroleum Systems of the South Atlantic Margin, November 16-19, 1997, Rio de Janeiro, Brazil.

Gassmann, E. (1951). Elastic waves through a packing of spheres. *Geophysics*, 16 (3), 673-685.

Greenberg, M.L., and Castagna, J.P., (1992). Shear wave velocity estimation in porous rocks: theoretical formulation, prelimining verification and applications. *Geophys. Prospect*. 40, 195–209.

Han, D., (1989). Empirical relationships among seismic velocity, effective pressure, porosity and clay content in sandstone. *Geophysics,* 54, 82–89.

Klett, T.R., Ahlbrandt, T.S., Schmoker, J.W., and Dolton, J.L. (1997). Ranking of the world's oil and gas provinces by known petroleum volumes. U.S. Geological Survey Open-file Report.

Krief, M., Garat, J., Stellingwerf, J., Venter, J., (1990). A petrophysical interpretation using the velocities of P and S waves (full wave from sonic). *Log Anal.* 31, 35–369.

Murphy, W., Reischer, A., Hsu, K., (1993). Modulus decomposition of compressional and shear velocities in sand bodies. *Geophysics* 58, 227–239.

Obafemi, S., Oyedele, K., Omeru, T., Bankole, S., Opatola, A., Okwudili, P.N., Akinwale, R., Ademilola, J., Adebayo, R., Victor, A.L. (2022). 3D facies and reservoir property prediction of deepwater turbidite sands; case study of an offshore Niger delta field. *Journal of African Earth Sciences*, 194, 104633.

Petroconsultants, (1996). Petroleum exploration and production database. Houston, Texas, Petroconsultants, Inc.

Pickett, G.R., (1963). Acoustic character logs and their application in formation evaluation. *J. Pet. Technol.* 15, 650–667.

Rezaee, R., Motiei, H. and Kazemzadeh, E. (2007). A new method to acquire m exponent and tortuosity factor for microscopically heterogeneous carbonates. *Journal of Petroleum Science and Engineering*, 56, 241 – 251.

Shannon, P. M., and Naylor N. (1989). Petroleum Basin Studies: London, Graham and Trotman Limited, 153-169.

Stacher, P. (1995). Present Understanding of the Niger Delta Hydrocarbon Habitat. In: *Geology of Deltas* (Eds. Oti, M.N., Postima, G. and Balkema, A.A). Rotterdam, Netherlands, 257-267.

Tuttle, M. L. W., Charpentier R.R., and Brownfield M. E. (1999). The Niger delta petroleum system: Niger delta province, Nigeria, Cameroon, and Equatorial Guinea, Africa: USGS Open-file report, 99-50-H.

Wang, P. and Peng, S. (2019). On a new method of estimating shear wave velocity from conventional well logs. *Journal of Petroleum Science and Engineering,* 180, 105–123

Wu, S. and Bally, A.W. (2000). Slope tectonics, comparisons and contrasts of structural styles of salt and shale tectonics of the Northern Gulf of Mexico with shale tectonics of offshore Nigeria in Gulf of Guinea. In: Webster, M. & Talwani, M. (eds) Atlantic Rifts and Continental Margins. *American Geophysical Union Geophysical Monograph*, 115, 151–172.

Zhang, Y., Zhang, C., Ma, O, Zhang, X., Zhou, H. (2022). Automatic prediction of shear wave velocity using convolutional neural networks for different reservoirs in Ordos Basin. *Journal of Petroleum Science and Engineering,* 208, 1 – 13.

Student Transition, continued from p.15

Dylan says EAI has given him the opportunity to enhance his management skills by visiting and working on multiple job sites. He hopes his studies will help him to improve the environment and impact people's lives for the better.

In addition to learning technical skills, each company has its own culture and approach to things. Take the lead from the policies, procedures, and preferences of your leadership, and do your best to meet those criteria. Like our interns Shea and Dylan, be open to learning new skills that can broaden your horizons, and capabilities.

Additionally, many of our interns are hired full time and stay with EAI for the long-term. Three of our student interns turned employees are still with company in a full time capacity, including: Zarah Thanasides, PE and VP; Theodore Cheevers, Project Engineer; and Edward Safer, Project Manager.



Applying Liquid Boot vapor barrier.

3. Dress for the Part

If you perform sales for a technical company, such as a contractor or engineering firm, you may dress a bit more formally than the company's onsite foreman, and what you wear may depend on the context. If you travel to construction sites with debris, rebar, and framing, you'll want to wear steel-toe boots. You might "dress up" a construction outfit with boots, jeans, and a company-branded Polo shirt, for example. Or you might keep your boots in your trunk so you can go from a more professional sales meeting or networking luncheon to a job site with minimal upheaval. Always keep a hard hat and safety goggles in your car or on hand. While job sites can typically loan you one, it shows you are prepared for walking a site which will increase your credibility.

4. Offer Your Fresh Insights & Creativity

Experience is very valuable, but the youthful open-mindedness and fresh perspective of newly graduated students (of any age) can also help businesses create better processes and innovations. While you want to be cooperative, thoughtful suggestions to improve things or approach work in a new creative way are always welcome. Enthusiasm and excitement are contagious. Even though you are learning at a rapid speed, remember that you still have something valuable to offer.

Your Journey of Learning Continues

Internships are a valuable resource for future employment, and they can introduce you to a certain industry or company more easily if that's an area of interest. It's also important to take what you learned in your college experience and apply it to your first post-graduation job. Staying open to continuing your learning beyond college, maintaining a professional outlook, and providing creative solutions will make you an impressive employee wherever you go.

How Studying Abroad Has Enhanced My Understanding of Geology



Phoebe Valerie Ann Futcher, SA-11510

There was a saying taught in my first year as an undergraduate, "no field picture is ever good without a scale"; nothing could prepare me for this statement to ring true more than when I passed Sideling Hill along Interstate 68 during my first ever American road trip (Figure 1). Having commented on the remarkable roadside geology about two miles prior, the last thing I was expecting was to see a syncline of immense proportions appear in my horizon. Far from my first encounter with a syncline, yet it remains one of my favorite geological formations that I have ever seen in-situ due to its sheer grandeur and yet abrupt placement along a highway. That moment captured a sentiment I wish for all my peers navigating the academic field of geoscience to experience. After all, geology is best observed outside the confines of a textbook or museum image. And the United States has no shortage of it, even in places you least expect.



Figure 1. Sideling Hill syncline viewed travelling east along Interstate 68, Maryland.

One of the earliest memories during my childhood years of education centered around my desire to visit other countries, and more specifically the United States. Curiously, I can never pinpoint why exactly the U.S. was such a topic of fascination for my young self. Perhaps the appeal could be attributed to television shows or movies I used to watch? Regardless, my sights were set on the U.S. from an early age, and this followed through until at 15 years old when I finally got the chance to visit Florida for a family vacation. Almost immediately my expectations were exceeded, and thus closely followed the decision that I wanted more than just the occasional fleeting visit. I wanted to live and study in the U.S. and from that moment made it my life's ambition to take every opportunity to get there. Through waiting patiently and saving up anything I could during my part-time job, I managed to visit a further two times before I started university. Keeping to my ambition, I even enrolled in a degree program specifically with a study abroad component.

Though I was born and lived the first 18 years of my life in England, in my first year as an undergraduate I moved to Wales. By my second year, my family decided to leave behind the city life and make the move across the Bristol Channel to join me. Together we settled in the quaint town of Pontypridd in the South Wales Valleys. Our home is a late 19th century former coal miner's house, complete with a retired Victorian mine shaft underneath its foundations. Upon researching the history of my new home, I discovered that during the same period in which it was built many mine workers from the South Wales Valleys immigrated to Appalachia to contribute to the already booming coal industry. Soon after moving, and approaching my third year as an undergraduate, I was provided with a list of possible study abroad locations by my university. Coincidentally, the first listed under the U.S. category was none other than West Virginia University. West Virginia is the only state to be entirely within the bounds of the Appalachian region. I took the connection as a sign that I too wanted to make the same journey the ancestors of my town once did, with the intention of learning more about the local geology and industry which built my home.

I am not ashamed to admit that some of my biggest revelations in geology came only when I had the opportunity to study in the field during my second year as an undergradu-

ate. In April of 2022, I embarked on a physically and mentally demanding project focused on the northernmost region of Spain. Only then did some of the mental jigsaw-pieces of geology start to connect. Despite myself and my classmates having studied hundreds of images and videos of sedimentary structures and the like, there was something inexplicable about seeing them in-situ where we could make measurements and detailed observations (Figure 2). That moment reaffirmed what I had already established years prior, that I wanted to see more, and thus was a catalyst in my decision to spend a year studying abroad.



Figure 2. Crescent shaped trace fossil hypothesized to be from a trilobite in black shale of Silurian age, found during my geological project in the Cantabrian Mountains of northern Spain.

Being one of a handful of students from my department to move to the United States, and one of two to arrive at West Virginia University, it was no easy feat packing my belongings into a single suitcase for my trip over the Atlantic. And supplied with the reassuring words: "as long as I remembered my compass, clinometer, and field notebook, I could figure out the rest." After settling in, I kept in contact with the other student who accompanied me to West Virginia University. Often to the confusion of passers-by who would overhear our accents and much to our amusement, we liked to meet up on campus to discuss our experiences. Ultimately, the fall semester went by in a rush, and for the first time in my academic career, I had the autonomy to tailor my classes to my specific interests. So, I decided to take full advantage of the opportunity.

It has been an insightful and rewarding experience to be able to settle into a culture that shares so many similarities to my own, but not without its own distinct differences. Resoundingly, I was welcomed to West Virginia with open arms. Perhaps the most blatant difference was the contrast in accent, and still to this day I receive surprised comments each time I introduce myself. Interestingly I hadn't experienced this during my previous visits to the US, which can be attributed to myself staying in highly populated tourist areas such as Orlando. A far cry from the small population of Morgantown, West Virginia. The parallels of Morgantown to my own hometown of Pontypridd are hard to ignore. Both situated in mountainous regions of roughly the same population and still carrying community-spirit, it is no wonder I settled so quickly and seamlessly.

A significant benefit of studying abroad is that I was faced with the option of taking many classes that do not exist in my home institution. Therefore, I catered my classes towards regionally specific geology and even branched into the field of mining engineering. It can be said without exaggeration that in doing so I have completely changed my perspective on how natural resources are used in industry. So much can be learned from understanding the approaches and values of different cultures, an experience that unfortunately most seldom discover. In an age where many students progress through a college education, it is experiences such as these that can set a student apart from their peers. In my instance the personal, academic, and professional enrichment was almost immediately gratifying. I never could have perceived how much I would learn in such a short period of time since moving abroad.

Many of the early interactions with my peers helped shape the direction I took regarding my overall study abroad experience. Presented with almost complete freedom over what courses I could take, it was overwhelming at first. However, with gentle guidance from faculty members and fellow students I was able to tailor a schedule which both challenged and interested me. I attribute a lot of my success to my choice of living space, a variable that can often be overlooked as an exchange student. By complete luck I was assigned to an apartment with three amazing housemates, which has helped me immerse myself in the culture in ways unlike my original expectations. Living amongst them, whom are all from different states along the east coast of the U.S., has broadened my perspective on different states and given me the unique chance to travel to many places I wouldn't have sought to visit previously (Figure 3). Therefore, my advice to fellow study abroad students, or those seeking to do so in the future, would be to interact with as many native students and locals as possible.



Figure 3. Standing on the western limb of the Wills Mountain anticline at Seneca Rocks, West Virginia.



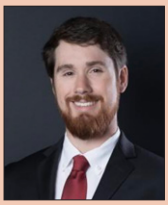
Figure 4. Group excursion to the unlit lower cavern of calcareous sandstone lithology at Lauren Caverns, Pennsylvania.

As some of my favorite memories and experiences stemmed from exactly this principal.

Since my first semester, I have had the chance to visit numerous local sites of geological interest as part of my education. After being lowered 500 feet into an underground coal mine, navigating through narrow sandstone caverns, and hiking to the top of mountains, the scale and abundance of geology here never ceases to amaze me (Figure 4). Coming from a country with diverse geology, yet distinct lack of outcrop, it is fascinating to see formations of grand scale in almost continuous exposure in the US. It led me to reflect on how this provides such a valuable tool for educators who are lucky enough to live and teach in this country, as the continuous nature of some formations removes the mystique of the subsurface. This is certainly something I wish I would have had access to in my early stratigraphy classes!

For students reading this who may be presented with the prospect of studying abroad, I encourage you to seize the opportunity. Professionals and other readers alike, take that overseas trip you have been planning for years or travel to one of the many national parks here in the U.S. It is said that education is a lifelong process, and thus it is never too late to pursue new ambitions. We are privileged as geologists and geoscientists for the ubiquitous nature of this industry. That is, we are surrounded by it in our everyday lives and what better way to explore it than to travel?

THE OPTIMAL PATH TO PROFESSIONAL LICENSURE & WHERE I WENT WRONG



Patrick H. Szopinski, SA-8499

There are two main early-career advancements that geoscientists can make that help them stand out from their peers and earn higher paying roles. These are completing higher education and becoming a licensed Professional Geologist. Not many geoscientists are aware of the latter option at the onset of their career, as professional licensure is seldom discussed in most university undergraduate programs, but it is a fantastic avenue you can take if you want to help launch your career off to an early success. I was lucky enough to be aware of and working towards my Professional Geologist license right out of undergrad, but my path towards achieving it has been quite unconventional.

For the uninitiated, here's a brief review of Professional Geologist licensure. The license that designates someone as a Professional Geologist (a PG) is given by the state in which they work. It typically lasts for a number of years and allows you to sign documents and approve proposals for projects dealing with "work of a geological nature." To earn your PG license, you need at least a bachelor's degree in a geoscience field, a number of years of experience doing "work of a geological nature," and passing grades on two official exams. These exams are the FG (Fundamentals of Geology) and the PG (Practice of Geology), and they are issued twice a year by ASBOG (the National Association of State Boards of Geology). These exams are standardized so that any interested applicants around the country will take the same test on the same date. That way you don't have to know the intricacies of Texas oil field stratigraphy if you're living in Pennsylvania.

Given these requirements to earn the professional license, there's a conventional "optimal path" that geoscientists tend to follow: finish up your BS degree, pass the FG exam either in your last semester or right after graduating, get hired in an entry-level geologist role, find a coworker who already has their own professional license and who can serve as your mentor, apply for the GIT (Geologist-in-Training) certificate, work as a geologist for the number of years your state requires, then pass the PG exam. Complete all that [in a timely manner]

Continued on p. 30

Candidate for AIPG National President-Elect



David Heidlauf
CPG-9365
Chicago, Illinois

Since I was a child, I have loved the outdoors, exploring nature, learning about the earth's history, and collecting rocks. I embraced the study of geology my sophomore year in college and completed a master's degree in clastic sedimentology to prepare for a career as a petroleum geologist. However, the realities of the mid-eighties oil crash led me to begin a career in the environmental arena. For the last thirty-six plus years, I have enjoyed a rewarding career as an applied environmental hydrogeologist, working across the country in different geologic terrains and industrial settings with a broad variety of complex projects. I have also enjoyed seeing the world with my geologist spouse Lisa, who recently retired as a college adjunct professor after a 25-year teaching career.

In my work as an applied geoscientist, I care deeply about responsible stewardship and development of our earth's natural resources, about supporting the applied practice of geology through AIPG, and about supporting the education and development of the next generation of geologists.

> "...I care deeply about responsible stewardship and development of our earth's natural resources, about supporting the applied practice of geology through AIPG, and about supporting the education and development of the next generation of geologists."

Unfortunately, in today's world, the profession and practice of science is often disparaged for political gain. This is detrimental to our society, our citizens, and our world. Ignoring the reality of this world's finite resources for short-term "gains" that benefit only a few is fundamentally wrong, harms many, and will harm future generations. To help counter this crisis, we need all geoscience professions to flourish. Through my active participation in AIPG at both the section and national level, my understanding of the value of different areas of applied geology such as mining, environmental, hydrogeology, geotechnical, and petroleum has deepened. I have witnessed firsthand, through my spouse's work in a college geology and environmental science department, the critical importance of maintaining excellent undergraduate and graduate geoscience programs while intentionally recruiting and developing the next generation of geoscience professionals. I cannot overstate importance of time spent interacting with geoscience (or potential geoscience) students at all levels during our demanding professional careers. Likewise, time spent recruiting, training, and mentoring geoscience staff at work is as important as the technical work we do.

This last week I have had the pleasure of joining a group of Wheaton College students and alums on their geology spring break field trip to the Grand Canyon. Experiences such as this bring back good memories from my time as a geology student long ago and provide meaningful interactions with geoscience practitioners of our future. On the work front, I am active in my firm's Site Solution characterization and remediation group, I have served as a planning member of our firm's bi-annual technical conference (which focused on professional development of younger staff), and I am presently leading the effort to develop a subject matter expert skills matrix for my firm's America-based geologists.

In closing, it would be my honor to give back to the profession that I love, to serve in the roles of President Elect, President, and President Emeritus. I am deeply committed to bring my passions, vision, and experienced-based wisdom to these roles. My term of service will focus on initiatives of responsible stewardship and development of natural resources, supporting the practices of applied geology, and fostering the development of the next generation of geoscientists.



Candidate for AIPG National President-Elect



Sara Pearson
CPG-10650
Portland, Michigan

I strongly believe in AIPG and our profession! I am honored and thrilled to accept the nomination for President-Elect.

Building partnerships, sharing knowledge, and advocating for the geological sciences are so important and motivate me to think beyond the obvious and raise the bar with each new endeavor. Our organization's core principles of competence, integrity and ethics are what sets us apart. They align with my personal beliefs and how I want to be perceived as a professional. This is why I feel like I belong as a member, and I believe this is one of the reasons why you are a member as well. I do understand that the CPG credential is valuable in certain fields more than others, and this is another prominent reason why people are members. For me, it is not required, but I value my credential because of the ideology of AIPG. We are an organization capable of supporting professionals who tackle resource challenges, foster improvements to society, protect public health and the environment and the future. Our expertise and knowledge are needed, and we are better together.

The Michigan Section's Environmental Risk Management Workshop that I co-founded with fellow CPG Kevin Lund is a prime example of how partnership building makes us better together. We developed the workshop to bring regulators, consultants, and owners of contaminated properties together to share case studies about experiences with clean up and managing releases of hazardous substances to the environment. Since 2011, we have built on this concept inviting students, researchers, service providers, and other practitioners to the event expanding the breadth of knowledge shared and building the foundation for trust and working relationships. I believe we have become better together solving challenging remediation and risk management issues in our state and beyond in the past decade because of our efforts.

Part of being better together includes sharing knowledge. We all benefit from hearing about other's successes and lessons learned because science is ever-evolving and the rate at which we must address emerging issues is increasing exponentially. The public is impatient and we are expected to become experts overnight. No one individual or entity has the magic solution, but when we share knowledge broadly, we can advance faster. It is for these reasons along with a significant turnover in the environmental industry with so many retirements and new professionals entering the field needing information that I "pitched" the concept of a webinar series to my organization, the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The resources and technology were already available for immediate launch through EGLE. As part of my "pitch," I wanted to include partnership with AIPG and other environmental professional focused organizations to reach out to their members, include their members as speakers, and continue to connect professionals with the information they need. Our series is in its third year, and I have heard from AIPG members in Michigan and across the nation that they appreciate the series. I am very excited about AIPG's YouTube videos and variety of webinar series now offered directly by AIPG. As President-Elect, I will be a strong proponent of the videos, webinars, in-person events, and other platforms like *The Professional Geologist* to connect and share information.

I am the design editor for *The Professional Geologist* collaborating with Editor Adam Heft, CPG-10265 and previously, John Berry, CPG-04032. Modernizing the look and building a cohesive message of advocacy for the geosciences have been my goals.

Advocacy for our profession is so critical now, particularly with the dismissive attitude society seems to have about the sciences. Legislators campaigning to eliminate licensure dismiss the importance of our role in protecting the public. This action has a rippling effect that influences choices students make regarding career decisions, lawmaking and policy decisions, resource development and management, natural hazard planning and more. As an organization, we are better together in influencing the future, promoting geoscience education from kindergarten to college, and building partnerships with other organizations with common values and visions. We belong to AIPG because our values align, and we share a vision of advocacy for our profession. I have been working with the National Executive Committee in recent months facilitating conversations about revisions to the strategic plan which was last revised in 2009. The strategic plan is key to moving AIPG into the future. Our mission must be focused, our vision clear and values spelled out. We can then set achievable short-term and long-term goals designed to succeed in our mission. I am impressed with the progress and so energized by working with such talented professionals.

Lastly, as President-Elect, one of my short-term goals is to foster a culture of belonging to promote membership growth using my skills in partnership building, outreach, and advocacy. I am driven because I know we are better together and will approach the role with as much energy, enthusiasm, and creative thinking as my other roles in AIPG. I'm happy to talk about future goals and strategies for AIPG. Feel free to contact me at pearsons@michigan.gov. I would like to thank you for your consideration in selecting me to represent you and AIPG.

Candidate for AIPG National Vice President



Todd McFarland
CPG-11348
Nashville, Tennessee

> A geological community that strives to constantly advance must include students and early career professional members who understand the value of the profession."

I am thankful for the opportunity to be nominated for Vice President of AIPG and would like to thank the nominating committee for this opportunity. I joined AIPG in 2008 and upgraded to a CPG in 2010. Although field work consumed most of my time during my initial years as an AIPG member, I remained involved with the organization on the Section level and became the Tennessee Section President in 2013. My first trip to the annual AIPG meeting was the 2013 meeting in Colorado where I was subsequently elected to the Advisory Committee for 2014. I was honored to serve as Vice President in 2015 following my year on the Advisory Committee. I was the Tennessee Section President in 2017 as well as the general chairman for the 2017 National Meeting. I served as AIPG President in 2020 as AIPG navigated through the covid pandemic. Although far from a traditional presidential tenure, it was a great experience to see how we all adapted to the constant changes. The staff members of this organization and the members we serve are a two of the reasons why I want to continue serving this organization.

A geological community that strives to constantly advance must include students and early career professional members who understand the value of the profession. Engaging student members and early career professionals as soon as possible in their careers will foster growth and participation in the organization on National, Section, and student chapter levels. This should include promoting AIPG to university geology departments with student members and to employers of early career professionals. I will accomplish this goal by coordinating with National and state Sections to support programs and initiatives to continue development of student chapters and grow early career professional membership. I have also volunteered to be on the AIPG membership committee. I am excited to have the opportunity run for a second term as Vice President and appreciate your support.

Professional Licensure, continued from p.27

and you can have your PG license in under five years after graduating. Sounds simple enough.

As you might expect, life almost never goes that simply. I can attest to just how difficult it can be to meet these requirements. Here's a recap of my experience working towards Professional Geologist licensure has gone so far. Note just how many times I deviate from the "optimal path."

I didn't find out that Professional Geologist licensure even existed until I was a junior in undergrad. By that point, my schedule was full of classes, job hunting, and my senior thesis project, so I didn't even consider adding the FG exam to my plate. I opted to instead land a geoscience-related job after graduating, and then study and take the exam while studying on my own time. On paper, this plan would've worked just fine. I graduated from the University of Nebraska-Lincoln in 2019 with my BS and returned to my home state of Illinois. I was lucky enough to land a full-time geotechnical role after a few months. During my time there, I learned that Illinois does not actually offer the GIT certificate. They only provided the FG exam to applicants who were also qualified for the PG exam, in an effort to get more applicants to take both exams on the same day. That approach seemed too arduous for me, as I was mostly looking to pass the FG exam so I could attach it to my resume. So, I started looking into visiting other states to take the FG in the fall of 2020.

As you can imagine, that plan did not come to fruition, thanks to a certain virus that swept the world. Once 2021 rolled around, I had also secured a new role as a geologist in St. Louis. I shipped out to Missouri, where I've lived ever since, fully aware that I'd already strayed from the optimal path.

Nevertheless, I applied to take the FG exam on October 2021. From May to September, I studied for the exam off and on. Sometimes I'd task myself to read through x many pages of a given textbook or review guide in a certain week. Other times, I would just play it by ear based on how my work and personal schedules shook out. What was easily the biggest help was connecting with REG Review. They're an organization dedicated to helping early career geologists study for the ASBOG exams. For a fee, they provide study guides, note cards, practice tests, online review sessions, and the option to discuss with other test takers in your state. I made it a point to go through their review guides multiple times, paying special attention to the sections where I had less experience (for me, this was hydrogeology).

October eventually arrived, and off I went to Jefferson City. This particular date wound up having the highest turnout ever

Candidate for AIPG National Vice President



Matthew Rhoades
CPG-7837
Overland Park, Kansas

I have been a member of AIPG for more than 30 years and I have seen a lot of change in that time. The CPG designation carries a lot of weight and I am glad to have it on my business card. With that said, we need to redouble our efforts to attract new members and sow continued goodwill in the geologic community. Maintaining a steadily increasing membership roll count is critical to our success. I would like to continue with those efforts; directing the membership committee as Vice-President.

In order for the AIPG to compete with other organizations on an ongoing basis, we must continue to tailor, refine and hone our offerings of core services to existing and new potential members. Annual dues alone will not get the job done. Value-added services and events will attract new people. We have seen a lot of success with Marquette and hope to see more in Covington. I have heard it said on many occasions that new millennial scientists just aren't "joiners" looking to participate in large organizations. Some of that may be true. However, I do know that many younger geologists welcome the opportunity to interact with their peers and with capable mentors if it means they can grow intellectually or professionally. These include field trips, geology club functions, lecture series', museum trips and group social functions. Reaching these groups and supporting them through AIPG's student sponsorship and student chapters is key to our continued, collective growth. As a mindset, all of AIPG's members should be willing to work with people much younger and less experienced in an effort to continually infuse the sense of wonder of geology and the benefits of hanging around with other like-minded professionals. It is how we can best 'pay back' the debt that we owe to those who mentored us along our own meandering professional paths.

> "With that said, we need to redouble our efforts to attract new members and sow continued goodwill in the geologic community."

As a member of the Executive Board, if elected, I will join in the brainstorming and policy-making efforts designed to move AIPG forward. As the Vice-President, I see my role in maintaining continuity with the great work of previous Vice-Presidents. I would like to participate in discussions regarding student recruitment, scholarships, professional development opportunities, ongoing mentoring opportunities, and networking and advocacy. All of these will have an economic impact and I would look to support those opportunities that will have a positive impact on added headcount to the Institute.

in Missouri, since so many other applicants had to postpone their exams as well. I credit myself with staying calm and collected during the actual exam since I had attempted to replicate the test conditions whenever I did a practice test from REG Review. This is one of their strategies that I took to heart: allot yourself four uninterrupted hours, take the test closed book, with pencil and paper, filling out the multiple-choice questions as you go. By practicing in this style several times, I felt more at ease on exam day. And I was elated to hear, almost two months later, that I had passed the FG on my first try! That was one of the most make-or-break steps on the path to licensing off my plate!

However, the next step wound up being much trickier, and only served to force me even farther off the optimal path. I corresponded with the Missouri State Board of Geologists, stating my request to receive a Geologist-Registrant-in-Training (GRIT) certificate. This is an intermediate license status granted by the state of Missouri to those who are working in a geoscience role, have a Bachelor's of Science, and have passed the FG exam. To qualify for it, you need to have an approval signature from someone you work with who is already licensed as a Professional Geologist in the same state where you work. The trouble was that nobody at my workplace had a PG license, and, in Missouri, being cosigned by someone with a PE license (Professional Engineer) did not count. With that dreadful realization, I then began job searching for the next six months.

This was around the time that Missouri was seeing a downswing in COVID-19 pandemic-related restrictions. A lot of companies were looking to start growing again and needed fresh talent to make that happen. In each of the interviews I had, I always requested to speak with the registered Professional Geologist they had on staff, stating that I would need their approval to earn my GRIT certification. I like to think that having such a specific goal and a plan to achieve it helped my chances. If I were hiring for a geologist, I know that I'd want a candidate dedicated to earning professional

Continued on p. 35

Candidate for AIPG National Secretary



Robert Andrews
CPG-11975
Lockbourne, Ohio

Greetings. I am a geologist from Ohio and I am honored to be nominated for the office of Secretary for the Executive Committee of the American Institute of Professional Geologists (AIPG).

Let me begin by tell you a about myself. I earned a Bachelor of Arts degree in Geology from the College of Wooster in Wooster, Ohio and a Master of Science degree in Geology from the University of Kentucky in Lexington, Kentucky. In addition to my CPG, I am a Licensed Professional Geologist in the state of Indiana. I currently work as the Wellfield Protection Coordinator for the City of Columbus Ohio, Division of Water where I protect the groundwater aquifer that provides potable water for a portion of the Greater Columbus Area. In this position I manage the collection of groundwater quality and level data from a series of monitoring wells located around the City's wellfield. In addition, I provide hydrogeological support to the rest of the Division of Water. Prior to joining the City in 2007, I worked as a Geologist for several consulting firms and the Kentucky Geological Survey on various remedial and resource investigations. While at the Survey, I worked on projects estimating the availability of coal resources, using remote-sensing and drilling techniques to locate groundwater supplies in fracture rock, and assessing non-point source pollution within a river basin in the eastern part of Kentucky.

I have been a member of AIPG since 2012, joining after I returned to Ohio from my time in Kentucky. In 2014, I began serving on the Executive Committee for the Ohio Section and have served various positions including Member At Large (2014 to 2016), Treasurer (2017 to 2019), President-Elect (2019 & 2021), Past-President (2021), and President (2020 & 2022). For 2023, I am serving as Past-President.

In 2019, I was one of the founding organizing members of the Ohio Section's Charity Golf Scramble. This golf scramble was conceived as a social event for members and as a way to raise money to support the geology students in Ohio Student Chapters. Over the last four years, this event has raised over $8,500. To date, this money has been used to provide second chance scholarships to students from Ohio Student Chapters that applied for but did not win a National undergraduate scholarship.

On a National level, I am currently involved with the planning of this year's 60th Annual Conference to be held in Covington, Kentucky. For this event, I serve as co-chair of the finance committee. In addition, this year I am serving as one of the Advisory Board Representatives on National's Executive Committee.

So why am I involved and support AIPG? Since joining the organization in 2012, I have come to realize that AIPG is the best organization to support and represent geologists working in consulting and industry. The geologists in this organization represent a diverse group of specialties such as oil & gas exploration, mining, geophysics, and hydrogeology.

> "...I have come to realize that AIPG is the best organization to support and represent geologists working in consulting and industry."

Within this organization this diverse group of geologists have regular opportunities to network with each other on a State and National level. Plus, one can obtain recognition as a certified professional geologist, which is highly valued especially for those working in states that do not have professional registrations such as Ohio. In addition, this organization provides great opportunities for college students to network with a working geologist so that they can prepare to grow in the profession.

Running for the office of Secretary provides me with another way to serve this organization on the National level. There are several important issues facing AIPG. These include 1) Growth of membership and support of existing membership; 2) Continued development of student chapters to allow for college students the opportunity to benefit and knowledge of existing members; 3) Continued development of educational opportunities so that members received a value for their membership; and 4) Financial viability and sponsorship of the National organization so that the organization is responsibility using its resources to benefit the members.

If elected, I promise to perform the duties of the office and be a representative to all members of this organization and faithfully support it.

Thank you for reading this bio and considering me for this office.

Candidate for AIPG National Early Career Professional



Brigitte Petras
ECP-0851
Campbell, Ohio

I am honored by the AIPG National Nominating Committee as I accept a nomination to run for a second term as National ECP Representative for 2024. I am grateful that I've had the opportunity to engage current and incoming students and ECPs in 2023, and I'd be happy to continue my service with AIPG to represent this demographic and encourage and facilitate more folks to get involved with such an exceptional organization.

As some may know from my past nomination, I was a co-founder of the Youngstown State University AIPG Student Chapter of the Ohio Section. I was fortunate to present at a national conference, implement local fundraisers, outreach events, joint geological field trips, and attend Ohio Section meetings. I was so fortunate to have taken advantage of technical knowledge, professional development, and networking opportunities and I would like to continue to advocate these experiences to students and their advisors throughout the United States. I understand that many collegiate organizations, including AIPG student chapters, became dormant during the height of the pandemic, so I would like to help set a plan to bolster AIPG student engagement at those locations. After all, students are the future of our organization! I'd like to provide support to those incoming students, current students, and their AIPG Liaison as ECP Representative. Additionally, I'd like to continue to develop and advertise the mentorship program to students (and other professionals). As a mentee throughout my education and early career, I highly valued the guidance which enabled me to succeed in my goals. This year I was a part of the mentorship committee, and I wrote additional tips to make it easier for mentees to find a mentor. Moreover, I encourage more professionals to sign up to be a mentor for this program.

> "I view the role of the National ECP Representative position as an integral part of inspiring students and ECPs through coordination and facilitation."

I would like to continue to develop content specifically relevant to students and ECPs which could include the extension of the 2023 Student/ECP webinar series. This year the webinars are related to professional licensures and certifications, GeoCareers panel discussions, how to write a CV/resume, and more. Other topics to consider based on interest would be discussions on tips for career advancement, additional GeoCareer panel discussions with geologists in other foundational and emerging geology careers, and tips for technical presentations. Additionally, I could help facilitate workshops and training opportunities related to students and ECPs in 2024, as I think this would be very interesting to those looking to succeed in their careers.

For the annual meeting in 2024, I would like to remain on the Student/ECP Day planning committee and improve the event based on the interest and engagement of the Student/ECP Day I am co-chairing this year at Covington, Kentucky. This year we hope to have speakers for licensures/certifications, the mentorship program, at least mock interview opportunities at the event, and more. Additionally, I will continue to encourage early career professionals to sign up for leadership opportunities at the annual conferences, such as participating in subcommittees or signing up to be technical session chairs.

I view the role of the National ECP Representative position as an integral part of inspiring students and ECPs through coordination and facilitation. Ultimately, retaining and increasing AIPG membership and engagement relies on the outreach, support, and opportunities for students and ECPs.

I feel that my perspectives and experiences will continue to benefit AIPG in this ECP role. Please contact me at petras@battelle.org if you have any additional ideas on future events and opportunities for students and ECPs that you would like to see (or if you would like to get involved with such ideas). Thank you for the opportunity to contribute more to AIPG and its members.

AIPG Event CALENDAR

CANDIDATE FOR AIPG NATIONAL 2024 PRESIDENT-ELECT



Dave Heidlauf

CPG-9365
Chicago, Illinois

Statement of Purpose or Goals you have for AIPG: I am committed to bring my passions, vision, and experienced-based wisdom to serve in the roles of President Elect, President, and President Emeritus. My term of service will focus on initiatives of responsible stewardship and development of natural resources, supporting the practices of applied geology, and fostering the development of the next generation of geoscientists.

Universities Attended	Degrees Granted	Dates
Wright State University	Hydrogeology Coursework	1989-1992
Northern Illinois University	Environmental Coursework	1987-1988
Univ. Of Illinois - Champaign-Urbana	M.S. Geology	1983-1986
Wheaton College	B.S. Geology	1978-1982

Company	Title	Dates
ENVIRON/Ramboll	Principal	2002-present
MWH	Supervising Hydrogeologist	2000-2002
Mittelhauser/Clayton	Senior Project Manager	1989-2000
CCJM	Environmental Geologist	1987-1988
US Army Reserves	Captain/Field Artillery	1982-1992

AIPG Activities	Dates
National Executive Committee - Treasurer	2021-2022
Illinois-Indiana Section – CPG Applicant Screening Committee	2022-present
Illinois - Indiana Section Vice President	2017-2022
Illinois - Indiana Section Committee - Field Trip Coordinator	2015-2017
National Meeting Podium Presenter	2011-2015, 2017, & 2021

CANDIDATE FOR AIPG NATIONAL 2024 VICE PRESIDENT



Matthew Rhoades

CPG-7837
Overland Park, Kansas

Statement of Purpose or Goals you have for AIPG: My overarching goal is to add to the value proposition that AIPG poses to its members. That is to say, to add to the various learning experiences (webinars, seminars, short courses, lectures,) that we present. In doing so, our members will see tangible value in continued membership and participation.

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

Company	Title	Dates
AlterEcho	Project Manager/Geologist	2022-present
Rhoades Associates	Principal Geologist	2019-2022
United Battery Metals Corp.	CEO, President & Director	2016-2019
NM Bureau of Geology & Mineral Resources	State Geologist	2015-2016
WorleyParsons Corp.	Principal Hydrogeologist	2007-2015
Maxim Technologies, Inc.	Principal Hydrogeologist	1998-2007
Harding Lawson Associates	Associate Hydrogeologist	1984-1998

AIPG Activities	Dates
National President-Elect, President, Past President	2021-2023
National Treasurer	2019-2020
National Conference Chairman	2013
Colorado Section President	2010

CANDIDATE FOR AIPG NATIONAL 2024 PRESIDENT-ELECT



Sara Pearson

CPG-10650
Portland, Michigan

Statement of Purpose or Goals you have for AIPG: As President-Elect, I will focus on the goals set forth in the new strategic plan, promote specific achievable initiatives, and strive to create a culture of belonging to encourage membership growth. I believe that we as an organization have the ability to unite and be the positive influence that will strengthen and advance our profession.

Universities Attended	Degrees Granted	Dates
Michigan State University	Great Lakes Leadership Academy - Leadership Advancement Program	2008-2010
Western Michigan University	M.S. Earth Science (Hydrogeology Emphasis)	1994
Aquinas College	B.S. Geography & Environmental Studies	1992

Company	Title	Dates
Michigan Department of Environment, Great Lakes, and Energy	Unit Supervisor/	2016-present
	Technical & Program Support Specialist/	2012-2016
	Senior Geologist	2004-present
Superior Environmental Corp.	Staff Hydrogeologist/Project Manager	1994-2004
	Marketing Representative	1992-1994

AIPG Activities	Dates
National Ethics Committee Chairperson	2017-present
National Presidential Certificate of Merit	2019
Design Editor, The Professional Geologist	2017-present
Michigan Section Executive Committee Secretary through Past-President	2017-2021
Michigan Section Technical Workshop Co-founder & Co-chair/Chair	2011-present
Michigan Section Field Trip Coordinator & Co-Coordinator	2008, 2010-2013, 2016, 2018, 2019
Michigan Section Newsletter Assistant Editor	2011-present
National Section Leadership Award	2015
Significant Contribution to the Section Award	2008, 2011
Michigan Section Executive Committee Secretary through Past-President	2006-2010

CANDIDATE FOR AIPG NATIONAL 2024 VICE PRESIDENT



Todd McFarland

CPG-11348
Nashville, Tennessee

Statement of Purpose or Goals you have for AIPG: Continue to promote professionalism within the geological community with a focus on students and early professional members. I will accomplish this goal by coordinating with national and the state sections to support programs and initiatives to continue development of student chapters and grow early professional membership..

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

Company	Title	Dates
WSP	Assistant Vice President	2022-present
Wood (Amec Foster Wheeler)	Senior Geologist	2006-2022
Shield Environmental Associates, Inc.	Staff Geologist	2003-2006

AIPG Activities	Dates
National President Elect, President, Past President	2019-2021
National Committee Conference Chairman	2017
National Vice President	2015
National Executive Committee Member - Advisory Board	2014
Tennessee Section Past President	2014
Tennessee Section President	2013

CANDIDATE FOR AIPG NATIONAL 2024-2025 SECRETARY



Robert Andrews

CPG-11975
Lockbourne, Ohio

Statement of Purpose or Goals you have for AIPG: To assist AIPG, AIPG's National Executive Committee, and its various ad hoc committees as they support the Institute. If elected, I will fulfill the duties as Secretary and be a representative for all members of this organization.

Universities Attended	Degrees Granted	Dates
University of Kentucky	M.S. Geology	2002
College of Wooster	B.A. Geology	1989

Company	Title	Dates
City of Columbus, Division of Water	Wellfield Protection Coordinator	2007-present
Los Alamos Technical Associates	Project Geologist	2004-2007
Leggette, Brashears, & Graham	Project Geologist	2004
Kentucky Geological Survey	Geologist	1992-2004
Parsons Engineering Science	Project Scientist	1990-1992

AIPG Activities	Dates
National Executive Committee - Advisory Board Member	2023
National 2023 Conference Planning Committee (Co-Chair for Finance)	2022-present
Ohio Section Award for Outstanding Service to the Institute	2021
Ohio Section President Elect, President, Past President	2019-2021, 2021-2023
Ohio Section Treasurer	2017-2019
Ohio Section Various Ad-Hoc Committees	2014-present
Ohio Section Member-At-Large	2014-2016
Ohio Section Presidential Certificate of Merit	2019

CANDIDATE FOR AIPG NATIONAL 2024 EARLY CAREER PROFESSIONAL



Brigitte Petras

ECP-0851
Campbell, Ohio

Statement of Purpose or Goals you have for AIPG: My goals in this role are to advocate for the profession of geology and contribute to the development of AIPG's student members and early career professionals. I would engage more students and young professionals to join and participate in AIPG and its activities, such as their mentorship opportunities. I look forward to developing the Student Day and early career professional activities at the national conference.

Universities Attended	Degrees Granted	Dates
West Virginia University	M.S. Geology	2019-2021
Youngstown State University	B.S. Geology	2014-2018

Company	Title	Dates
Battelle Memorial Institute	Geologist	2021-Present
Pure Earth Resources	Geologist	2022
Greenfields Environmental Corp.	Environmental Scientist	2022
West Virginia University	Graduate Teaching & Research Assistant	2019-2021
Pearl Oil & Gas	Geology Intern	2019
Cleveland Museum of Natural History	Geology Research Intern	2017

AIPG Activities	Dates
National ECP Representative	2023
National Conference Committee– Student/ECP Day Subcommittee	2023
National Mentorship Committee	2023
Ohio Section Member-at-Large	2022, 2023
The Professional Geologist, vol. 56, issue 1	2019
Director's Award, AIPG National Student Poster Contest	2018
Youngstown State University Student Chapter President	2018
Youngstown State University Student Chapter Co-Founder	2017

Vote online! Watch for an e-mail to cast your vote or go to www.aipg.org

Professional Licensure, continued from p. 35

licensure and knowledgeable about the steps required to earn it. Plus, I'd always say that I would be of greater value to the company once I had the GRIT certificate, as that carried a greater level of responsibility with it.

Luckily, I was able to find a new job as the Laboratory Manager for a soil and construction materials consulting firm in my area. The week after I started, I had all the signatures needed for my GRIT application (including a co-signature from a notary), and off it went to Jefferson City for approval. I'm proud to say that the state of Missouri now officially recognizes me as a Geologist-Registrant-in-Training! I even have the card inside my wallet to prove it.

Despite all that progress, my work is still not done. Because my work at my first job in St. Louis wasn't approved by a registered Professional Geologist, it doesn't count towards the three years of work experience I need. Neither does the work I did in Illinois, sadly. At this rate, I won't have the three years of professional experience knocked out until 2025. And that's all assuming that I don't move out of Missouri or change jobs again. On top of that, I still need to pass the PG exam, which, although shorter than the FG exam, is no less grueling.

When I think of all those roadblocks still in my way, it's easy for me to get disheartened. It's easy to beat myself up with thoughts like "If only I'd taken the exam back in Nebraska, or stayed working in Illinois, I could have this all taken care of by now." But thoughts like those overlook the progress I've already made. I passed the FG exam on my first attempt (only about 60% of applicants do that). I landed a geoscience job with lots of potential for growth and where my contributions are felt. I'm broadening my network of other geoscientists every day. My name is on the official Missouri registry of geologists (plus I get access to their newsletter every month). Those are genuine successes that I should take pride in, not lament about how much better I could have done if things had gone the way I wanted. Because life almost never goes the way you want. Not to mention that some of the obstacles I faced were just unpredictable – I certainly never counted on a pandemic happening!

All this is to say that that the path to success is not a straight line where every check box is filled one after the other. Life gets in the way. You'll encounter setbacks, diversions, changes in your environment beyond your control. And you'll be faced with no choice other than to rebalance yourself, take stock of where you are, and keep moving forwards. Encountering failure in the past doesn't mean you can't succeed in the future. As long as you have a goal in mind and understand the steps you need to achieve it, the only missing pieces are time and persistence. Here's an illustrative example: I have one coworker who failed the FG exam three times in a row, only to then pass both the FG and the PG exams on the same day.

A Tale of Discovery

Bill Williams, CPG-11435

Abstract

The exploration for natural resources, specifically ore and oil-and-gas deposits, requires an understanding of geological principles to identify prospective areas. Both direct, e.g., geologic mapping, and indirect, e.g., geophysics, are then applied at all scales to ultimately choose locations to drill-test selected zones. Methodologies used in the process are generally not learned in university classes, but rather are learned "on-the-job" by working with experienced geologists and/or within a company's mentoring program. Furthermore, the exploration geologist must also be empathetic to the effects any work may have on the affected community's health and socioeconomic conditions as well as be aware of, and thus mitigate, the environmental impacts the field work may have, all of which must lie within the regulatory framework and, when required, properly permitted.

This is a tale of the discovery of a porphyry copper deposit in the Americas. It began with a simple geological concept, followed by regional field work to target prospective areas, followed by the delineation of prospective zones, and ultimately ended with the various drill programs that intersected the deposit at depth. Yet it was the other aspects beyond geologic principles that were instrumental in the process. Indeed, a discovery was made, except…….

Keywords: Oligocene PCD Belt, stream sediments, geophysics, drilling, discovery

Introduction

I have entered the sixth decade of exploring for natural resources whereby the first decade was occupied by the search for oil-and-gas deposits and the remaining decades were spent exploring for, developing, and overseeing operations on ore deposits with a focus on copper, zinc, and gold. My efforts to apply the relevant geological principles were challenging and it was a perpetual learning experience, but exploration for these natural resources requires a multi-disciplinary approach that goes beyond geological principles and, in fact, geosciences in general. Whereas oil-and-gas exploration is founded on drill-testing structural and/or sedimentary traps most typically in depositional basins, metals exploration focuses on the inherent physical and chemical characteristics possible in all three rock classes and the potential mineralogy, including the hydrothermal alteration of host rocks, to site drill holes. Both exploration processes use geophysics; whereas seismic data can be integral to the location of that first well to determine whether hydrocarbons have been trapped, methods identifying resistivity/conductivity and/or magnetism, e.g., induction potential, magnetotellurics, magnetometry, to interpret favorable conditions characteristic of a mineral deposit are applied to the exploration thereof. And, importantly, if that first well does not encounter any oil or gas, the "gig is up" for the most part; on the other hand, the initial test for metals is comprised of a drill program, i.e., at least a few drill holes. Moreover, if that first well discovers oil and gas, subsequent wells are drilled to not only delineate the size of the oil-and-gas deposit, but to assess the reservoir's physical characteristics, e.g., porosity, permeability, as well; on the other hand, once drill holes have determined that the mineral deposit, or the alteration known to be on the periphery of a mineral deposit, may be economically viable, many drill programs follow to collect samples in order to determine its size, the propensity of the key commodities to be extracted, smelted, and refined, among other things, to convert that mineral deposit into an ore deposit. And if those distinctions are not enough, note that in oil and gas, a "well" is drilled and when the process is initiated, it is said that the "well was spud"; for minerals exploration, it is simply a drill hole, which is "collared". Most importantly, however, none of these considerations are possible without community support, mitigation of environmental impacts, and permitting.

Much of what was discussed in the preceding paragraph, apart from geologic principles, are generally not part of the curriculum necessary to be granted a B.S. degree in Geology at universities in the United States. In fact, it is not necessary to obtain an M.S. degree on a topic that segues into a job where that topic is applicable. Indeed, I obtained my M.S. in Geology documenting a feeble effort to discern the geochemistry and superposed folding in a patch of rock older than 2,500 my that was part of the oldest outcrops in the conterminous United States; my first job as a professional geologist was exploring for oil-and-gas deposits in the Gulf of Mexico, one of the youngest hydrocarbon basins in the world. A transition from very old amphibolite facies rocks and trondhjemites to Mississippi muds. Huh!

With that background, the following is a story about the discovery of a porphyry copper deposit (PCD). It discusses the aspects of that process from the beginning to the present day (the period to this tale has not been inserted yet). The discussion includes some basic geologic principles, but most of this story is about the other factors that contributed to the discovery, many of which are learned outside of university education.

The Concept

The northern Chilean Andes are the expression of plate subduction since the Jurassic. The processes related to subduction are ideal for the formation of PCDs, a deposit type that can host large tonnages of copper that are easily extracted by both leaching and/or flotation methods; in fact, PCDs account for 40% of the world's copper production today. And it is common knowledge that the known PCDs in northern Chile formed time-specific, NS-trending belts during the Tertiary, e.g., the Paleocene Belt, the Oligocene Belt. During the 1990s, substantial money was spent exploring for PCDs in northern Chile and significant discoveries were made, e.g., Spence.

The extension of these time-specific, linear belts in Chile does not clearly extrapolate into Peru, especially the prolific Oligocene PCD Belt, within which lie the La Escondida and Chuquicamata PCDs. And any projection of that belt, regardless of geometry and orientation, would invariably lie across some of the most rugged terrain, much of which was >4,000 meters above sea level (masl), in Peru; as big as the area could be, it was highly unlikely that all of it had been properly mapped, sampled, and evaluated with modern methods.

It was upon this concept that this tale of discovery commenced, which led to the definition of a 100km x 200km target area presumed to be the extension of Chile's prolific Oligocene PCD Belt in southern Peru.

The Methodology

Regional Evaluation

Large area. Rugged terrain. Limited roads. And only a few geologists. Worse yet, the onset of the 21st century was not friendly to metals prices so the first things that got cut were exploration budgets and geologists; fortunately, some geologists were assigned to work at the mines, a task that most exploration geologists find boring. Thus, a small staff with a substantially reduced budget would have to get the job done.

The most cost-effective direct method of regional exploration was to collect stream-sediment samples and analyze the geochemistry. Hundreds of samples were collected. Protocols for sampling and sieving the sediments were established and clearly communicated. Geologists walked up and down hundreds of meters of critical relief day after day. Sometimes one person could only collect two or three samples a day as there was no road access to many of the rivers and streams. Care was taken to sample every stream because no one wanted to return to an area and walk up and down any visited canyon twice! At one point, two geologists were detained overnight for alleged "trespassing" on communal land; lawyers don't resolve issues like this in this part of the world, geologists do, and these geologists were released the following morning.

Nearly a year passed before all sample results were received and plotted on a map.

Local Evaluation

The principle of sampling stream sediments is that any geochemical anomaly would be indicative of a mineralized outcrop(s) upstream. So, various elements were plotted up on maps and anomalies circled. This then required field follow up that included mapping and sampling of the presumed anomalous rocks. After various follow ups yielded no joy, only one area was left to verify.

Three geologists with their technical assistants – always travel in twos for safety reasons and, besides, geologists always collect "too many" samples and can't carry them all – did various traverses. One thing notable in the high Andes of Peru is that locals have walked much of that ground at high altitude for various reasons and they recognize "color"; this goes back to their ancestors (Incas), who were very good miners that knew how to extract metals, especially gold, silver, and copper. Thus, throughout the high country, many areas have small pits from which mineralized rocks were collected. Our work only found one pit with a very narrow vein containing tetrahedrite. Some dikes with copper oxides were also encountered. But, overall, the area was covered by a veneer of glacial deposits and true outcrops were hard to distinguish; in fact, a cirque, at least 700m across and with critical relief of at least 100m, was filled with a meters-thick pile of boulders.

The mapping and sampling were completed. Interesting copper anomalies were found and even daylighting copper oxides, but nothing seemed to hold together. Part of the problem was the outcrops – quartzite and redbed shales and siltstones. Yet there had to be "blind" intrusions causing the anomalies and the various dikes that were mapped supported that idea.

The budget was tight, but more information was needed. Geophysics! As it turned out, a trusted colleague was acquiring geophysics for another company a mere ten kilometers from the project. I convinced him to run a couple of induction potential (IP) lines across the prospect to save money on the mobilization costs (it was a remote location, and he was already there!). IP yields two data sets: 1) induction potential, which detects the difference when there is movement between a conductor and the magnetic field and can be indicative of disseminated sulfide mineralization and 2) resistivity/conductivity, the latter which can be indicative of more massive sulfide mineralization. The quartzite would be resistive, so if there were any sulfides below the surface, they would show up at least on the IP and, if "clustered", could be a conductor. The planned principal IP line started as far back against the high wall of the cirque then outward for 1,000m. Well, the quartzite was fractured and didn't hold any water near the surface, and the IP tool does not work without water; the geophysicist poured buckets of water at the stations so that a current could be sent beneath the surface. A failure.

Well, more money for drilling. We had to drill it! I gave the project a name of a small village approximately 15km from the site. I didn't want anybody to locate this project.

The Drilling

Motivated by a limited budget, I negotiated a turnkey price, i.e., all-inclusive cost per meter – if I guaranteed 1,000 m of reverse-circulation drilling. This is not a lot for a drill program and the only reason the drilling contractor agreed is that he wanted to use this turnkey contract, a type of contract

not common at that time, as a marketing tool for his newly formed company.

The crew got there late in the year and the rainy season was approaching. Rain at near-freezing temperatures at 4,200 masl is not an ideal work condition, let alone pleasant for those in a pup-tent camp that was infested with pericotes, which is Spanish for a large muskrat.

We were working in what was one of the most impoverished rural areas of Peru, so anybody who wanted to work, could work; but payday was Monday because any Friday payday was fraught with heavy weekend consumption of mind-altering liquids (and none of the kind you're thinking). So, the children and women were spectators to the drill program as there was no cable TV out there; they spoke little Spanish as Quechua was their tongue. One of the occasional spectators was a blue-eyed, blonde teacher who only spoke Quechua, something that compromises the senses but was in fact a reminder that the English were in town mining gold during the 1950s.

The drilling was difficult. We were using a face-sampling hammer, an invention that improved sample quality by minimizing contamination of ground rock samples as they went up through the middle of the hammer and directly into the inner tube of the drill pipe; with conventional drill bits or hammers, air/water was forced down the inner tube, but ground rock samples moved upwards in the annulus, the area between the drill pipe and rock, and into a crossover a few feet above the drill bit where the sample entered into the outer tube of the drill pipe, thus increasing the possibility of contamination. The face-sampling hammer worked well until we cut through the oxidized zone and hit the water table at the contact with the sulfide zone; the drillers couldn't control the water flow and the holes were lost. This was a problem. We needed to drill 1,000m.

It is important to note that in the oil industry, the company drilling engineer oversees everything and the geologist is generally limited to logging samples, and often there's a third party doing that task. Drilling for mineral deposits requires that the geologist runs the show and must have knowledge of the mechanics of drilling to be able to properly supervise the driller that works for the drill company. What class was that taught in?

Well, things were not going well. One of the drill holes was near an area with copper oxides hosted by a dike. It too was lost at a shallow depth.

It seemed hopeless. I was communicating with the geologist by satellite phone and his frustration was obvious – he brought up the pericotes. Oh, it was raining and 30º F. The drill rig was useless. Etc.

This is when creativity really takes hold. Yep, we're in the extension of that prolific Oligocene PCD Belt. Yep, we killed it with the stream-sediment sampling program. Yep, copper oxides daylighted on the property. And yep, we couldn't drill past 80m in most places. So, I told the geologist that the drill rig should mast down at that dike, enter the exit road, and mast up and drill like hell at the first flat spot! Genius, no? Except that just when hole trouble started, the axle on the driller's water truck broke. No water, no drilling. Hallelujah! No requirement to pay up for the few hundred meters not drilled and everyone gets paid!

The Results

Andean exploration geologists in the mining industry never work a fixed schedule. They stay in the field until the hot dogs in the cooler turn green. When they get back home, family quality time prevails, but the rocks beckon and call. I knew that the staff had returned to Lima, but they didn't come into the office for a few days without notice. No need to call them. They'd eventually show up. They deserved some time off.

When drilling with a face-sampling hammer, samples are chips that are as much as three or four times the size of the holes in a common kitchen sieve. A select part of the >2kg sample is collected and put into a compartmentalized plastic box, heretofore referred to as the chip box, for storage and possible review at a later date.

A few weeks later, the sample analytical results were received. The lowermost ten meters of the last hole drilled, #7, reported 1.2% copper. OMG. The geologist requested the chip boxes be sent to the Lima office immediately. They arrived a couple of days later and the geologist and I put our hand lenses on that interval. Neither of us saw any copper of any significance; maybe a black speck or two that could have been chalcocite. In the corner of my eye, I could see the geologist hang his head. When I asked him what happened, he looked at me and said that they had sieved all of the samples, thus only the coarse fraction was kept in the chip boxes. In other words, the copper, likely chalcocite, was in the fines, and they had been discarded. Perhaps not a discovery yet, but we were on to something.

The Return

I was faced with the closure of the office the following year and was told to drill the best two prospects in the portfolio in order to justify the continuation of the exploration program. One of the prospects was not worthy of the drill bit, but I was under orders; the second one was Phase II at our "discovery". It was on.

The area across the river to the north was being offered in a privatization tender administered by the government. Given our interest in that property, I was hosting my superior once removed plus our in-house PCD expert to visit that property. The helicopter landed and the project geologist, his moniker is Chip hereinafter, approached us as we disembarked. Chip was about ten meters from us when he tripped and fell and the rock he was holding slipped out of his hands and split in two when it hit the ground. As we helped him up, the three of us realized that the core of the broken rock was composed of massive chalcocite. Oh my! The geologist said they found it when making the drill roads; he also confessed that he had broken it with his hammer before our landing and only pretended to trip and fall to feign the breaking of the rock.

He then passed a chip box each to the PCD expert and me saying that it was mostly pyrite. After glancing over a few compartments in the chip box with our hand lenses, the expert and I lifted our heads and looked at each other and almost simultaneously said, "It's bornite!" That came from hole #8, which is what we considered the discovery hole in the eastern sector of this PCD. The geologist is no longer called Chip.

The Budget

The review of the property to be privatized went quickly as a site visit to the discovery was warranted. There was not much time because given the altitude and the afternoon weather, the

helicopter had to leave early. Holding the hand of the top dog was worthwhile as not only was the budget increased to drill more, but money was also granted to buy a few trucks given that our geologist had arrived at the helicopter landing site in a borrowed truck; our trucks were broken down in camp.

Phase III Drilling

With plenty of money to pursue our discovery but totally lacking numbers and expertise geologically in the field, we slowly tried to put the story together. At one point the geologist informed me by satellite phone that the bulldozer making our drill roads (yes, geologists have to "engineer" roads) in the western sector had exposed a leached cap, which is the part of the PCD where pyrite had been dissolved by weathering thus forming sulfuric acid that leached the copper-bearing minerals, in this case mostly chalcopyrite; in fact, upon closer inspection in a proximal drainage, thin veneers of chalcocite, formed from those copper-bearing fluids above, were recognized in small eroded quartzite chips. However, chalcocite was not a major constituent of the deposit, and we did have a long intercept of high-grade copper in oxide mineralization, which is considered the discovery hole for the western sector of this PCD; we estimated ~1Mt of copper in oxide minerals overall after completing the third phase of drilling but couldn't rightfully estimate the sulfide portion of the deposit. Unfortunately, we did not drill enough around that leached cap in the western sector and we could never drill through the colluvium comprised of large boulders in the cirque in the eastern sector. This program was eventually cut off from any more funding as it was regarded internally as an insignificant discovery; the exploration program was terminated soon thereafter, and the office was eventually closed.

The End

The property was optioned to a Canadian junior company who managed to drill through the glacial boulders in the cirque and intercepted a high-grade copper zone in the eastern sector; nearly 30,000m had been drilled on the project by that time. Their perseverance resulted in the delineation of over 5Mt of contained copper at potentially economic grades. This geologic team successfully interpreted this complex deposit, which included various igneous phases as well as post-mineral thrust faults that dismembered this PCD. They sold the deposit to a major copper company who had the financial resources to build a mine, if indeed it would be determined to be an ore deposit one day. Today, the project's future is questionable as the communities in the area are unhappy about a nearby mine operation. There has been essentially no activity at the project for over ten years.

Post Script

A discovery is what an exploration geologist works for. Making that discovery a mine, or a producing oil/gas deposit, is the ultimate end, then on to the next one. Unfortunately, this discovery has yet to become a mine, which technically renders the venture a failure. Nevertheless, it's not all about geology. It is about the community and their involvement, the mitigation of environmental impacts, the sampling program design, a safe camp and good food therein, the control of the drill program, and all other things related. It is important to recognize that no exploration work gets done and no mine gets built without community consent.

On my last day in the office prior to my repatriation, I told the group there is one thing they will never take away from our time together – this discovery experience - and that they take every aspect of it and use it; I know that some of them have. We did everything we could, except to make a mine……

New Website Illuminates COVID-19 Pandemic's Impact on Geoscience

As with the rest of the geoscience community, AIPG members have been profoundly affected by the coronavirus pandemic. Disruptions have transformed higher education, business and industry, and the broader economy. Beyond such generalizations, though, how are we to understand the specific effects of the pandemic on the geosciences? Which effects are most pronounced? And which appear to be lasting?

To help shed light on such questions, the American Geosciences Institute (AGI) recently unveiled its Geoscience COVID-19 Impacts Study website (https://covid19.americangeosciences.org/) sharing findings and insights from a three-year study supported by the National Science Foundation (Award #2029570). The website provides a look at how the pandemic has changed the geosciences in recent years, with resources including a wealth of data briefs, presentations, and an archive of oral histories from the project.

Over the past three years, the Geoscience COVID-19 Impacts Study has examined the nature and extent of the COVID-19 pandemic's impact on the geoscience workforce and academic programs, from early effects to more permanent changes in the workforce and academia. The project's oral histories and webinars offer in-depth looks at the strategies used by employers, academic departments, faculty, recent graduates, and post-doctoral fellows to overcome pandemic-related impacts on their work, research, and learning.

Geoscience professionals of varied backgrounds have participated in the study's periodic surveys in recent years. AGI's analyses paint a larger picture of the pandemic's effects on academia and other workplaces.

In the coming months, AGI will continue enriching Geoscience COVID-19 Impacts Study website, a uniquely useful resource, with additional data, oral histories, and the final project report.

Funding for this project is provided by the National Science Foundation (Award #2029570). The results and interpretation of the survey are the views of AGI and not those of the National Science Foundation.

AIPG is a member society of the AGI federation of scientific and professional associations representing over a quarter-million geoscientists. AIPG's individual members enjoy enhanced access to a variety of resources and benefits (https://www.americangeosciences.org/members/benefits)through their affiliation with AGI. To learn more, visit AGI today (https://www.americangeosciences.org/).

In Memoriam

Dave Holmes, CPG-06316

Lakewood, Colorado

July 18, 1934 - June 13, 2022

Member Since 1983



Obituary information collected and provided by David Abbott, CPG-04570.

Dave Holmes passed away peacefully at his home in Lakewood on June 13, 2022, with his wife, Fely, at his side. He was 87. The couple had recently moved from Montrose, Colo., to be closer to their large and growing family. During their 52-year marriage, they lived in various locations in Australia and the United States and traveled widely both internationally and in the U.S. Holmes was a highly respected authority and friend to the US industrial minerals sector. Holmes joined the Society for Mining, Metallurgy, and Exploration (SME) in 1964 and was a Legion of Honor Member. He was a long-time supporter of the Forum on the Geology of Industrial Minerals and frequently contributed papers to the Forum. He received his Certification as a Professional Geologist from the American Institute of Professional Geologists in 1983 and served as an officer of the Colorado Section over the years. He was also a long-time Fellow of the Australasian Institute of Mining and Metallurgy.

Holmes was born in Tacoma, Washington, on July 18, 1934. He graduated from the University of Puget Sound in 1956 with a Bachelor of Science degree and received his Master of Science in Geology from the University of Idaho in 1958. His first job was with the US Geological Survey mapping the course of two previously unsurveyed rives in Idaho. Holmes held the position of Exploration Manager at Occidental Petroleum, then at Burlington Northern Resources, evaluating the minerals in the railroad-owned checkerboard sections in western states. In 1991, Holmes started a long career as an industrial minerals consultant evaluating industrial mineral resources worldwide, assisting clients on mineral development and business issues, much of it overseas, he worked on 40 projects in 26 countries.

For a number of years. he served as an adjunct professor at the Colorado School of Mines, teaching an undergrad/grad course on Industrial Minerals Geology every other year until 2013. He completed his full-time professional journey with a nine-year stint working with Native American tribes through the Bureau of Indian Affairs beginning in 2004. He acted as Technical Advisor to Indian Tribes on mineral assessment and development issues, preparing regional marketing studies of aggregates and industrial minerals for Tribal business. Thereafter, he continued with part-time consulting work.

In addition to his extensive knowledge of industrial minerals, Holmes was always excellent company regaling colorful tales of mineral exploration at home and abroad (and not only about zeolites, one of his favorites). Holmes was particularly passionate about mentoring young hopefuls taking their first steps into the industry. Lynn Carpenter, a colleague at the BIA, recalled, "I still have times when I wish I could call Dave and ask his opinion on something completely obscure—he'd say, 'Oh I've seen that deposit' or 'that deposit sounds very much like XXX deposit that I mapped 40 years ago,' or something like that. Such a wealth of knowledge and SUCH a mentor. So generous. He is and will be missed."



David Holmes with Lynn Carpenter and Tom Newman at the 2013 SME Annual Meeting in Denver.

Alistair Turner, CPG-07056

Littleton, Colorado

November 7, 1942 - April 3, 2021

Member Since 1986



The following information and photograph were excerpted from the Horan & McConaty funeral services website…

Alistair Ronald Turner passed away April 3, 2021 at the age of 78. He was born November 7, 1942 to Dr. James Ronald and Helen Muriel Turner in Kilcoy, Queensland, Australia where his father was serving as a medical doctor during World War II. In 1947, Alistair and his family moved back to their home country of New Zealand where he was raised and educated. Alistair earned his Bachelor of Science degree in Geology from Canterbury University in Christchurch and later continued his post graduate studies at the University of Adelaide in South Australia, earning a Master of Science degree in Economic Geology. On October 8, 1966, Alistair and Kristen McDonald were married in Blenheim, New Zealand.

Alistair was a dedicated Professional Geologist specializing in precious metal exploration. His work took him to many locations throughout Australia for the Anaconda Company in search of nickel and gold deposits including the Kalgoorlie region of Western Australia. In 1977, Alistair accepted a new position from Anaconda in the USA to explore the Stillwater district in Montana principally for chromium, platinum, and palladium. As a result, he and Kristen and their young family immigrated to the USA, settling in the small mountain town of Nye. While in Montana, Alistair explored the Beartooth Range (Stillwater Valley) discovering economic deposits of chromium and palladium which are being mined to this day. In 1979, Alistair moved for a final time with his family to

Littleton, Colorado to work from Anaconda's North American headquarters in Denver. In 1989, he led the North American branch of the Australian-based company Boulder Gold Group in Denver, developing precious metal and steel projects. His work took him all over the world including Alaska, Canada, South Africa, Madagascar, Mauritius, Iceland, Germany, and Russia prior to retirement. Alistair was well respected by his peers for his knowledge and strong work ethic. These traits have been passed down to his family of which he was immensely proud and supportive.

Alistair enjoyed exploring the western USA with his family on camping vacations visiting many different National Parks and other points of interest. Alistair was good with his hands, completing carpentry and home improvement projects in his spare time and was an avid stamp and coin collector.

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.

Robert (Bob) J. Melvin, CPG-08686

Lakewood, Colorado

December 8, 2022

Member Since 1992



Robert graduated from the University of Pittsburgh in 1978 with a degree in Earth and Planetary Sciences. He was a hydrogeologist and environmental specialist with ICF Kaiser from 1987 through 1994, and then with the Arcanum Group from 1999 through 2015. Robert was a CPG since 1992, and passed away on December 8, 2022 in Lakewood, Colorado.

Jerome Cuzella, MEM-0293

Lakewood, Colorado

December 31, 1949 - November 24, 2022

Member Since 2003



Obituary provided by Douglas Peters from Rocky Mountain Association of Geologists.

The Rocky Mountain Association of Geologist is incredibly saddened to announce Jerome John "Jerry" Cuzella, 72, of Lakewood, Colorado, passed away on November 24, 2022 at home in Lakewood.

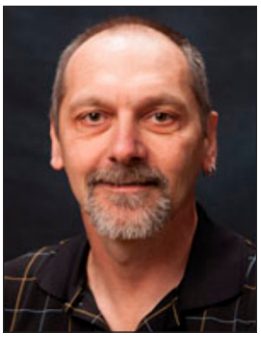
Jerry was born in Illinois to Jerry F. and Amelia Cuzella on December 31, 1949. An incredibly diligent and intelligent man, he earned a B.S. in Geology from St. Joseph's College in 1971; an M.S. in Geology from Bowling Green University in 1973; and a professional degree in Hydrogeology from the Colorado School of Mines in 1993. With 49 years of experience, Jerry enjoyed a highly productive career in the oil and gas industry beginning with his work for Sargent & Lundy in 1973, through his work for Amoco International Oil Company, the U.S. Department of Interior, Anadarko Petroleum Corp., the National Cooperative Refinery Association, Anderson Oil Company, Redstone Resources, Inc., Enduring Resources, LLC, BOPCO, LP, and the U.S. Department of Interior, Office of Indian Energy and Economic Development. He had served as president, publications committee chair, and vice president of the Rocky Mountain Association of Geologists ("RMAG") and as North Central Section treasurer for the Association of Environmental and Engineering Geologists ("AEG"). Jerry was a member of the American Association of Petroleum Geologists ("AAPG"), American Institute of Professional Geologists, AEG, Geological Society of America, and the American Institute of Professional Geologists. He received a public service award from the AAPG in 2013, a distinguished public service award from the RMAG in 2005 and was recognized as an honorary member of the RMAG in 2012. Jerry was an active member of the geological educational community in Colorado through his organization involvement and oversaw the applications and selection of earth science teachers for the RMAG Excellence in Teaching of Earth Science Award. He was instrumental in the City of Denver's design of the geological display at the Red Rocks Park visitor center and educational materials distributed throughout schools in the metro area in connection with the display at the Park. Jerry was chair of the AAPG Youth Education Activities Committee in 2009 for the AAPG annual convention and in this role, he organized and designed teachers' field course events at Dinosaur Ridge in Colorado. Jerry was an incredible public servant. Jerry has numerous geological publications to his name including Application of Structural Methods to Rocky Mountain Hydrocarbon Exploration and Development, published in association with the American Association of Petroleum Geologists in 2013.

In short, he greatly enjoyed the outdoors, including hiking, hunting, fishing, and skiing. He served the Boy Scouts of America in various leadership roles over the years, including as adult troop leader for the Philmont Scout Ranch in Cimarron, New Mexico in 2001 where he led a troop of scouts on a 105 mile trek through the back-country and helped the scouts earn their geology merit badges. His service extended to his religious life in which he served his church community at St. Bernadette's Catholic Church in Lakewood, Colorado and the Knights of Columbus in many roles including lector, eucharistic minister, and 3rd degree Knight for over 20 years.

Jerry loved music, cooking, debating the merits of good wine, "dad" jokes, and teasing his loving wife and two children.

Jerry is survived by his devoted wife, Virginia, two children, Jeanette and James, dear sister, Cathy, his nieces and godchildren, Christina and Ann, and countless friends. He is preceded in death by his father, Jerry, and mother, Amelia.

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Remarkable, Unique & Interesting

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

My first ever geology job was summer work as a 'field remediation technician' for a small environmental consulting firm in southern Missouri. We did the standard types of field remediation that you would expect. We removed leaking underground storage tanks, responded to spills (most often oil or gasoline, but occasionally something more exciting), provided assessments of risk during commercial property transactions, monitored contaminant plumes in groundwater, and performed a host of other tasks related to environmental remediation. We also did some things that weren't routine. (For those of you who thought I was going to talk about the time I helped clean out some damaged railroad tanker cars full of animal fat heading for a rendering plant, guess again. If you are interested in that story, please refer to my column on page 26 in the Jul/Aug/Sep 2021 edition of *TPG*…) Another one of those not-so-routine tasks was to clean the rifle tube at a local sporting goods store with an indoor firing range.

The rifle tube was 225 feet long and was used mostly to 'sight-in' newly purchased rifles. For a small fee, one could bring their own rifle into the store and use the range to adjust their own weapon. The tube was just over three feet in diameter. We cleaned it every 90 days or so. The procedure required a full-face positive pressure respirator, a Tyvek suit, with gloves and boots, and taped joints to minimize exposure to any lead dust. Since I was the newest person on the team, I got to be the 'gopher,' what our group called any person who was performing a confined entry. As a bonus, this was overnight work, because the indoor rifle tube was very popular, so cleaning had to occur after hours. I also had to shave my beard to insure a good tight seal for the respirator. I was none too happy about the late hours or losing my facial hair.

The afternoon prior to cleaning the range each person on the team went to a local medical facility to have a blood draw to establish a baseline blood chemistry for later comparison. After cleaning we had another draw to determine if we had been exposed to lead during the cleaning process. I dutifully had my blood drawn and arrived at the range that evening, ready to work. I'll never forget what it was like to crawl down that tube. I'm a geologist, and I've been in dozens of mines and probably hundreds of wild caves over the course of my life and career, but nothing was quite like being in that tube, crawling all the way to the end and then working my way back, slowly cleaning, scraping, and wiping every possible surface. At the end of the tube was a small pile of lead powder, some bullet fragments, and thousands of small remnants of paper targets. About once an hour I would slowly crawl back bringing waste and expended cleaning supplies with me. Cleaning the tube generally took about four hours, and I always got a 20-minute break somewhere near the halfway point. I cleaned that range four times over the course of two years, and never once was I or anyone on the team exposed to lead. During my travels, I've never met another person who has cleaned an indoor rifle range tube, though I suspect there are several of us out there who have performed this task.

I tell this story because it makes me think about all the other remarkable, unique, and/or interesting things that geologists do. I know geologists who sample the water that accumulates when fires in commercial buildings are extinguished, because the contents of the building or the building materials themselves might be sources of contamination that must be contained. The book *Volcano Cowboys* chronicles the dangerous adventures of the team of United States Geological Survey geologists who laid the foundation for our modern ability to assess volcanic threats, often at great personal risk. Geologists often work at great depths below Earth's surface where the world's deepest mines are more than 12,500 feet underground. We've also sent at least one geologist to the moon. One of my colleagues who also happens to be godfather to my daughter, was in Alvin as they investigated the geology of the sea floor, just off the East Pacific Rise. I suspect our profession might hold the record for the greatest amount of distance between the highest and lowest elevations of our work assignments.

> "Unfortunately, most people have not even the slightest inkling of the remarkable things geologists do."

Unfortunately, most people have not even the slightest inkling of the remarkable things geologists do. Often, we hear about a new advance in medicine, or a

Continued on p. 56



The Complication of Defining A Geologist

Dawn Garcia, CPG-8313
dawnhgarciacpg@gmail.com

What is a geologist? After serving as "the Geologist" on the multi-disciplinary Arizona Board of Technical Registration, being a screening committee member for AIPG, participating as Subject Matter Expert for the Association of State Boards of Geology (ASBOG), and having discussions with a variety of domestic and international professional societies and government bodies, I have seen the complex background about why there is consternation behind the definition of a "geologist". The bafflement hits home in the story of a friend who worked for a company that won't let him use the title of "geologist" because his undergraduate degree was in earth sciences, even though he is a licensed professional geologist in multiple states and an AIPG CPG. The AIPG Executive Committee is having discussions about the CPG qualifications and how to review transcripts from applicants who have majors with non-traditional nomenclature, that is based on an interdisciplinary degree, and have taken classes with names that don't follow a checklist.

Does soil physics equate to geology?

How about a degree in meteorology, physical oceanography, agronomy, or soil chemistry?

Does a Bachelor of Arts in Sustainability Management have enough geology-centric coursework to qualify that applicant as a geologist?

What curriculum is covered in the "earth systems" class?

How do we know when it's just semantics as opposed to core differences in the lecture material?

Even geology majors can be overwhelmed when talking to practicing geologists and finding out about the enormous range of work carried out by geologists. I'm paraphrasing, but the gist of the remark made by a student recently was "I had no idea about all the things that geologists do and where they work." I'm in total agreement. It is fascinating to learn what other geologists do. It's also difficult to ensure that AIPG and other professional organizations have similar definitions of "geologist"

> *"Being able to have a standard ruler to measure out a person's qualifications to be licensed or certified as a geologist has become complex."*

Being able to have a standard ruler to measure out a person's qualifications to be licensed or certified as a geologist has become complex. The states that license geologists have a wide variety of criteria. In general, education, experience, and passing the ASBOG examination are the basic requirements, but there are exceptions. California has taken the approach of listing classes and the minimum number of credits to establish a qualifying degree and coursework. California Code of Regulations, Title 16, Division 29, §3022 requires that the applicant graduate *"from a college or university with a major in geological sciences or any other discipline relevant to geology"* where graduation must be *"with a baccalaureate degree or higher in geology or a related geological science from a program accredited by the Applied and Natural Science Accreditation Commission of ABET, Inc., the organization defined in Section 404(a) of Title 16, California Code of Regulations."* The applicant must have successfully completed 30 semester hours in relevant geology courses, including 15 hours of geologic concepts, 4 hours of earth materials, 3 hours of structural geology, 3 hours of stratigraphy and sedimentation, and 5 hours of upper-division field geology. The regulation provides definitions of the topics in those courses, and a list of applied upper-division geology coursework that is acceptable to meet a minimum of 6 semester hours (such as geomorphology, engineering geology, hydrogeology, California geology, paleontology, resources geology, environmental geology, geophysics, technology applications in geology, and applied geoscience topics).

In other states the requirements are very different from the California requirements. Alaska's professional geologist certification requires that the applicant must first be an AIPG CPG before applying. Alaska has no board of geologists; Professional certification is based solely upon the registration requirements of AIPG. Arizona's regulations do not specify the degree type, nor the minimum number of credit hours. I think that these traits stem partially to being early in the game to

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

1. The geometric configuration and three-dimensional morphology of geologic features are important in our understanding of their geneses and significance. Of the following, which would best mimic the shape of a chevron syncline?

a) $x^2 + y^2 = 1$.
b) $y = 2|x|$.
c) $y = x^2$.
d) $y = 2x$.
e) Hey, hombre, this is starting on a reeeeaaaal bad note!!!!

2. Regarding the geologic history of Europe, which of the following orogenies occurred in the Devonian-Carboniferous time frame?

a) Variscan.
b) Caledonian.
c) Alpine.
d) Uralian.
e) "Don't know much about history, don't know much biology, don't know much about science books, don't know much about the French I took…."

3. These single-celled organisms with shells of cellulose are classified as phytoplankton, although they have characteristics of both plants and animals. The vast majority are marine, but some inhabit freshwater bodies. They are important in present-day environments and in the fossil record. Marine varieties play a major role in the biology of coral reefs. They can produce toxins that may accumulate in shellfish. What are we describing?

a) Diatoms.
b) Dinoflagellates.
c) Gyrogonites.
d) Agglutinated foraminifera.
e) Horrid little critters.

4. The formula $C_{10}H_{16}O$ describes:

a) Amber.
b) Cyclohexane.
c) Benzene.
d) Azulane.
e) Is this beer, dude? I'll have another one…

5. With which type of soil would you associate the presence of bauxite?

a) Pedalfer.
b) Pedocal.
c) Laterite.
d) Caliche.
e) Gooey soils, dude. I was doing field work once and fell flat on my face onto one of these and lost my lunch box, one of my field boots, my hard hat, my Brunton compass, my alidade, my rock hammer, my supply of M&Ms, my bags of popcorn, my bottles of bourbon…It was tragic, man…



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
303-394-0321, dmageol@msn.com

False and Misleading Mining Exploration Press Releases

Mining exploration is a very risky business. Public mining exploration companies compete for funding by selling stock and by issuing press releases that hopefully will encourage investors to buy more stock and increase the stock's price. There is a great temptation to make the reported activities seem more encouraging than warranted. This discussion uses press releases by two rare earth element (REE) exploration companies to illustrate various false and misleading statements.[1] REE exploration involves not only the significant geological risks of mining exploration, but also the risks associated with the difficulties and risks associated with processing REE-bearing minerals to produce the oxides of the individual REE elements.

Major rare earths deposit confirmed—project 1 press release highlights:

- Maiden drill program completed.
- Nine core holes drilled, for 917 meters (3,008 feet).
- High-grade XRF observations ranged from >3,000 ppm to values exceeding 20,000 ppm.
- Consistent REE enrichment to at least 100 meters (350 feet).
- 822 core samples sent to [named] assay labs for analysis.
- Planning for maiden resource drilling underway.

Highlight—*what they want you to read*: an encouraging maiden drill program was completed and "maiden resource" additional drilling program is underway. *What they don't want you to read:* this is the initial drilling on the prospect; the suggestion that a major REE deposit has been identified appears to be unjustified.

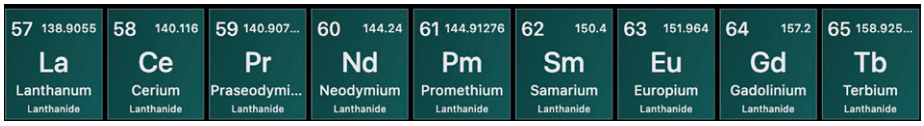
Highlight—*what they want you to read:* nine core holes drilled, for 917 meters (3,008 feet). *What they don't want you to read:* The nine holes were drilled in two different areas about 5 km apart. Five holes are clustered in area A and four holes were drilled along an SW-NE line over 1 km in area B. The suggestion that a major REE deposit has been identified appears unjustified.[2]

Highlight—*what they want you to read*: high-grade XRF observations ranged from >3,000 ppm to values exceeding 20,000 ppm. *What they don't want you to read:* XRF from an Olympus Vanta 3-beam XRF spot depth measurements on 1 vein and 3 core holes. Analyses were for lanthanum, cerium, neodymium, and praseodymium. "It should be noted that these values are qualitative and cannot be construed as mineable grades." The 20,603 ppm reading was from one allanite sample. The 31 common rock samples averaged 2,990 ppm with a maximum of 6,897 ppm and a minimum of 500 ppm.

Highlight—*what they want you to read:* there was consistent REE enrichment to at least 100 meters (350 feet). *What they don't want you to read:* the 31 common rock sample XRF analyses for La_2O_3 + Ce_2O_3 + Nd_2O_3 + Pr_2O_3 were variable, averaging 2,990 ppm with a standard deviation of 1,657, a maximum of 6,897 ppm, and a minimum of 500 ppm. This is hardly "consistent" enrichment.

Highlight—*what they want you to read:* "overall, core across all 5 [area A] holes was homogeneous. This homogeneity, coupled with the XRF field assays, indicates the Red Mountain Pluton, which encompasses [both project areas], is potentially an incredibly massive REE mineralized structure. …If the lab assays match XRF field assays, the Company will be highly motivated to work toward a maiden resource…" *What they don't want you to read:* The lab assays for all samples are unlikely to match the XRF assays. The XRF analyses were not homogeneous.

Highlight—*what they want you to read:* "We are extremely excited about what we are seeing in this world-class project as it continues to exceed our expectations. …Based on the sheer size, scale, and grade of this deposit, [the project] has the potential to be one of the largest rare earths projects in the US." *What they don't want you to read:*

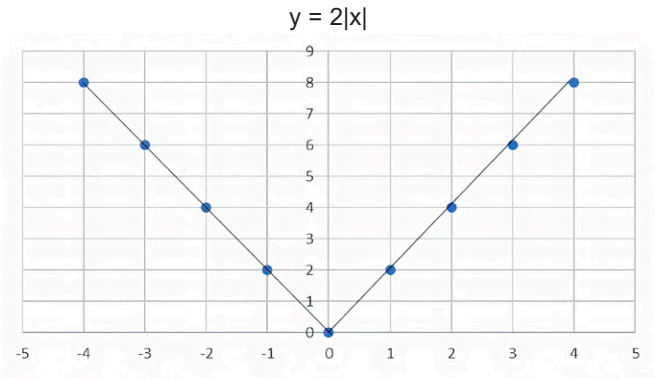


Continued on p. 48

1. REEs are primarily those elements in the lanthanide series that are shown as the upper of the two horizontal bars at the bottom of the periodic table. The chemical characteristics of the REEs are very similar thus making the separation of the various REE oxides metallurgically or chemically complex. The primary minerals in which REEs occur are monazite, (Ce, La, Th)PO_4, or bastnaesite, CeCO3(OH, F).
2. The format, "what they want you to read" and "what they don't want you to read" is based on *The Fabrication of a Mining Company* by Douglas B. Silver for the Western Gold Explo held in Denver in September 1989.

Answers:

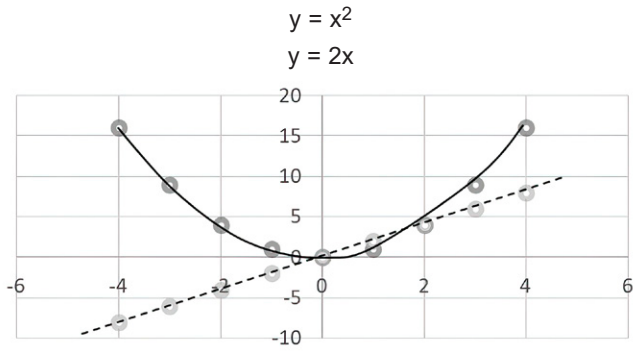
1. The answer is choice "b" or "y = 2|x|". Since "y" is a function of the absolute value of "x", "y" is always positive. A graph of the function is shown to the right:



Chevron synclines or the V-shaped valleys of a young stream are approximated by the geometric configuration of the general equation y = m|x-h|+ k. In the equation, the vertex occurs at (h,k) and "m" is the slope.

Choice "a" is a circle of radius r = 1. Oolites, rounded boulders, etc., may have cross-sectional profiles approaching circular shapes.

Choices "c" and "d" are the equations of a parabola, $y = (x-h)^2 + k$, and a line, y = mx + b, respectively. In our case, these simplify to $y = x^2$ and y = 2x. These are graphed to the right:



Concave-upward parabolic shapes are found in more gently folded synclinal structures, glacial valleys, etc. A linear equation of the form y = 2x has a slope m=2 and may represent a shear fracture where the angle between the minor principal stress (horizontal) and the crack itself is approximately 63º (Please note that this angle is distorted in the graph due to the difference between the vertical and horizontal scales).

2. The answer is choice "a" or "Variscan."

Orogeny	Time Frame	Comments
Alpine	Eocene-Miocene	Uplift of the Alpine mountains of Europe, the Middle East and NW Africa. Deformation of the Carpathian Mountains (stretching from the Czech Republic to Romania) started in Jurassic-Cretaceous continuing through the Eocene.
Uralian	Permian	Linear deformations and mountain building in the Ural Mountains of western Russia.
Variscan or Hercynean	Devonian through Carboniferous	Deformation of western Iberia, SW Ireland, SW England, central and western France, southern Germany, Czech Republic.
Caledonian	Ordovician to Silurian	Deformation of western Scandinavia, Britain, Ireland.

3. The answer is choice "b" or "dinoflagellates." Dinoflagellates possess two flagella, one transverse and another longitudinal. The transverse flagellum occurs around the center of the organism and allows for forward motion and spin. The longitudinal flagellum acts more like a rudder. During "red tides", caused by an excess of nutrients, blooms of these organisms produce toxins that can kill fish and make shellfish dangerous for humans to eat. The toxins can also make the surrounding air problematic to breathe. The blooms often turn the water red. More commonly dinoflagellate bioluminescence is bluish-green in color.

Diatoms are also a form of phytoplankton, but their shells are made of silica (SiO_2) rather than cellulose $(C_6H_{10}O_5)_n$. Unlike dinoflagellates, diatoms thrive off the excess phosphates, nitrates, and silicates. According to Harrison et al, (2015), larger diatoms have cell volumes 200,000 times greater than small diatoms. In contrast, large dinoflagellates have cell volumes 1,500 times greater than small dinoflagellates.

Charophytes are a class of fresh water green algae that is well represented in the fossil record. The oogonium is the female reproductive organ of these algae. Fossilized oogonia or gyrogonites can be found in the stratigraphic record.

Agglutinated foraminifera are single-celled benthic marine to brackish-water microfossils (animals) that build their tests by gluing sedimentary grains together, in contrast to the other types of foraminifera which secrete calcium carbonate to form their shells.

4. The answer is "a" or "Amber." Amber is the hardened and fossilized resin of certain trees, popularly used as jewelry, etc. As a compound of organic acids, it consists of around 78% carbon, approximately 11% oxygen and about 10% hydrogen. Insects and plant remain are found preserved in amber. Some well-known amber deposits are found in the Dominican Republic, the Baltic region of Europe and in Myanmar.

Choice "b" or cyclohexane is a hydrocarbon comprised of a ring of six carbon atoms surrounded by twelve atoms of hydrogen. It may be used as a raw material in the manufacturing of nylon. It has a role as a non-polar solvent (a fluid with non-polar molecules that dissolves covalent compounds and is not miscible with water). It is a volatile organic compound.

Choice "c" is benzene (C_6H_6) or a hydrocarbon consisting of a ring of six carbon atoms with one hydrogen atom attached to each. Benzene is a colorless volatile liquid hydrocarbon present in coal tar and petroleum. It is used in the production of plastics, resins, nylon and synthetic fibers, detergents, pesticides, dyes, lubricants, rubber, and drugs.

Choice "d" is azulene ($C_{10}H_8$), an organic compound and an isomer of naphthalene. As isomers, both naphthalene and azulene have the same chemical formula but different interatomic arrangements and properties. Naphthalene is a white, crystalline, water-insoluble hydrocarbon obtainable from coal tar. It is used in the manufacturing of dyes and as a moth repellant. In contrast to naphthalene, azulene is dark blue. The atomic structure of naphthalene is more stable than that of azulene.

5. The answer is choice "c" or "Laterites."

Laterites are nutrient-poor soils rich in aluminum and iron oxides occurring in tropical areas with high rainfall and intense leaching. These are found in hot, wet, tropical areas. Bauxite (the main source of commercial aluminum) is found associated with laterites.

Pedalfers are soils rich in aluminum and iron oxides forming thick soils in temperate climates. These dark brown, fertile soils are common in deciduous forests.

Pedocals are thin soils rich in calcium with little leaching and organic matter occurring in semi-arid regions with capillary action and evaporation. This type of soil is common in grasslands. The more arid the climate, the more the calcium content increases in the soil.

Caliches are calcite-cemented soils forming from evaporation.

In Memoriam continued from, p.41

Curt Chapman, MEM-02912

Ann Arbor, Michigan

March 19, 1954 - December 22, 2022

Member Since 2017



Obituary excerpted from the Ann Arbor News.

Curtis Robert Chapman, 68, loving father, husband, brother, uncle and beloved Grampy, passed away, at home, on Thursday, December 22, 2022. Born March 19, 1954 to Robert and Betty (Snyder) Chapman in Battle Creek, Michigan. Curt graduated from North Central High School in Indianapolis, Indiana in 1972. After receiving his Bachelor's and Master's degrees in Geology from Indiana University and Miami of Ohio University, respectively, and his Master's in Finance from the University of Houston, he went on to have a long and happy career, first in the oil industry and then in the environmental consulting world.

He married Kristen (Maris) Chapman in 1978 and they had three children for whom they modeled values of lifelong learning and curiosity, resilience, kindness, and love of family and friends. Curt was interested in everyone he met, remembering even small details they shared about their lives. He had a passion for history, both of the world and the earth, which helped to make him an endless font of fun and fascinating facts. He was proud of his family's own history, including his father's military service in World War II, his grandfather's hardware store in Marshall, Michigan, and the family farm in Fulton, Michigan.

Curt was a caretaker for both the people in his life and the animals, going so far as to break a leg one winter while feeding stray cats outside his office. He knew the name of every bird in the yard and always made sure the bird feeder was stocked for all the backyard creatures. (Ask his family about the time he *almost* invited a squirrel into the house).

Curt was greatly respected in his professional life and appreciated by his colleagues not only for his deep knowledge but also the personal relationships and mentoring that he prioritized. In the last few years, he also enjoyed reconnecting with colleagues on geology field trips to Missouri, Wisconsin, and the Porcupine Mountains in the Upper Peninsula of Michigan.

Curt is survived by his wife, Kristen, his daughters, Meghan (David) Weinberg of Washington, D.C., Katherine (Jacob) Leite of Ypsilanti, Michigan and son, David Chapman (Liliana Jacobs) of Santa Rosa, California, his grandchildren Benjamin, Jay, Elliott and Mary, his brother, John (Jaime) Chapman, nephews Jonathan Chapman (Amanda Strelow) and Joshua (Jade) Chapman, and niece Sarah (Landon) Pund and their children.

Donations in Curt's memory may be directed to the American Institute of Professional Geologist Donation Funds, which help support educational programming and scholarships for geologic studies, https://aipg.org/donations/.

Professional Ethics, continued from p. 45

The sizes of other REE deposits were not given. What makes this deposit "world-class"? [3]

Highlight—*what they want you to read:* "Based on the sheer size, scale, and grade of this deposit, [the project] has the potential to be one of the largest rare earths projects in the US. …The project's rare earth elements (REEs) occur in allanite containing the full suite of naturally occurring REEs, significantly high-value magnet REEs neodymium, praseodymium, dysprosium, and terbium."[4] *What they don't want you to read:* The XRF assays only reported neodymium, Nd, and praseodymium, Pr. The average neodymium was 552 ppm. Praseodymium was only detected in 9 of 31 analyses and averaged 216 ppm. No disclosure was made about the other REEs, light or heavy.

Material Omission: no processing capacity is discussed for project #1. 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, as noted in footnote 4, large amounts of additional elements, including thorium and uranium are commonly found in 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.

Project 2 confirmed as 2nd largest indicated-or-better REE deposit in the US: press release highlights: *What they want you to read:*

- Updated feasibility study confirms the project is second only to Mountain Pass, CA.[5]
- Model does not include REE production.
- Updated feasibility study does not take into account the impacts of the costs of materials and operating expenses from inflation, pandemic-caused supply chain issues, and geopolitical unrest, given their fluid nature.

What they don't want you to read: if REE production is not in the model, how can the project be compared to the REE deposit at Mountain Pass, CA? The qualifiers on the feasibility study essentially admit that the feasibility is unreliable and no good.

Project 2 confirmed as 2nd largest indicated-or-better REE deposit in the US: press release highlights: *What they want you to read:*

- REEs evaluated as a potential by-product to mining niobium, titanium, and scandium using a previously determined net smelter return from the Nb_2O_5, TiO_2, and scandium resources.
- Total REE oxides (TREO) estimated at 632.9 kilotonnes.

What they don't want you to read:

- The 632.9 kt figure is too precise for an indicated resource estimate by at least one order of magnitude.
- The resource estimate includes no REE production.
- The project's REE (non-) production is focused neodymium-praseodymium (Nd-Pr) oxide, dysprosium (Dr) oxide, and terbium (Tb) oxide at commercial purity.
- Only 137 kt of Nd-Pr, Dy, and Tb oxides are estimated for production; what relevance does the 633 kt estimate have? The 137 kt estimate is made in supplemental information linked at the bottom of the press release.
- The recovery of the Nd-Pr, Dy, and Tb oxides depends on the results of the outcome of planned metallurgical (processing) testing.

Enforcement difficulties with press releases: While the press releases for Projects #1 and #2 clearly contain language that misleads readers about the quality and viability of these projects, the facts demonstrating the misleading character of these statements were also found by carefully reading the whole press release. Press releases are not normally filed with securities regulatory authorities. The language in the press releases does not undergo the review that offering documents and annual reports receive. The result is that press releases continue to contain flights of the promoter's imagination. Press releases can be covered in class action lawsuits. Because mining exploration companies generally have limited assets, the "deep pockets" that attract private litigation are absent. The result is that investors are generally unprotected from misleading and false press releases.

Visual Thinking, 2022, by Temple Grandin, an exploration of diversity and the need for inclusion

Dr. Temple Grandin, Professor of Animal Science at Colorado State University and a prominent speaker and author about autism, is one of the first people on the autism spectrum who spoke about her own experiences and perceptions. She was dubbed "an anthropologist on Mars" by Oliver Sacks. In 2010, *Time* named her on the list of the 100 most influential people in the

3. After this press release was issued, the discovery of a 1 million tonne REE deposit near the Kiruna iron deposits of northern Sweden was announced. The lack of an environmentally acceptable method of processing the REE minerals was noted.
4. Allanite has the general formula $A_2M_3Si_3O_{12}[OH]$, where the A sites can contain large cations such as Ca^{2+}, Sr^{2+}, and rare earth elements (including cerium, which is radioactive), and the M sites admit Al^{3+}, Fe^{3+}, Mn^{3+}, Fe^{2+}, or Mg^{2+} among others. However, a large number of additional elements, including Th, U, Be, Zr, P, Ba, Cr, and others may be present in the mineral.
5. The Mountain Pass REE deposit in southern California was the major REE producer in the past and has a higher REE grade than most of the deposits currently being explored. But Mountain Pass shut down for cost and environmental reasons. While modest production has resumed and supplies around 15% of the world's REE production, the Mountain Pass concentrates are sold to refiners in China who produce the oxides of the various REEs.

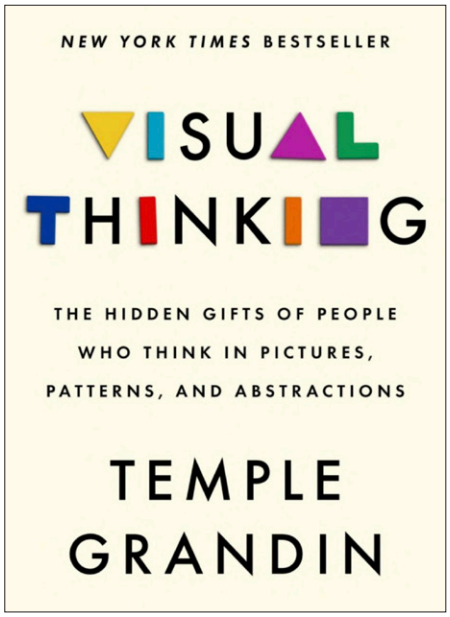


Image Source: Penguin Random House, 2022. https://www.penguinrandomhouse.com/books/673207/visual-thinking-by-temple-grandin/

"Heros" category. She was the subject of the Emmy- and Golden Globe-award-winning biographical movie starring Clare Danes that recounted her efforts in improving animal husbandry and the understanding of autism.

In *Visual Thinking, the hidden gifts of people who think in pictures, patterns, and abstractions*, Grandin notes that if you have a keen sense of direction, a love of puzzles, and the ability to assemble furniture from IKEA without crying, you are a visual thinker. There are photo-realistic object thinkers like Grandin herself who have an intuitive knack for design and problem-solving. Others are the abstract-thinking, mathematically inclined "visual spatial" thinkers who excel in pattern recognition and systematic thinking and who may be great computer program coders. Grandin remarks, "object thinkers build the trains, and spatial thinkers make them run." Then there are the more common verbal thinkers who are sequentially inclined. As Grandin states, "The first step toward understanding that people think in different ways is understanding that different ways of thinking exist. The universally accepted belief that we are all hardwired for language may be why it took me until I was nearly thirty to understand that I am a visual thinker. I am also autistic, and I didn't have language until I was four. I didn't read until I was eight, and that was only with considerable tutoring in phonics. The world didn't come to me through syntax and grammar. It came through images." Visual thinking is about how the brain processes information.

In addition to describing the two types of visual thinkers, Grandin describes the unfortunate consequences of the educational system's focus on the verbal thinkers who are viewed as normal and on the need to go to college ignoring shop, home economics, drafting, and auto mechanics classes and the opportunities to enter valuable and well-paying trades like electricians, carpenters, plumbers, and welders. Those who should have grown up to invent things are often considered poor performers academically and are shunted off to special education programs. Those on the autism spectrum are treated in the same way and whose special educational programs often don't really provide the needed skills to build on the abilities and interests that they do have. Grandin believes that visual thinkers are the tinkerers who invent things and who are able to keep the inventions running. *Visual Thinking* is filled with stories about the tinkerers and inventors whose products can then be refined by mathematically inclined engineers. Grandin advocates recognizing, rewarding, and encouraging all types of thinkers, not just the verbal variety, in order to have a more diverse and rewarding society. I urge everyone who is interested in diversity, equity, and inclusion to read *Visual Thinking* in order to expand their breadth of understanding of intellectual diversity.

> "The first step toward understanding that people think in different ways is understanding that different ways of thinking exist."

Switch to Calibri from Times New Roman?

The Washington Post reported the State Department has specified that effective February 6, 2023, all documents sent to the "Executive Secretariat" must use Calibri 14-point font replacing the Times New Roman font that has been the standard since February 2004. Calibri is a sans-serif font, that is it lacks the 'wings' and 'feet' of serif fonts. A 14-point font is also larger. The reasons given for the change are to improve accessibility issues for individuals with disabilities who use Optical Character Recognition technology or screen readers. Dyslexics also can have recognition issues with serif fonts.

While many use Times Roman 12 point as the standard font for their reports, other serif fonts can be used. I often use Garamond 12 point just because it's slightly different, which might be important in determining if someone is altering a report. Some may prefer the older Arial font to Calibri. The important point here is serif versus sans-serif fonts.

The books I've read on typography over the years have generally recommended sans-serif fonts as being easier to read. For most people, this may be true. This topic's text uses Calibri font (although the font size for the *TPG* is 9 point). The rest of the column is in Century Schoolbook which is very similar to Times Roman. What is your font preference? Should we collectively change to sans-serif fonts to assist in the readability of our documents for an important group of people? Share your thoughts.

Electronic Signatures and Seals for Reports

The Texas Board of Professional Geologists Winter 2022 Newsletter announced, "The Board recognizes that use of a digital signature (which offers multi-layer authentication features) has gained acceptance and is now commonly used in most day-to-day legal/business documents." The Board appointed a volunteer committee to examine the Texas rule on using electronic signatures and seals. The conclusion was that the use of digital signature software that uses multi-layer authentication is recommended and that Adobe Acrobat® Sign or Docusign® are the two most common programs used for this purpose although there are others. Searching the PE&P index in the topics 'computing,' 'professional practice,' 'reports,' and 'seals' leads to the various earlier PE&P columns addressing this issue.

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licensing of geologists (licensing of geologists was established in Arizona in 1956). Now regulatory boards contend with the rise of the non-traditional degrees, the challenge of changing a state regulation, and the pressure to de-regulate the practice of geology. In my opinion, all those factors have resulted in geologists keeping a low profile, including geologists in my home state trying to keep from rocking the boat in the Arizona state capitol. If you are interested in seeing how your state compares to others, ASBOG has compiled an overview of professional geologist requirements by state on the ASBOG website under member resources link (https://asbog.org/matrix/MatrixJuly2018.pdf). The "member resources" page is not restricted; it is publicly accessible.

The AIPG Bylaws state that our No. 2 purpose is to "Establish qualifications for professional geologists". The Institute has debated internally over the qualifications under the changing landscape of geology degrees, and whether we should revise any of our standards. The subject is a regular topic in the ExCom meetings and in our discussions with other associations.

AIPG's requirements for certification are based on education, experience and references who have personal knowledge of the applicant's qualifications, integrity, and conduct. The education component requirement is to *"Hold a baccalaureate or higher degree in a geological science, and a minimum of thirty-six semester hours or fifty-four quarter hours in geological sciences as recognized and approved by the Executive Committee; and at the discretion of the Executive Committee; acceptable continuing education to demonstrate a currency with technical, regulatory, and economic factors affecting the profession."* The Institute's requirements for the number of hours of geology coursework matches the California example that I gave earlier, but the decision of which courses qualify is left to the discretion of the reviewers on the local screening committee and ultimately the ExCom when an application is elevated to the national screening committee due to uncertainties. AIPG's Bylaws also require that the applicant prove the coursework with a transcript, which is problematic for many applicants with degrees from academic institutions outside of the United States, because many foreign institutions don't provide transcripts. Another roadblock for CPG applicants residing outside of the United States is the requirement to have the application notarized, which is another service not available throughout the world. Even within the United States a notary is a rare creature, as opposed to having one in every office when I first started working.

Our screening committees at the section and national levels have wrestled with the coursework descriptions, the need for an official transcript and the need for a notary signature. It is extremely challenging for us because we receive applications with transcripts from schools all over the country, and universities from other countries. The volunteer job of someone sitting on a state board reviewing applications from primarily in-state schools with known programs sounds much easier than what our screening committee volunteers may need to handle. After reading the California requirements, I'm not sure how a foreign applicant could qualify.

In my view, the scope of technical issues tackled by geologists should be recognized as very broad. Should AIPG have a standard list of "core coursework". Yes, but the upper division coursework can be interdisciplinary to account for that range of technical issues. The key is that the practitioner needs to take responsibility for staying within their expertise when acting as a CPG. When we look at any certification or licensing program, we are qualifying someone based upon what we consider to be minimum competency. Within AIPG we are also requiring ethics and integrity, verified through sponsors, to give a client or the public the confidence that the practicing CPG knows what he/she is doing (that is, practicing within the field of expertise) and will carry out the work in accordance with industry practices, and in an ethical manner. The work doesn't need to be done by the "A" student in the class and it doesn't need to be in accordance with best practices when the client didn't ask for best practices. Many clients are looking for adherence to industry standards and are not attempting to comply with "best practices". An AIPG member could state work in accordance with industry practices when that's what was done and best practices according to a referenced guidance document when that's what was done.

I anticipate that a group called the Global Geoscience Professionalism Group (GGPG), which is similar to a previous collaborative group that was formed under the International Union of Geological Sciences (IUGS), will be looking at this topic. Organizations such as AIPG, Australasian Institute of Mining and Metallurgy (AusIMM), Geoscientists Canada, *Berufsverband Deutscher Geowissenschaftler* (BDG), European Federation of Geologists (EFG), International Raw Materials Observatory (EFG/INTRAW) and South African Institute of Mining & Metallurgy (SAIMM) are already members of GGPG. All the acronyms may be daunting, but there is a common goal to serve the field of geology, and an international collaboration will be critical to maintain comity between professional geologist certification programs.

So, have I made how to land on the definition of a geologist any easier? Of course not. But if you hadn't considered some of the complex details behind the discussions, you should now be able to see why the matter continues to be debated.

In the meanwhile, I hope that you will be able to take of advantage of the many webinars and in-person events planned for 2023. There are opportunities to earn Continuing Education Units (CEUs), participate in field trips, sit in on a free webinar and network in-person with colleagues. And if you really want to plan ahead, AIPG is working on another international field trip as a follow up to the trips to Iceland in July and August 2023. We are finalizing the details of a trip to Scotland for May 19 through May 29, 2024. We hope to present a webinar in May 2023 about the areas that would be visited: the Northwest Highlands, Moine Rocks, Central Highlands, Midland Valley, and Siccar Point. Check the AIPG website calendar for upcoming AIPG events being held by Sections and by AIPG National and be sure to keep an eye out for announcements via email.

Best wishes

Dawn

Dawn H. Garcia, 2023 President

Transportation of Natural Gas Containing Helium from Wellhead to Refinery

William Horn SA-11148, Barbara Echohawk PhD., and Uwe Kackstaetter PhD, MEM-2437.

Abstract

Loss of helium is likely to occur during transport of natural gas from wellhead to refinery. Liquid helium boils at 4.2 K (-268.95° C), and gaseous helium readily diffuses and escapes containment by effusion. Appropriate containment vessels and valves are required to minimize helium loss during transport and storage. Shared methods by industry leaders provide a model of best practices for minimizing helium leakage. Research from the nuclear industry provides insights into ideal valve materials for containing helium leakage. Leakage rates are calculated for helium in a gaseous mixture in a typical tanker truck under a range of temperature and pressure conditions; cumulative leakage volume is calculated for specific pressure-temperature combinations. Learning to minimize helium lost to leakage during transport and storage is critical to successful production of this strategic resource.

The Helium Supply Chain

The majority of helium recovered in the United States is a byproduct of the oil and gas industry. Natural gas, composed primarily of methane, may also contain helium, typically in proportions up to a few percent. Not all sources contain large quantities of hydrocarbons; helium-bearing gas with over 90.0% nitrogen by volume has been found ("Helium," n.d.).

From the wellhead, raw natural gas is either transported via pipeline or over the road to an extraction/refinement facility where helium is extracted through a process of liquefaction. Hydrocarbons and most nitrogen are liquefied and separated, resulting in concentrations of gaseous helium generally ranging from 50 to 70% by volume (National Research Council, 2000). Further refinement produces a liquid product with over 99.999% purity (Malinowski *et al.*, 2018) (Figure 1).

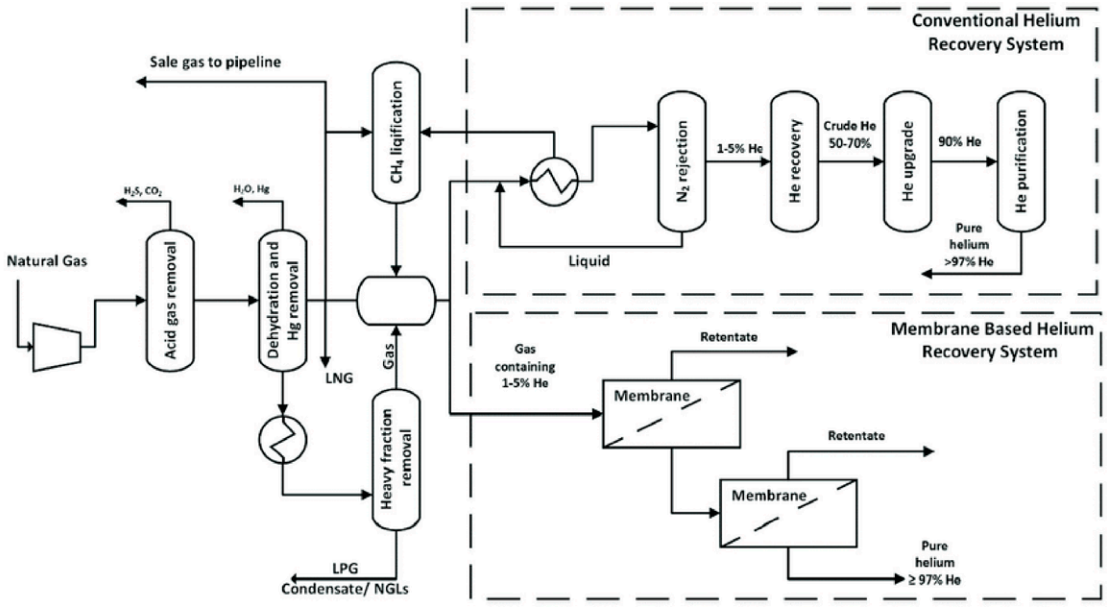


Figure 1. Schematic of Helium processing and refinement (*Helium Recovery and Liquefaction*, 2016).

The purified helium enters the distribution network via over-the-road trucking in containment vessels designed to hold liquid cryogenic fluids. Typically, the major distributors deposit the refined helium product into transfill stations. These stations are the distribution hub to end users regardless of the end user's location or specific need for liquid or gaseous helium.

Transportation of Natural Gas Containing Helium from Well to Refinery

The primary forms of transportation for raw natural gases from well to refinery is pipeline or over the road truck. Although pipelines guarantee continuous supply and delivery of the raw product, there are significant areas of the United States without pipeline infrastructure. In addition, pipeline installation and operations can introduce avoidable adverse environmental impacts. Over-the-road trucking may provide the only feasible economic option available for transport.

Leakage of helium during transport is also a primary concern. Leakage resulting in product loss equates to the capital loss for future expansions and the development of additional resources. Regulations regarding the transportation of hazardous materials including compressed gases are subject to compliance with both state and federal requirements. The federal regulations and requirements may be found in the National Archives Code of Federal Regulations site: https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-C/part-178/subpart-J. The state of Arizona regulations for the transportation of hazardous material may be found at the Arizona state site: https://azdot.gov/node/5132.

Industry Leaders in the Transportation, Refinement, and Storage of Helium

Three current industry leaders in helium transport, refinement, and storage are Linde Engineering, LLC, Matheson Tri-Gas, Inc., and Air Liquide S.A.

Linde Engineering specializes in cryogenic gas storage and has an extensive international footprint in the storage and shipment of refined liquid helium. Linde uses storage and transportation vessels with a stainless-steel double shell design. The storage vessels, known as ISO containers, are commonly used for short- or long-term transportation and storage of liquid helium (Figure 2). The outer shell is filled with liquid nitrogen at a temperature of approximately 5 Kelvin (K) (-269.1°C) to insulate the liquid helium-filled inner shell from significant temperature changes for up to 40 days (Helium Solutions, n.d.). Boil-off of liquid helium occurs at temperatures above 4 K (UN-Portable-Tank-for-Helium, n.d.). Ideally, liquid helium is kept between 1K to 3K to avoid boil-off during extended transport or storage. Linde also uses small Dewar's containment vessels and conventional gas cylinders to provide end-users with flexibility in volumes of helium available.



Figure 2. Linde UN/ISO Cryogenic Liquid Transportation Vessel (UN-Portable-Tank-for-Helium, n.d.).

Matheson Tri-Gas operates in storage, distribution, and transportation of cryogenic gases. Matheson employs ISO systems for long- and short-term transport and storage of liquid helium while offering end-users the option of receiving either gaseous or liquid helium. A tube trailer (Figure 3) is one option for gas delivery. Matheson also employs gas cylinders and small containers for liquid helium like Dewar's vessels. As always, controlling liquid helium's temperature is critical in preventing boil-off and excessive product loss.



Figure 3. Tube Trailer for gaseous helium (*Helium (He)*, n.d.).

Air Liquide S.A., with its enormous international footprint as a supplier and refiner of high-grade helium, is one of the largest competitors in the helium marketplace. Air Liquide operates helium extraction and refinement facilities around the globe. Like Linde and Matheson, Air Liquide also employs the ISO type containment and shipping containers (Figure 4). Dewar-type and conventional gas cylinders are also available to accommodate end-user needs.

General Industry Practice for the Storage and Transportation of Liquid Helium

All three competitors in the transportation and storage of refined helium use a containment vessel known as an ISO/UN container for shipment and storage. According to the ISO manufacturer, Gardner Cryogenics, "Over 97% of the world's liquid helium is transported in liquid helium UN Portable tanks" (*Helium Products*, n.d.).

The double-shell ISO storage vessels typically have the outer shell filled with liquid nitrogen at 5K. This cryogenic blanket slows the transfer of external heat to the internal shell filled with liquid helium, which is held at around 1K-3K. As liquid Helium will boil at 4.2K, the cryogenic blanket reduces the boil-off rate and minimizes the pressure increases that



Figure 4. Air Liquide Cryogenic UN/ISO Container (*Maritime Logistics*, 2016).

occur when the phase change happens *(Helium Recovery and Liquefaction*, 2016). Out of the three industry leaders reviewed, none identified the valve type used in conjunction with the containment vessels.

While the ISO system combats the boil-off experienced with Dewar-type containment vessels, nothing is leak-free when it comes to helium. A more quantitative investigation by industry leaders could identify the specific products that result in the least amount of loss. Each of the three leading corporations was more than willing to divulge the containment vessels used, but not one mentioned the types of valves employed on these vessels. While there is product loss through effusion past containment walls, as shown in helium leak detection testing, the largest single source of leakage is through and around the valves (Zhang *et al.*, 2013).

Valves Designed Specifically for Liquid or Gaseous Helium

Despite a relatively large quantity of helium-specific valves on the market, most suppliers and transportation companies do not discuss the valve types used for these purposes. The United States Department of Transportation (US DOT) regulates valves used with cryogenic liquids. However, S. DOT, US DOT regulations do not specify a valve type required to transport UN 1936 classified liquid helium. US DOT states, "Any part of a portable tank, including fittings, gaskets and pipe-work, which can be expected normally to come into contact with the refrigerated liquefied gas transported must be compatible with that refrigerated liquefied gas" (*49 CFR 178.277 -- Requirements for the Design, Construction, Inspection and Testing of Portable Tanks Intended for the Transportation of Refrigerated Liquefied Gases*., n.d.) As such, the responsibility for the specific valve type used in conjunction with the storage and transportation of liquid helium is in the hands of the Professional Engineer tasked with design. However, other sources offer information on valve types that minimize the helium from leaking.

There is research related to valve leakage rates for cryogenic helium systems that operate at the Large Hadron Collider (LHC) and the International Thermonuclear Experimental Reactor (ITER) (Zhang *et al.*, 2013). This research suggests that soft-seated valves are most commonly used in this cryogenic service (Zhang *et al.*, 2013). The study suggests using polychlorotrifluoroethylene (PCTFE) as the flat seal material of the valve seat, which during the associated research resulted in measured leakage rates of helium at 293K of 10^{-8} Pa m^3 s^{-1} and nitrogen temperature of 77K of 10^{-4} Pa m^3 s^{-1}. Unlike traditional valves, which have seats comprised primarily of a metal machined to the limit of mechanical closure tolerances, these seats are made from materials closer to specialty plastics. These valves allow for a closure tolerance far exceeding that of traditional valves, suggesting a possible avenue to greatly decrease currently acceptable leakage rates. So far, the ability to produce a 100% leak-free connection has eluded the industry, and just a reduction of that leak rate has been accepted as the best option (Zhang *et al.*, 2013). Most corporations use storage and shipping vessels that require valves of similar design, namely soft-seated valves, ideally composed of material engineered to minimized leakage.

Helium and Mechanisms of Escape

The primary mechanism through which helium is dispersed in a closed system is diffusion, the process of transferring gaseous molecules from areas of higher concentrations to areas of lower concentration. The rate of diffusion is greater for lighter molecules (Tro, 2016).

Helium also disperses by effusion, the escape of molecules through small holes within a retaining membrane, valve, seal, or shell due to the pressure differential across that barrier (*Graham's Laws of Effusion and Diffusion Chemistry Tutorial*, n.d.).

Calculations for relative rates of diffusion and effusion for helium and atmospheric nitrogen N_2 (Appendix A) show that gaseous helium diffuses and effuses at a rate 2.65 times greater than that for N_2.

Modeling Escape of Helium During Transport

In this model, a tanker truck (Figure 5) transports helium-bearing raw natural gas. The tanker is filled with 90 % N_2 and 10% He. It operates at a maximum of 2580 psi or 176 atm (CNG Equipment & Tube Trailer Suppliers, n.d.). The calculations are based on researched helium leakage rates using PCTFE seating material (Zhang *et al.*, 2013) at variable temperatures and periods with a leakage rate of 2.0 E-8 Pa m^3 s^{-1}.



Figure 5. Tanker used to simulate the models and hereafter (*CNG Equipment & Tube Trailer Suppliers, n.d.*).

Table 1. Helium Leak Rate Vs. Temperature and Pressure Increases

Scenario	Kelvin	ATM	Leak Rate Mol/s
1	163.95	163.948	1.989E-03
2	165.62	165.619	1.999E-03
3	167.29	167.289	2.009E-03
4	168.96	168.96	2.019E-03
5	170.57	170.571	2.029E-03
6	172.24	172.241	2.039E-03
7	173.91	173.912	2.049E-03
8	175.58	175.582	2.059E-03
9	177.19	177.193	2.068E-03
10	178.86	178.864	2.078E-03
11	180.53	180.534	2.087E-03
12	182.21	182.205	2.097E-03
13	183.88	183.875	2.107E-03
14	185.49	185.486	2.116E-03
15	187.16	187.157	2.125E-03
16	188.83	188.827	2.135E-03
17	190.50	190.498	2.144E-03
18	192.11	192.108	2.153E-03
19	193.78	193.779	2.163E-03
20	195.45	195.449	2.172E-03
Average	179.70	179.7049	2.082E-03

Table 1 summarizes leak rates from the tanker with increasing temperature and pressure. Table 2 summarizes leak rates over increasing intervals of time for specified temperature-pressure combinations. These temperature and pressure ranges were chosen to simulate the environmental conditions at or near the Holbrook Basin.

These scenarios tabulate estimated instantaneous rates and overall volumetric leakage of helium from a gaseous mixture for specific combinations of time, temperature, and pressure. These are only hypothetical scenarios; actual operating conditions in the field may differentially impact the total volume of helium lost during loading, transport, and unloading. For example, what is the starting temperature of the gas as it leaves the well? Temperature is a critical variable in the proper calculation of leak rates. Is this gas compressed, or does it expand upon entering the tanker? Compression or expansion will alter the initial temperature and affect the overall leakage rates. Will the tanker be loaded directly from the well, or will a storage vessel be used to load the tanker? If so, what type of vessel, and what is the expected hold time?

An additional period of vessel containment and exposure to variable temperatures would also need to be explored to fine-tune estimates of overall product lost during the entirety of transport to the refinery. In addition, loading and unloading practices can have the most potential for helium release in the entire process. An example could be the accidental release to atmosphere during the transfer process due to operator not inspecting connections on transfer equipment and missing a loose connection. Will there be established procedures to ensure that accidental releases or product loss through the

Table 2. Total volume of Helium leakage using previous temperature/pressure scenarios over time.

Scenarios	15 min	30 min	45 min	60 min	75 min	90 min	105 min	120 min
35°F/163.9 ATM	0.109 ft^3	0.218 ft^3	0.328 ft^3	0.437 ft^3	0.546 ft^3	0.655 ft^3	0.764 ft^3	0.873 ft^3
40°F/165.6 ATM	0.110 ft^3	0.219 ft^3	0.329 ft^3	0.439 ft^3	0.549 ft^3	0.658 ft^3	0.768 ft^3	0.878 ft^3
45°F/167.3 ATM	0.110 ft^3	0.221 ft^3	0.331 ft^3	0.441 ft^3	0.552 ft^3	0.662 ft^3	0.772 ft^3	0.882 ft^3
50°F/167.0 ATM	0.111 ft^3	0.222 ft^3	0.332 ft^3	0.443 ft^3	0.554 ft^3	0.665 ft^3	0.776 ft^3	0.886 ft^3
55°F/170.6 ATM	0.111 ft^3	0.223 ft^3	0.334 ft^3	0.446 ft^3	0.557 ft^3	0.668 ft^3	0.780 ft^3	0.891 ft^3
60°F/ 172.2 ATM	0.112 ft^3	0.224 ft^3	0.336 ft^3	0.448 ft^3	0.560 ft^3	0.672 ft^3	0.784 ft^3	0.896 ft^3
65°F/173.9 ATM	0.112 ft^3	0.225 ft^3	0.337 ft^3	0.450 ft^3	0.562 ft^3	0.675 ft^3	0.787 ft^3	0.900 ft^3
70°F/175.6 ATM	0.113 ft^3	0.226 ft^3	0.339 ft^3	0.452 ft^3	0.565 ft^3	0.678 ft^3	0.791 ft^3	0.904 ft^3
75°F/177.2 ATM	0.114 ft^3	0.227 ft^3	0.341 ft^3	0.454 ft^3	0.568 ft^3	0.681 ft^3	0.795 ft^3	0.908 ft^3
80°F/178.9* ATM	0.114 ft^3	0.228 ft^3	0.342 ft^3	0.456 ft^3	0.570 ft^3	0.684 ft^3	0.798 ft^3	0.912 ft^3
85°F/180.5 ATM	0.115 ft^3	0.229 ft^3	0.344 ft^3	0.458 ft^3	0.573 ft^3	0.687 ft^3	0.802 ft^3	0.917 ft^3
90°F/182.2 ATM	0.115 ft^3	0.230 ft^3	0.345 ft^3	0.460 ft^3	0.575 ft^3	0.690 ft^3	0.806 ft^3	0.921 ft^3
95°F/183.9 ATM	0.116 ft^3	0.231 ft^3	0.347 ft^3	0.463 ft^3	0.578 ft^3	0.694 ft^3	0.810 ft^3	0.925 ft^3
100°F/185.5 ATM	0.116 ft^3	0.232 ft^3	0.348 ft^3	0.465 ft^3	0.581 ft^3	0.697 ft^3	0.813 ft^3	0.929 ft^3
105°F/187.2 ATM	0.117 ft^3	0.233 ft^3	0.350 ft^3	0.467 ft^3	0.583 ft^3	0.700 ft^3	0.816 ft^3	0.933 ft^3
110°F/188.8 ATM	0.117 ft^3	0.234 ft^3	0.352 ft^3	0.469 ft^3	0.586 ft^3	0.703 ft^3	0.820 ft^3	0.938 ft^3
115°F/190.5 ATM	0.118 ft^3	0.235 ft^3	0.353 ft^3	0.471 ft^3	0.589 ft^3	0.706 ft^3	0.824 ft^3	0.942 ft^3
120°F/192.1 ATM	0.118 ft^3	0.236 ft^3	0.355 ft^3	0.473 ft^3	0.591 ft^3	0.709 ft^3	0.827 ft^3	0.946 ft^3
125°F/193.8 ATM	0.119 ft^3	0.237 ft^3	0.356 ft^3	0.475 ft^3	0.593 ft^3	0.712 ft^3	0.831 ft^3	0.950 ft^3
130°F/195.4 ATM	0.119 ft^3	0.238 ft^3	0.358 ft^3	0.477 ft^3	0.596 ft^3	0.715 ft^3	0.834 ft^3	0.954 ft^3

For all pressure-temperature combinations, cumulative helium loss increases with time (Table 2). This model does not consider the possibility of an increasing rate of helium leakage over time.

transfer systems are minimized while maximizing load volumes under ideal conditions?

Last but not least, the number of wells transporting loads to the refinery may become backed up as they await unloading, creating additional stress on the tanker containment systems, a logistical concern that must be considered in future loss estimates.

Conclusions

Industry leaders share a standard practice for the containment of helium. All industry leaders use similar ISO/UN double-shell containment vessels to store and transport liquid helium on a local and international scale. No industry leaders identified the valve type used in conjunction with the containment vessels.

In the nuclear industry, specialized materials are used in valves to contain cryogenic helium. A valve gasket made from PCTFE demonstrated a measured leak rate of 2.0 E-8 m^3/s at STP (Zhang *et al.*, 2013).

References

49 CFR 178.277—Requirements for the design, construction, inspection and testing of portable tanks intended for the transportation of refrigerated liquefied gases. (n.d.). Retrieved January 2, 2022, from https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-C/part-178/subpart-H/section-178.277.

CNG Equipment & Tube Trailer Suppliers. (n.d.). Rawhide Leasing. Retrieved January 15, 2022, from http://www.rawhideleasing.com/fleet/.

Graham's Laws of Effusion and Diffusion Chemistry Tutorial. (n.d.). Retrieved January 14, 2022, from https://www.ausetute.com.au/grahaml.html.

Haider, S., Saeed, M., Lindbråthen, A., & Hägg, M.-B. (2019). Keywords Highlights Techno-Economic Evaluation of Helium Recovery from Natural Gas; A Comparison Between Inorganic and Polymeric Membrane Technology Article info. *Journal of Membrane Science and Research*, 5, 126–136. https://doi.org/10.22079/JMSR.2018.87998.1196.

Helium. (n.d.). Desert Mountain Energy-TSX-V: DME. Retrieved October 18, 2022, from https://www.desertmountainenergy.com/helium/.

Helium (He). (n.d.). MATHESON. Retrieved January 1, 2022, from https://www.mathesongas.com/gases/helium/.

Helium Products. (n.d.). Gardner Cryogenics. Retrieved January 2, 2022, from https://www.gardnercryo.com/helium-products/.

Helium Recovery and Liquefaction. (2016, February 19). Air Liquide. https://www.engineering-airliquide.com/helium-recovery-and-liquefaction.

Helium solutions. (n.d.). Linde Engineering. Retrieved December 31, 2021, from https://www.linde-engineering.com/en/plant-components/helium-storage-un-portable-tanks/index.html.

Maritime logistics. (2016, April 13). Air Liquide. https://www.airliquide.com/group/maritime-logistics.

National Research Council. (2000). *The Impact of Selling the Federal Helium Reserve*. The National Academies Press. https://doi.org/10.17226/9860.

OpenStax. (2016). 9.4 Effusion and Diffusion of Gases. https://opentextbc.ca/chemistry/chapter/9-4-effusion-and-diffusion-of-gases/.

Tro, N. J. (2016). Principles of chemistry: A molecular approach (Third edition). Pearson Education, Inc.

Zhang, N., Li, Q., Li, Q., Hu, Z., & Hu, K. (2013). Seat tightness of pneumatic cryogenic control valve. *Science China Technological Sciences*, 56(8), 2066–2069. https://doi.org/10.1007/s11431-013-5272-8.

Appendix A

Diffusion rates will be influenced by concentration gradients, total surface area, and the distance individual particles travel while diffusing (OpenStax, 2016). The rate of diffusion can be formulated with the following calculation:

$$Rate\ of\ Diffusion = \frac{Amount\ of\ gas\ passing\ through\ time}{per\ unit\ of\ time}$$

(OpenStax, 2016). While concentration gradients are the primary motivation for the even distribution of molecules in a solution within a closed system, not all molecules diffuse at the same velocity. The kinetic molecular theory states that molecules of different masses have the same kinetic energy, and if they have the same kinetic energy, they must have different velocities (Tro, 2016). In fact, lighter molecules will travel at higher velocities than heavier ones. This variation can be shown by calculating the Root Mean Square Velocity with the following equation:

$$u_{rms} = \sqrt{\frac{3RT}{M}}$$

In which:

μ_{rms} = Root Mean Square Velocity

3 = Proportionality Constant

R = Gas Constant

T = Temperature in K

M = Molar Mass in kg/mol

In the following example, the assumption will be for STP conditions to exist, as increases or decreases in temperature and pressure directly affect the kinetic energy of the molecules, resulting in higher or lower velocities of the sample. For example, let us look at the velocities of He and N_2 using the above equation while assuming STP conditions:

$$u_{rmsHe} = \sqrt{\frac{3(8.314\frac{J}{mol \cdot K})(298K)}{\frac{4.00\times10^{-3}kg}{1\ mol}}} = 1363\frac{m}{s}$$

$$u_{rmsN_2} = \sqrt{\frac{3(8.314\frac{J}{mol \cdot K})(298K)}{\frac{28.00\times10^{-3}kg}{1\ mol}}} = 515\frac{m}{s}$$

Now the velocities of these two molecules have been identified, finding the ratio of, He to N_2 will allow for further exploration of the diffusion rates between the two.

$$\frac{1363\frac{m}{s}}{515\frac{m}{s}} = 2.65$$

This means that Helium gas will diffuse at rate 2.65 times faster than Nitrogen gas based on the ratio of the two root mean square velocities. It is essential to understand the effects of diffusion on any solution, especially one in a closed system, but this explanation of movement only accounts for the distribution of molecules within that closed system. Another form of movement occurs when molecules are retained within a pressurized and closed system, and then they escape.

That other form of molecular movement is effusion. Which can be defined as the escape of molecules through small holes within a retaining membrane, valve, seal, or shell due to the pressure differential across that barrier (*Graham's Laws of Effusion and Diffusion Chemistry Tutorial*, n.d.). In the same manner as diffusion, effusion rates are also related to root mean square velocity in so much as heavier molecules will effuse at a slower rate than lighter molecules (Tro, 2016). Using Graham's Law of Effusion, it is possible to calculate the ratio of effusion between two gases. In this case, He and N_2 will once again be observed under STP conditions. Using Graham's Law of Effusion Equation:

(OpenStax, 2016).

$$\frac{rate_A}{rate_b} = \sqrt{\frac{M_B}{M_A}}$$

In which:

$rate_A$ = the effusion rate of He in mol/min

$rate_B$ = the effusion rate of N_2 in mol/min

MA = the molar mass or density of He

MB = the molar mass or density of N_2

First the effusion rates of He and N_2 will be calculated using the effusion rate calculation:

Second, the density of He and N2 will be calculated by converting g/mol to g/L of each gas:

$$rate_{He} = \sqrt{\frac{1}{4.00\frac{g}{mol}}} = 0.5\ mol/s$$

$$rate_{N_2} = \sqrt{\frac{1}{28.00\frac{g}{mol}}} = 0.189\ mol/s$$

Third, all values will be inserted into Graham's equation to find the effusion ratio of these two gases:

$$\rho_{He} = \frac{4.00\frac{g}{mol}}{22.4\frac{g}{L}} = .1785\frac{g}{L}$$

$$\rho_{N_2} = \frac{28.00\frac{g}{mol}}{22.4\frac{g}{L}} = 1.25\frac{g}{L}$$

It is possible to now conclude that the effusion is 2.65 times faster than the effusion of N_2. As stated previously, the relationship between diffusion and effusion is based on the molecule's velocity in solution. This velocity can be affected by increasing the kinetic energy available to the molecule as temperature increases.

$$\frac{rate_{He}}{rate_{N_2}} = \sqrt{\frac{M_{N_2}}{M_{He}}} \rightarrow \frac{0.5_{He}}{0.189_{N_2}} = \sqrt{\frac{1.25_{N_2}}{0.1785_{He}}} \rightarrow 2.65 = 2.65$$

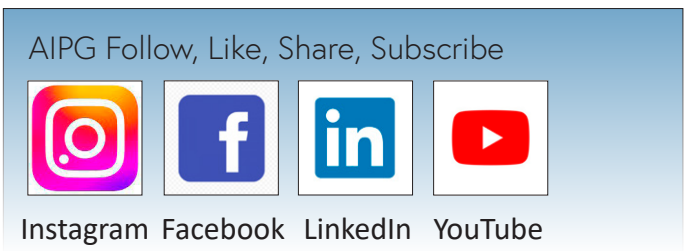
Executive Director's Message continued from p.42

new waterproof fabric, or new technology that makes cars safer. Sadly, when geology is in the news, it is routinely portrayed in a negative light, with a focus on the impacts of extractive industries. This is a narrative that we can change. At AIPG, we are trying to do just that, by using our YouTube channel and other social media to tell the stories of the amazing things geologists do. I invite every member of AIPG to create a short video (~10 minutes or less) that shows you doing your job. We call this project 'Geologists in Action', and we need you to help us make it a success.

Once you create your video, you can either upload it directly to https://aipg.org/page/videouploadandreleaseform or send it to Wendy at AIPG Headquarters. If you need inspiration or examples, the videos already posted can be found at: https://aipg.org/page/AIPGyoutubevideos.

I hope each of you has a wonderful spring.

Aaron



Scan code for "Geologists in Action" YouTube videos.



What I do as a Geologist: Developing Technologies in the Energy Transitions Field

Brigitte Petras, ECP-0851

Dear Students and Emerging Professionals,

Do you have an idea of what you'd like to do with your geoscience degree? Are you aware of the invaluable geology licensures and certifications? Are you confident in your resume and CV writing abilities?

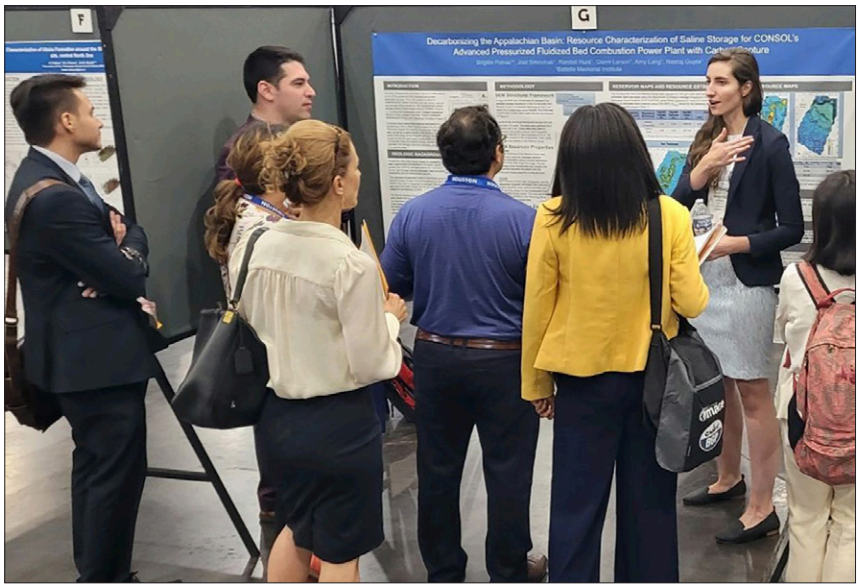
Luckily, AIPG has been hosting a webinar series for you to successfully transition as a successful early career professional. The next upcoming webinar is on *How to Write a CV/Resume,* so be on the lookout for the webinar link in your email. Webinars which have already occurred include *Licensures and Certifications* and a *GeoCareers Panel Discussion.* If you attended the last panel discussion, you may have a better idea of what different types of geologists really do. To expand on the panel discussion, I'd like to share what I do as an early career professional for an organization that does government contracting.

Currently, I am a geologist at Battelle, which is an applied science and research non-profit organization. Specifically, I work in the Energy and Resilience Division, which develops and deploys new technologies that are in the energy transitions field. This includes, but is not limited to, carbon capture and storage (CCS) and CO_2 enhanced oil recovery, hydrogen energy and storage, geothermal energy, and critical minerals and rare earth elements (CM/REE). The division is funded primarily through government contracting, from sources such as the Department of Energy (DOE) or subawards from the DOE (although there is also a commercial group that specifically works on CCS projects).

What does a regular day look like for me? My day may range from data collection, analysis, and interpretation, to presenting, reporting, and community outreach. I conduct geo-characterization to understand the subsurface systems, analyze well logs, and create 3D geocellular models (in subsurface geologic software such as Petrel) to prepare for the reservoir engineer to run storage simulations. Additionally, I develop and conduct risk assessments, get involved with monitoring methods, comply with regulations, and write permits. I present at conferences and client meetings and write reports. I also help develop DOE proposals and interact with stakeholders and partners to help us carry out this work. I could also develop Intellectual Property Disclosure and Records (IPDRs) such as a patent. Internal and external collaboration is an integral component of my work. I also conduct assessments for the Environmental Division as needed.

I really enjoy developing new technologies which can have large implications, communicating our findings to others, and studying the rocks! I enjoy the research I did as an undergraduate and graduate student, and I continue to conduct collaborative research. My background in sedimentology and stratigraphy, well log analysis, and writing has helped me on my career journey. I continuously apply my critical thinking skills to a variety of projects. Additionally, it's very rewarding that Battelle ultimately gives back to numerous communities since it is a nonprofit organization.

Studying rocks for these applications may not be your dream career, but there are many other exciting professional pathways (which you may have heard about in the last webinar). I recommend looking into these different possibilities as you develop your skills by choosing your course work and applying for internships. For more insights, please attend the Student/ECP webinars which are created for students and emerging early career professionals such as yourself! If you missed the past webinars (or would like to be able to refer back to them), you can access them on AIPG's website. Learn how to write a successful resume or CV by attending the upcoming Student/ECP webinar.



I presented my CO_2 storage resource assessment of some reservoirs at the 2022 AAPG SEG IMAGE Conference.



All Geology is Regional Geology

Case-based education in geology

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

Our classification of geology into physical geology (mineralogy, petrology, geomorphology and structural geology) and historical geology (stratigraphy and paleontology) was developed in the nineteenth century. Since then, this thematic branching has multiplied as geology has become highly specialized. It has also become a common practice to teach geology through thematic texts. Take any geology textbook and you will find a chapter on minerals, another chapter on igneous, sedimentary or metamorphic rocks, and so forth. Similarly, we have textbooks on individual disciplines – mineralogy, sedimentology, geomorphology, etc. Even field geology is usually treated as a separate subject with its books. The thematic approach has certain benefits: It offers a systematic and one-stop shop to see all that one needs to teach and learn about a particular subject. That is why it is also convenient for cataloging: If you visit the Natural History Museum in London (or any other major city), you will find the mineral collection, rock collection, fossil collection, etc. all in separate rooms. This compartmentalization, however, is an artifact – designed for our own convenience. Earth is not fashioned that way; Earth is an integrated, interacting system. While the thematic approach offers a sound, convenient and systematic start to teach and learn geology, the education need not stop there. We should also utilize other approaches in order to gain their unique benefits and even possibly higher-order thinking skills. One such approach is regional geology. I first discussed it in a brief article in 1997 (Sorkhabi, 1997), but since then, I have become more convinced of its value and need in our geology education.

The regional approach is a type of a more general educational method called case-based curriculum (CBC). David Goldsmith has reported a case-based curriculum for introductory geology he taught for five years (Goldsmith, 2011). Case-based teaching and learning method dates back to the 1970s (Stake, 1978) and was discussed in detail by Barnes et al. (1986) and Lundeberg et al. (1999). A large number of articles have described the CBC application to various branches of science, including medicine (Williams, 2005), biology (Bonney, 2015), and physics (Burko, 2016). There is even a National Center for Case Study Teaching in Science (www.nccsts.org) to collect case-based teaching experiences.

CBC is often associated with three other teaching strategies:

(1) Collaborative or group-learning method (e.g., Brufee, 1993) which means that all students should be involved in the learning process through working together in groups.

(2) Problem-solving method (e.g., Jonassen and Hernadez-Serrano, 2002) which requires the instructor formulate a set of questions in advance and lead the course towards answering the questions at the end. Students can then share their findings and answers either verbally (oral presentations) or in writing (brief essays).

(3) Audiovisual techniques in addition to text-based materials (Sorkhabi, 2020).

CBC can be used as a capstone course in geology and is very appropriate for geology education because a regional case study integrates all subject-matters of geology (from minerals, rocks and fossils to geomorphology and tectonics) in a natural setting – the way Earth truly functions and has evolved. Moreover, the regional approach makes geology education more intimate and accessible to students than a set of abstract learning materials.

In choosing a regional case for geology education certain criteria should be considered:

(1) The case should be interesting, physically well-known and relatable, and even culturally rich and attractive; this would give maximum story telling power to the instructor.

(2) It should render itself to interdisciplinary, versatile studies.

(3) There should be an ample amount of scientific knowledge and teaching materials about the region.

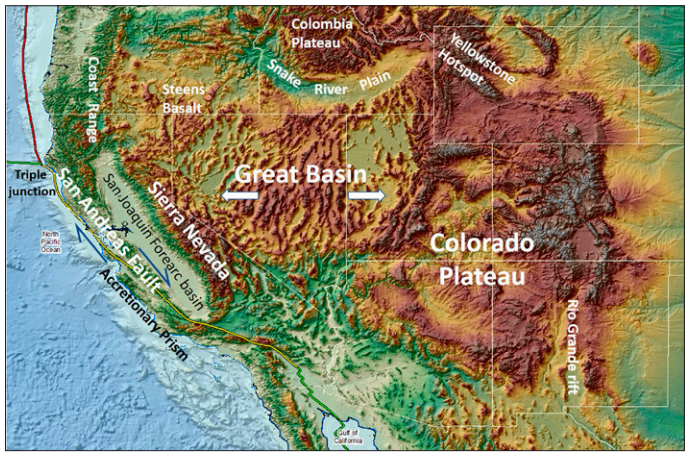
(4) The case study should have sufficient generality so that lessons learned can be applied to other regions with similar features and processes.

In this article, I have selected five regions that can be included in a case-based geology teaching.

1. The American West: California to Colorado

Major questions:

How did the Colorado Plateau uplift? How did the Great Basin acquire its north-south trending basin-and-ridge topog-



The American West: California to Colorado.

raphy? What are differences between accretionary prisms and forearc basins? Why is the American West vastly arid (compared to the US east coast)? What rock formations constitute the Red Sandstone country in southern Utah?

Major subjects to be covered:

- Plate tectonics: Subduction
- Subduction-related magmatism
- Subduction-related metamorphism
- Accretionary prism vs. forearc basin
- Ophiolites (in California)
- Orogens: Sierra Nevada vs. Rocky Mountains
- Rocky Mountains: Thin-skinned Sevier vs. thick-skinned Laramide orogenies
- Rocky Mountain foreland basins: Basin-fill, sedimentary facies, and basin deformation
- Plateau uplift: Colorado
- Crustal extension: Basin-and-Range region
- Crustal structure and variation across the region (east to west)
- Strike-slip fault: San Andreas fault
- River incision: Colorado River
- Desert/arid environments
- Geochronology: Relative dating
- Geologic timescale: Stratigraphy of "Red Sandstone" National Parks in Utah

2. India-Himalaya-Tibet

Major questions:

How did the Himalaya become the range containing the world's highest mountains? Why is Tibet the loftiest plateau on Earth? Where is and what constitutes the boundary (suture zone) between the Indian plate and Tibet (part of the Eurasian plate)? What happened to the ancient Tethys Ocean? How was isostacy discovered? How do the Himalaya and the monsoons together shape the climate in northern India versus Tibetan Plateau?

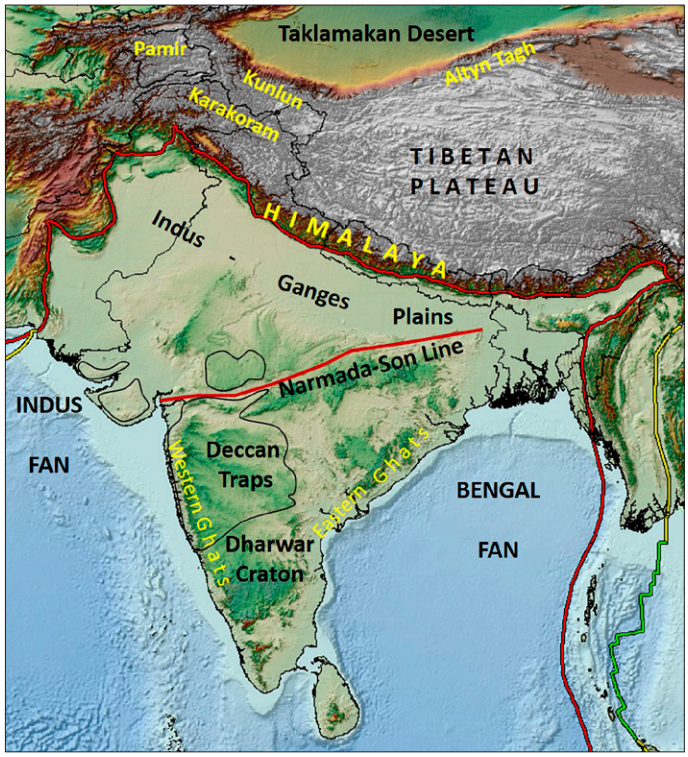
Major subjects to be covered:

- Precambrian shield: India
- Supercontinent: Gondwana
- Vanished ocean: Tethys
- Ocean opening: Indian Ocean
- Continental flood basalts: Deccan Traps
- Plate tectonics and continental drift of India
- Paleomagnetism
- Continental collision
- Orogenesis: Himalaya
- Plateau uplift: Tibet
- Rock deformation and thrust tectonics
- Earthquakes
- Regional metamorphism
- Deep structure of the continent: India vs. Himalaya vs. Tibet
- Isostasy
- Foreland basin
- Monsoons
- Rivers and deltas: Indus and Ganges

3. The East African Rift-Red Sea Region

Major questions:

What is a triple junction? How and when did the Red Sea rift apart? How do geologists determine the age of ancient

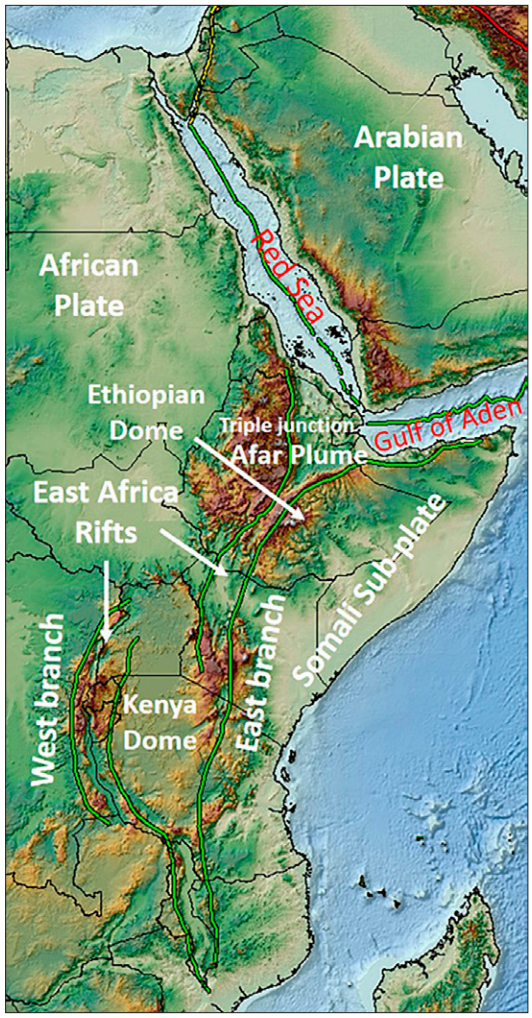


India-Himalaya-Tibet.

hominid remains? How did Kilimanjaro – the tallest mountain in Africa – form?

Major topics to be covered:

- Divergent margins: Continental rift to juvenile ocean basin
- Triple junction
- Rift-related volcanism
- Geochronology: Radioactive dating
- Rift-related topography
- Lakes: lacustrine deposition
- Evolution of Hominids
- Pliocene-Quaternary climate change



The East African Rift-Red Sea Region.

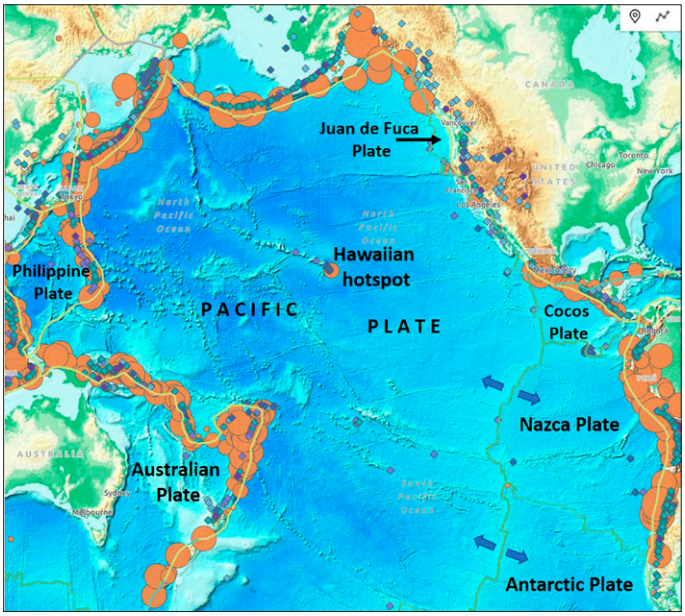
4. Circum-Pacific Region

Major questions:

What lies beneath the Pacific Ocean: Its ocean floor features and names of tectonic plates? Why is the Circum-Pacific region known as the Ring of Fire? How are volcanic eruptions and earthquakes related? What are the three main types of volcanoes? Why do we have Hawaiian Islands in the middle of the Pacific?

Major topics to be covered:

- The physical geography of the Pacific
- Mid-ocean ridges
- Sea-floor spreading and paleomagnetism
- Subduction zones
- Subduction-related magmatism
- Ocean-Ocean floor subduction: Aleutians
- Terrane assembly tectonics: Alaska
- Earthquakes and Wadati-Benioff zone
- Earthquakes and internal structure of Earth
- Mantle plumes: Hawaiian hotspot
- Plate tectonic mechanism: Convection currents
- Island Arcs
- Types of volcanoes: Stratovolcanoes, Shield volcanoes, Cinder Cones
- Ocean floor sediments



Circum-Pacific Region.

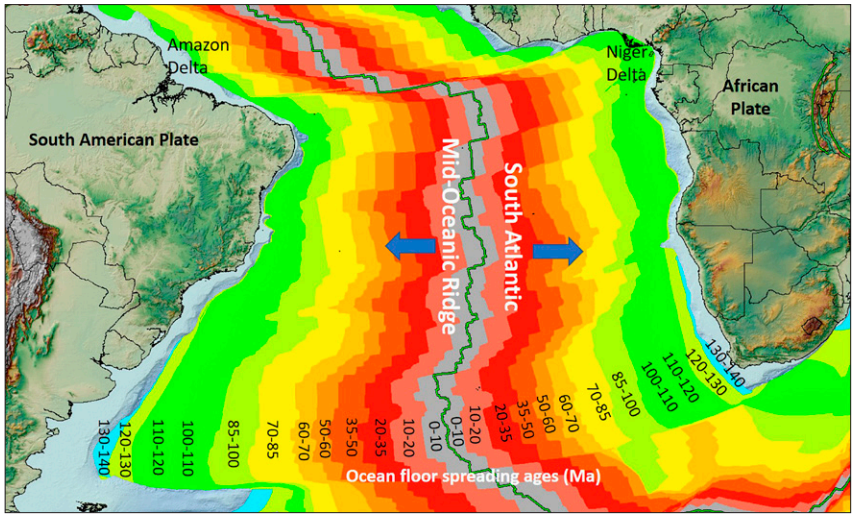
5. South Atlantic Ocean and Continental Margins

Major questions:

How and when did Gondwana form? What are the differences between active vs. passive continental margins? How do you define the three types of continental crust? How was the sea-floor spreading discovered? Where do we find turbiditic sediments?

Major topics to be covered:

- Supercontinent assembly: Gondwana and Pangea
- Passive continental margins: Rift to Drift



South Atlantic Ocean and Continental Margins.

- Failed rift basins (aulacogens)
- Oceanic, transition, continental crusts
- Sea-floor spreading and paleomagnetism
- South Atlantic mid-ocean ridge
- Fracture zones and transform faults
- Plate motions: Euler poles
- Continental shelf, slope, continental rise, abyssal plains
- Turbidites
- Deltaic basins: Amazon and Niger
- Oil and gas fields

Obviously, there are many other regional cases that can be used in geology education. Case studies are comprehensive, multifaceted and inherently coherent "stories" used as a teaching tool to demonstrate the application of concepts and theories to real situations. For more discussions on CBC refer to Herreid (1994), Krain (2016), Breslin and Buchanan (2008), and Noblitt et al. (2010). The late Kevin Burke (1929-2018) used to say that "All geology is regional geology." This is so true for geology education. A regional context is where rocks, rivers, faults and fossils communicate with each other. It is a lively environment to learn too. That is why one of the most popular geology books, Earth by Richard Fortey (2004), is actually a geological tour of the world's various regions.

References

Barnes, I.B., Christensen, C.R., and Hansen, A.J. (1986) *Teaching and the Case Method*. Harvard Business School Publishing Division, Boston, 333 p.

Bonney KM. (2015). Case Study Teaching Method Improves Student Performance and Perceptions of Learning Gains. *Journal of Microbiology and Biology Education*, 16(1): 21-28.

Breslin M, and Buchanan, R. (2008) On the Case Study Method of Research and Teaching in Design. *Design Issues*, 24(1), 36-40.

Bruffee KS. (1993). *Collaborative Learning: Higher education, Interdependence, and Authority of Knowledge*. Johns Hopkins University Press, Baltimore, MD.

Burko, L. M. (2016) Using the case study method in teaching college physics. *The Physics Teacher*, 54(7): 413-415.

Fortey, R. (2004) *Earth*. HarperCollins, London; Knopf, New York, 444 p.

Goldsmith, D.W. (2011) A case-based curriculum for introductory geology. *Journal of Geoscience Education*, 59: 119-125.

Herreid, C.F. (1994) Case studies in science: A novel method of science education. *Journal of Research in Science Teaching*, 23 (4): 221-229.

Herreid, C.F. (Ed.) (2007) *Start with a story: The case study method of teaching college science*. National Science Teachers Association Press.

Jonassen DH and Hernandez-Serrano J. (2002). Case-based reasoning and instructional design: Using stories to support problem solving. *Educational Technology*, Research and Development, 50(2): 65-77.

Krain M. (2016) Putting the learning in case learning? The effects of case-based approaches on student knowledge, attitudes, and engagement. *Journal on Excellence in College Teaching*, 27(2): 131-153.

Lundeberg, M.A., Levin, B.B., and Harrington, H. (Eds.) (1999) *Who Learns What from Case and How: The Research Base for Teaching and Learning with Cases*. Lawrence Erlbaum Associates Inc, Mahwah, NJ.

Noblitt, L., Vance, D.E., and Smith, M.L.D. (2010). A comparison of case study and traditional teaching methods for improvement of oral communication and critical-thinking skills. *Journal of College Science Teaching*, 39(5): 26.

Sorkhabi, R. (1997) Regional approach to geology education. *Journal of Geological Society of India*, 49 (5): 604-606.

Sorkhabi, Rasoul (2020) Educator's Corner: Documentary films in geology education. *The Professional Geologist*, 57(1): 44-45.

Stake, R. E. (1978) The case study method in social inquiry. *Educational researcher*, 7(2): 5-8.

Williams, B. (2005). Case based learning—a review of the literature: is there scope for this educational paradigm in prehospital education? *Emergency Medicine Journal*, 22(8): 577-581.



Role of Climate, Rocks, and Soils on the Wines of Napa Valley, California

Part 2 of 2

Barney Paul Popkin

This article is the second and final part of an earlier article (Popkin, 2023). It presents more detailed geological and pedological information and the insights into the wines of Napa Valley gained therefrom.

Table 1 illustrates estimated hydraulic parameters of selected soil types. Hydraulic conductivity is a measure of a material's capacity to transmit water. It is expressed as the volume of water at the ambient kinematic viscosity that will move during a unit of time under a unit hydraulic gradient through a unit area measured at right angles to the direction of water flow. Porosity is a measure of voids or openings within a material. It is expressed as the ratio of the volume of openings to the total volume of the material. Specific yield is the ratio of the volume of water that will drain under gravity to the total volume of the saturated material. Specific retention is the ratio of the volume of water retained after gravity drainage to the volume of the saturated material.

Down Among the Bedrock at Napa

Simply put, parent materials or rocks and underlying bedrock, erode and weather under the influence of water, microorganisms, and time to produce soil. The parent materials are the source of the soil's fertility and also impact its drainage and nutrient availability. Where soils are thin or well drained loams and sands, the roots of grape plants will seek water and nutrients from the fractures underlying the soil, as discussed below in "Sounding out the soils."

To paraphrase Geetapetals (2021), the different types of rocks will fracture in different ways. Some rocks fracture more than others, making water and nutrients more available to aggressive roots. Limestone fractures well, dolomites less so. Natural wines from roots in limestone, as in the case of Burgundy grown on limestone, for example in Venezia Giulia, northeast Italy, tend to have more acidity and a "chalky nose." Dolomite Burgundy has less chalk. The Venezia Giulia is a typical limestone region in northeastern Italy. Foradori is a typical dolomite high-altitude wine from this region.

French and German wines tend to be grown on calcareous soils derived from limestone and dolomite.

Young, undeformed granite is dense and not very fractured. Older, deformed, fractured, and weathered granites produce sandy regolith which yields high acidity and tannin experienced at the front of the mouth and on the lips. Such wines are produced in the Bolo region in northwestern Spain and north Portugal, in South Africa and the Northern Rhone valley.

Basalt tends to produce wines that aren't very tannic (dry, bitter, or astringent-like), with a marked acidity on the sides of the mouth. These wines may be perceived as tasting peppery. They are common in the U.S. west coast of Washington, Oregon, and California. Chilean wines tend to be a mixture of granitic and basaltic based.

Table 1. Estimated values of hydraulic conductivity, porosity, specific yield, and specific retention in selected soils. From Heath (2004).

Soil Type	Hydraulic Conductivity, ft/day	Porosity, % by volume	Specific yield, % by volume	Specific retention, % by volume
Loam	0.0000008-0.0008	55	40	15
Clay	0.002-10	50	2	48
Silt, loess	0.2-80	25-55	22-40	15-48
Silty sand	1-1,000	25-55	22-40	15-48
Fine to coarse clean sand		25	22-40	3-15
Sand		25	22	3
Gravel	2,000-15,000	20	19	1

Schist tends to produce wines with noticeable acidity in the upper back of the jaw, somewhat like a dentist drilling. There's also moderate tanning on the sides and front of the mouth. Such wines include Cote-Rotie Region of the northern tip of France's Rhône Valley, Riberia-Sacra from the Spanish Denominación de Origen Protegida in the Galicia, and Anjou from the Loire Valley in France.

Gneiss wines can be somewhat between granite and basalt.

Slate bridges the gap between schist and limestone. The Mosel Region in Germany is a good example.

Of course, there are a great many more examples of rock types and trace elements directly influencing wine varieties.

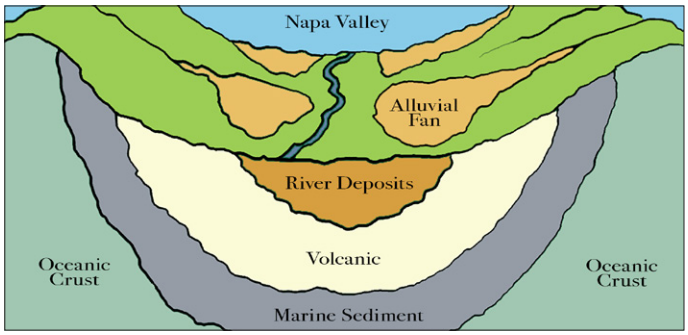


Figure 1. Schematic Geologic Panoramic of Napa Valley, California (Master Wine Tours, 2018).

Sounding out the Soils of Napa

Figure 1 is a schematic geologic panoramic of the Napa Valley, a world-renowned wine-production region in northern California. Note its inclusion of older oceanic crust beneath marine sediment, volcanics, and younger alluvial fans. The valley sits in a syncline of Cretaceous oceanic crustal rocks (the Franciscan) which was partially subducted beneath the Sierra Nevada (off the cross-section to the East) during the Oligocene. The Franciscan is overlain by the Great Valley sequence composed of land-derived synorogenic sediments and volcanic rocks derived from the Sierra Nevada.

As noted by Swinchatt (2002) and many others, the Napa Valley is "a rugged terrain of great variety in bedrock, soil and microclimate." This complexity and ruggedness have meant that the valley has been divided into 16 American Viticultural Areas so as to facilitate comparison of its many widely different wines.

To a large extent, it is the clay content of grape-producing soils that determines their drainage and fertility. According to Geetarpetals (2021), the topsoil layer is largely important for water retention and initial nutrient supply. More clay means higher soil-water retention, a longer ripening period, and more "black fruit" or abundant nutrients for natural wines. Less clay means fewer nutrients for the grapes, less time in which to ripen and more "red fruit". If the top layer is nutrient rich with plenty of water, then the grape vine can have small, short roots and will not struggle for water. It can make a bland juice, and not work hard to achieve its biological end goal of making sugar-rich grapes.

In well-drained loamy and sandy soils, the rock below the topsoil becomes more important. This is especially true for old-vine vineyards in the top classical wine producing regions. Poor nutrient and water content in the topsoil means the vines have to burrow deeply downward, seeking tiny rock fractures in their search for water and minerals. This is partially why limestone bedrock is favorable for good wines in poorly drained soils.

Wine grapes are generally associated with sandy soils on sedimentary rocks and soils on deep basalts. In Napa County, wine grapes are generally associated with Aiken, Bale, Clear Lake, Cole, Coombs, Cortina, Haire, Perkins, Pleasanton, Tehama, and Yolo soil series (Lambert and Kashiwagi, 1978). Well-drained and sloped-land soils generally require as much as twice the irrigation allotment as poorly drained and flat-land soils (see Table 2, columns 2 and 3). Since the 1970s, drip or trickle irrigation has replaced much sprinkler irrigation on sloped lands and sprinkler and row-flood irrigation on flat lands.

Wine-growing management practices include "suckering, pruning, turning winter cover crops under by disking, and controlling weeds by spring tooth and drag harrowing. Nematodes are controlled by fumigating the soil before planting. Sprinkler irrigation is used for planting, frost-protection, and heat-suppression. There is little or no response to fertilizers from fertilization. Sulfur-dusting controls mildew. Specific water management issues are noted below.

The irrigation unit "feet per acre" is commonly used in commercial farming and home gardening to describe the depth of applied water for a crop area to meet the specific crop's consumptive water demand for a specific soil type and condition, climate and water application method, Grape-suitable soils are classified by their irrigation water requirements as: Group 1, Early summer sprinkler irrigation at 0.5 feet/acre (ft/ac); Group 2, Tillage across slopes with early summer irrigation at 0.6 ft/ac; Group 3, Tillage across slopes with early summer sprinkler irrigation at 0.4 ft/ac; Group 4, Early summer sprinkler irrigation two or three times at 0.25 ft/ac; and Group 5, Tile drains or open ditches to keep the water table below the root zone, early summer irrigation at 0.6 ft/ac on loams and 0.3 ft/ac on clays. Well drained and sloped-land soils generally require as much as twice the irrigation allotment as poorly drained and flat-land soils. Since the 1970s, drip or tickle irrigation has replaced much of the otherwise sprinkler practices on sloped lands and sprinkler and row-flood irrigation on flat lands.

Soil texture, slope, and available water capacities define the grape-suitability groups as follows:

Grape-Suitability Soil Group	Description
Group 1: Pleasanton and Yolo	Group 1: Pleasanton and Yolo, Well-drained, moderate to slow vertical permeability, medium acid to neutral, thick loams on alluvial fans with less than 2% slopes and available water-holding capacities of 8-12 in. It has little or no erosion hazard, but occasional small-scale flooding.
Group 2: Pleasanton and Yolo well-drained	Group 2: Pleasanton and Yolo, Well-drained, moderate to slow permeability, medium acid to neutral, thick loams on alluvial fans and terraces with 2-5% slopes and available water capacities of 8-12 in. Soils are fertile, respond well to fertilizer, and are easy to till.

Grape-Suitability Soil Group	Description
Group 3: Perkins and Tehama	Group 3: Perkins and Tehama, Well-drained, slow permeability, slightly acid to mildly alkaline, thick gravelly loams or silt loams on alluvial fans and terraces with 0-9% slopes and available water capacities of 7.5-12 in.; Clear Lake, slow permeability, slightly acid to moderately alkaline, artificially drained clays on alluvial basins and valleys with 0-2% slopes and available water capacity of 8-10 in.; Coombs and Haire, moderately well drained and drained gravelly loam, moderate slow to very slow permeability, medium acidic to very acidic, loam or clay loam with 2-4% slopes and available water capacities of 3-10 in.; and Coombs and Haire, moderately slow to very slow permeability, moderately well drained or well drained, very strongly acidic to medium acidic. gravelly loam, loam or clay loam on old terraces and alluvial fans with 2-9% slopes and available water capacities of 3-10 in.
Group 4: Excessively drained Cortina	Group 4: Excessively drained Cortina, Rapid permeability, neutral to mildly alkaline, deposition prone and erodible and thick gravelly loam or very stony loam on alluvium with 0-5% slopes and available water capacities of 2-5 in. Requires light, frequent irrigation. Crops respond well to fertilizers. Tillage is limited by stones.
Group 5: Somewhat poorly drained Bale and Cole; and Clear Lake	Somewhat poorly drained Bale and Cole, moderate slow or moderate permeability, infrequently flooded, subject to sediment deposition, slightly acid to moderately alkaline, thick loam, silt loam, or clay loam with 0-5% slopes and available water capacities of 6-12 in.; and Clear Lake over-washed and high water-table, subject to sediment deposition, slow permeability, slightly acid to moderately alkaline, poorly drained clay with 0-2% slopes at low elevations in basins and valleys and available water capacities of 8-10 in.

There are 11 soil associations, or major groups of soil series, in Napa County, grouped according to their landscapes. Four soil associations are based on alluvial fans, flood plains, valleys, and terraces landscapes; and seven soil associations are based on upland landscapes. Generally, soils on alluvial fans, flood plains, valleys, and terraces are thicker, finer-grained with slower permeabilities and higher water-storage capacities than upland soil. These soils are loams to clays, formed in alluvium from sedimentary and igneous rocks.

The major wine-producing soil associations are in alluvial fans, flood plains, valleys, and terraces. They are: 1. The Bale-Cole Yolo, 2. Tehama, 3. Reyes-Clear Lake, and 4. Haire-Coombs. These associations cover about 16% of the county. However, other soils are capable of wine-grape production if properly managed.

The Bale-Cole-Yolo soil association covers about 6% of the county. It is nearly level to gentle sloping, well drained and somewhat poorly drained loams, silt loams, and clay loams on series is well drained to poorly drained, nearly level to moderately steep soils on flood plains, alluvial fans and terraces. Soils formed on deep deposits of alluvium are derived from basic igneous and rhyolite bedrock.

The Tehama soil association covers about 3% of the county. It is nearly level to gently sloping, well drained silt loams on flood plains and alluvial fans. Soils formed on deep deposits of alluvium are derived from sedimentary rock.

The Reyes-Clear Lake soil association covers about 4% of the county. It is nearly level, poorly drained silty clay loams and clays on tidal flats, in basins, and on basin rims. Soils formed on deep deposits of alluvium are derived from sedimentary and basic igneous rocks.

The Haire-Coombs soil association covers about 3% of the county. It is nearly level to moderately steep, moderately well to well drained gravelly loams, loams, and clay loams on terraces. Soils formed on deep deposits of alluvium are derived from sedimentary and igneous rocks.

The features of the 11 major Napa Valley vineyard soil series generally thought to be the best wine-grape production soils are summarized in Table 2 on page 67. Figure 2 illustrates Napa Valley wine-suitability areas. Over 90% of the Valley is suitable for commercial wine production.

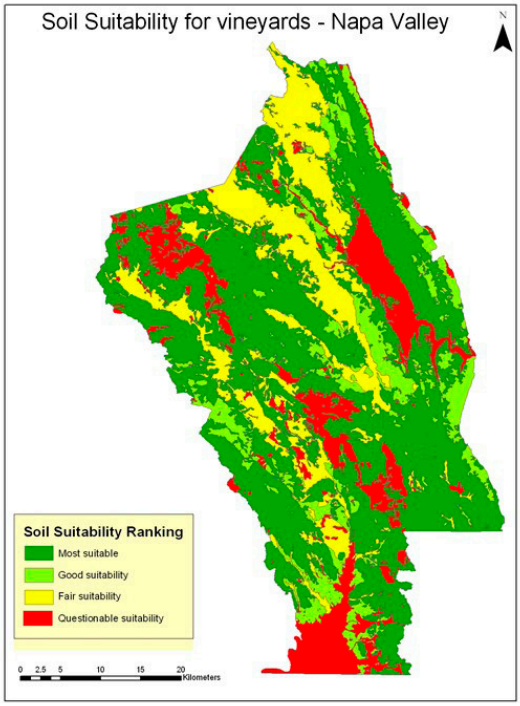


Figure 2. Napa Valley's Soil Suitability Ranking. From: University of British Columbia, 2015.

Topography and Climate/ Weather and Wine Grapes in the Napa Valley

The Mercedes Effect – fog slips in "as smooth as a Mercedes changing gears" to naturally irrigate the Nape Valley vineyards (Skinner, 2003). Topography plays several roles, including accumulating fog and moisture in low-lying areas as well as eroded materials from nearby high-lying areas.

Conclusions

The grape, a product of biology and terroir, and yeast provide the sugar for the alcohol which makes wine, while the soil provides the nutrients and trace elements which makes the 1) visual (color and brilliance), 2) smell (aroma), 3) taste (and tannin), and 4) touch (body and mass), detected four human senses related to wine. The clink of wine glasses adds the fifth sense, sound.

Based on USGS Geologist Dr. David Howell's (1999, 2002) and Swinchatt and Howell (2004) breakthroughs in Napa Valley geologic analysis and his several recorded interviews of vintners (MacNeil, 2020) of diverse and conflicting wisdom

about 20 years ago, it appears that with sound master-vintner knowledge, resources, skills, and management, high-quality fine wines may be produced from otherwise paltry terrane.

Recommendations for Research

Ongoing research into wine-making at universities like the University of California at Davis, Cornell, Washington State, California Polytechnic, and Oregon State, foreign universities and research centers (especially in Australia, France, Italy, Spain, and Israel), culinary schools, and wineries themselves is long-ongoing and challenging. As in any agricultural crop research, much time is required for multi-variate field trials over several conditions to establish definitive results. Some interesting research areas include: hardy cropping patterns (seed variety selection), drought/ flood resistance, crop pest and disease control, potential for genetically modified organisms, improved soil fertility, soil amendments and nutrients, water quality and watering amounts and frequencies (water consumptive use), factor analysis of determinative parameters for pruning, harvest scheduling, grape processing and juice mixing, wine processing, monitoring and evaluation of important parameters for improved productivity and quality, and mapping and modeling appellative areas.

Table 2. Summary and description of features of major Napa Valley vineyard soil series

Vineyard Soil Series and Description	Drainage	Slope, %	Landscape and Elevation, ft	Permeability	Parent material	Water Capacity, in.
1. Aiken: thin acid loam	Well	2-50	Upland soil; 300-2,500	Moderate to slow	Basic volcanic rocks: basalt and andesite	6.5-11
2. Bale: thick acid loam	Poorly	0-5	Alluvial fans, flood plains and low terraces; 100-300	Moderate	Rhyolite and basalt	6-9
3. Clear Lake: thick clay or clay loam	Poorly	0-2	Old alluvial fans and basins; 20-250	Slow	Sedimentary rocks	8-10
4. Cole: silt loam	Poorly	0-5	Alluvial fans and flood plains; 100-300	Moderate, slow	Alluvium from sandstone, shale, and basic rock	10-12
5. Coombs: thick, acid gravelly loam & clay loam	Well	0-5	Terraces; 100-500	Moderate slow	Mixed alluvium from igneous and sedimentary rocks	6-10
6. Cortina: thick gravelly loam	Excessively well-drained	0-5	Flood plains and alluvial fans; 100-500	Rapid	Recent stratified alluvium	
7. Haire: acid loam	Moderately well	0-30	Old terraces and alluvial fans; 20-300	Very slow	Alluvium from sedimentary rocks	
8. Perkins: acid gravelly loam	Well	2-9	Terraces; 150-1,500	Slow	Alluvium from igneous rocks	7.5-8.5
9. Pleasanton: acid loam	Well	0-5	Alluvial fans; 50-600	Moderately slow	Alluvium from sedimentary rocks	8-9
10. Tehama: acidic silty loam	Well	0-5	Alluvial fans and terraces	Slow	Alluvium from sandstone and shale	10-12
11. Yolo: thick, neutral loam and silt loam	Well	0-5	Alluvial fans	Moderate	Recent alluvium	0-12

Adapted from Carpenter and Cosby, 1938; Lambert and Kashiwagi, 1978.

Examples of possible research topics are:

- Optimizing irrigation scheduling and water quality for well-drained and poorly drained soils
- Appropriate addition of soil nutrients like nitrogen, phosphorus, potassium, and trace elements and amendments like sulfur and gypsum to calcareous and alkaline soils, as well as lime and alum to acidic soils
- Best grape harvesting scheduling and wine making and aging procedures
- Best integrated crop and pest management strategies
- Most important factors to focus on for best quality and yields

References

Geetarpetals, February 2021. Personal communication by Reddit.

Heath, Ralph C., revised 2004. Basic Ground-Water Hydrology. U.S. Geological Survey, Water-Supply Paper 2220.

Howell, David G., 1999. Earth Nectar, the Wines of Napa Valley and the Earth from Which They Arise.

Howell, David G., October 3, 2002. Earth nectar – the geology and wines of Napa. Presented to the Peninsula Geological Society, Stanford University, Peninsula Geological Society October, 2000 Lecture (diggles.com).

Lambert, G. and J. Kashiwagi, 1978. Soil Survey of Napa County, California. U.S. Department of Agriculture, Soil Conservation Service.

MacNeil, Karen, February 2020. David Howell Interview. WineSpeed, https://winespeed.com/people-to-know/david-howell/.

Master Wine Tours, 2018. Napa Valley American Viticultural Area (AVA) Tours. Napa Valley AVA | Master Wine Tours.

Popkin, Barney P., January-March 2023. Role of Climate, Rocks, and Soils on the Wines of Napa Valley, California, Part 1 of 2. American Institute of Professional Geologists, *The Professional Geologist*.

Skinner, Paul W., 2003. Weather and Wine Grapes in the Napa Valley. Terra Spase.

Swinchatt, Jonathan, 2002. The Foundations of Wine in the Napa Valley: Geology, Landscape and Climate in the Napa Valley AVA. EarthVission.

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Adam Heft, CPG-10265, *Editor*

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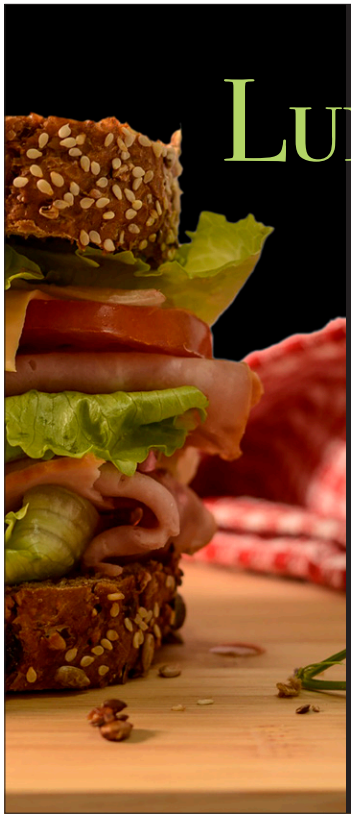
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2. **Off the Beaten Path - Unique feature/ formation.**
3. **Geologists in Action - people at work/ field trips.**
4. **Micro-Geology - Under the microscope.**

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**.

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