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THE PROFESSIONAL GEOLOGIST

VOLUME 62 NUMBER 1

STUDENT EDITION

JAN.FEB.MAR 2025

Getting Your First Job After Graduation
Your Career Path will Probably Change
Student Chapter Showcase

Peer reviewed
Testing the Accuracy of
Polycam® 3D Scanning Software



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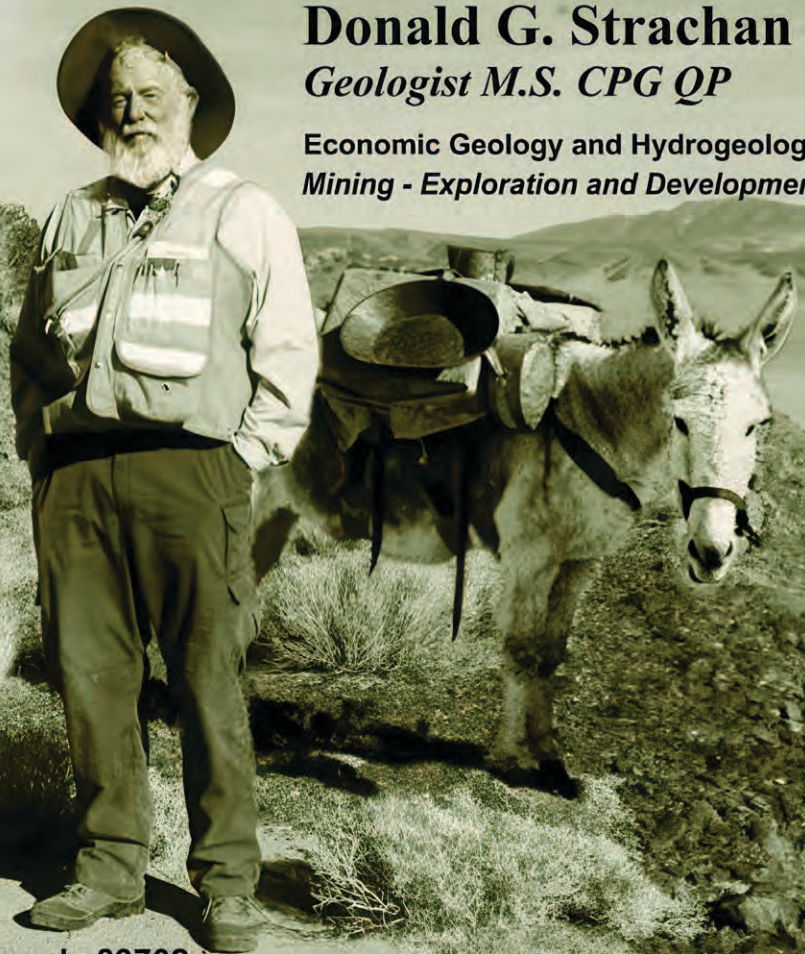
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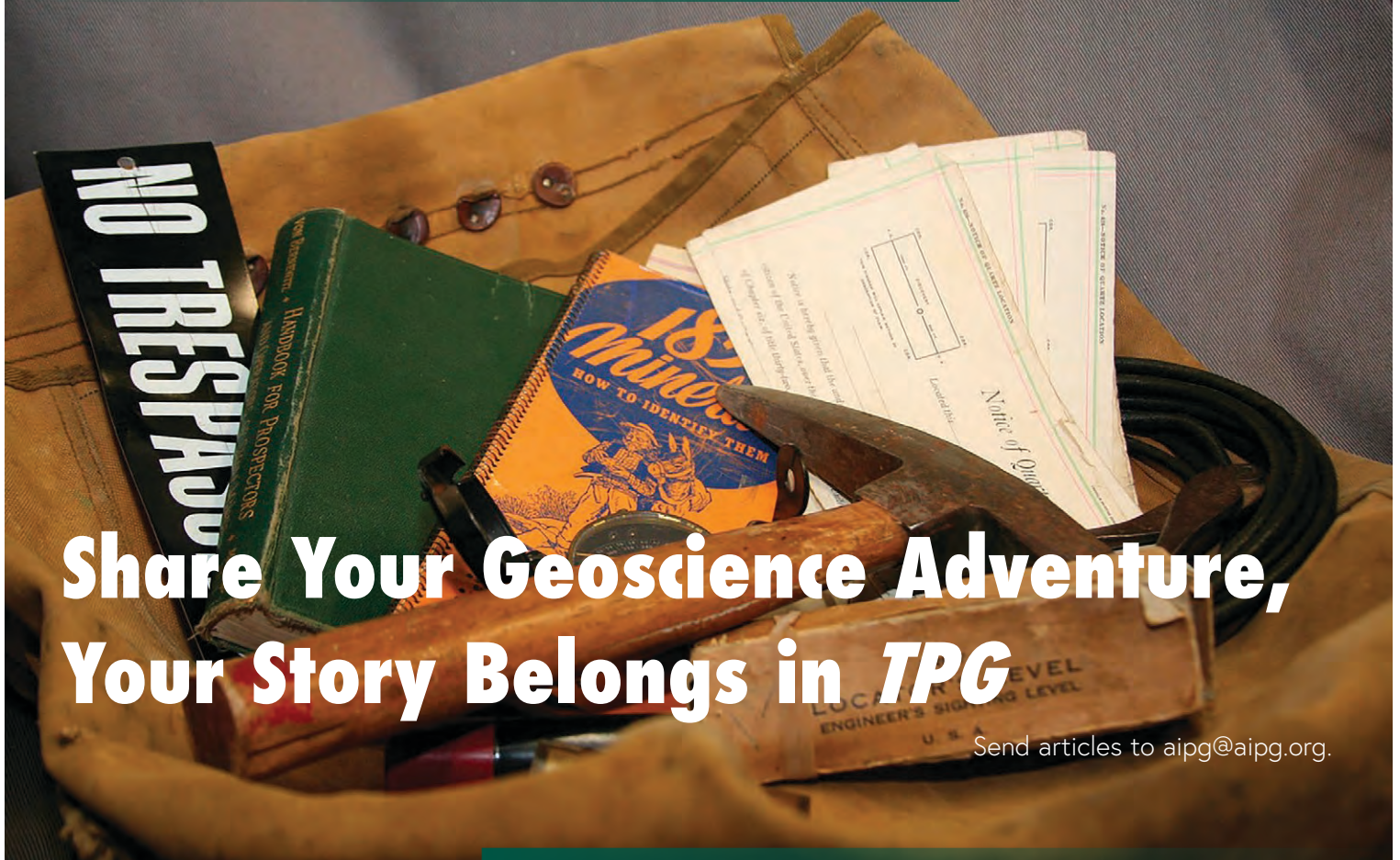
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The Professional Geologist

Volume 62 Number 1

JAN.FEB.MAR 2025

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On the Cover: 2025 Photo Contest Winner - Geologists in the Field - Viewing a Subsidence Fracture

Description: Viewing a Subsidence Fracture – Nearly 100 years of solution mining of halite in a Central New York valley resulted in subsidence and the opening of pre-existing joints in the lower bedrock walls of the valley. The halite deposits being mined are part of the Upper Silurian Salina Group shales and evaporites which occur 1,200 to 1,400 feet below the valley floor. Overlying the Salina Group are the Lower Devonian Helderberg Group limestones and dolomites. Middle Devonian Hamilton Group shales form the valley walls. Solution mining occurred in the late 1800s and early 1900s. The pre-existing joints and open fractures are primarily oriented just west of north and northeast.

Photograph by **Guy A. Swenson, III, CPG-7574**, AIPG Northeast Section, 2005.
2025 Photo Contest: Geologists in the Field. Runner Up on page 5.

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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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Adventures in Moving...

or the Geologist with the Most Rocks Wins

Adam W. Heft, CPG-10265

Happy 2025 and welcome to the Student Edition of The Professional Geologist! I have once again tried to make this edition something special and useful for students and professionals alike. In addition to the usual content that you've come to expect, we have a few articles written by students, including one of the 2024 Student Chapter of the Year submittals. **Peter Dohms**, CPG-07141, submitted an article on his career path. We also have a peer review article based on a student's research submitted by **Maurice Testa**, ECP-1178. And as promised, we have the AIPG member listing. I hope you opted in so you can show your friends and colleagues that YOU are a part of the Gold Standard of the geosciences!

You've all probably heard the statements "the geologist with the most rocks wins" and, from one of the AIPG t-shirts "you might be a geologist if you have more rocks in your house than in your driveway". I can tell you from my own experience that both are true. I've claimed on more than one occasion that I have at least 10,000 pounds of rock; some of you have heard me make this claim. Allow me to explain...

In September 2020, Sara and I were married, and I moved in with her. Over the next year and a half, we worked on renovating my house and began putting everything that didn't fit into her house into storage. This included most of the items in my pole barn – all my wood shop equipment, lumber, rock saw, and of course, my rocks. As these were scattered all over the barn (and outside it) and in various containers, or loose, they went to storage in stages. I knew, of course, that there were a lot but the full weight of them didn't completely register. The other thing is that given the sheer volume of material that needed to go into storage, I needed to get a second storage unit to house everything, even after packing everything in as tightly as possible. By July 2022, everything was in storage, the house was fully renovated and put on the market. It sold quickly.

Fast forward a couple of years. Early in 2024 we located property that suited us, purchased it, and began construction activities. We had a driveway put in and then a new (and larger) pole barn built. With the barn built, I began moving things out of the storage units and into it. It took numerous trips with my truck to mostly empty the two units. Because I'm not entirely sure yet where things will be, I temporarily segregated materials into different areas. The rocks all ended up in

one place in the back. Something we discovered while trying to put the rocks into storage was that cat litter totes make great containers for storing (and carrying) rocks.

Take a look at the photo – you will see I have not exaggerated the number of rocks I have. The poles of the back wall are 10 feet apart, and the rocks come out about 10 feet from the wall. The rocks take up about 200 square feet of floor space and are piled or stacked up to two feet high. And in case you're wondering, no, this isn't all of them. There are still a handful of rocks that have not yet been brought over from storage, and there are quite a few still here at our house that will need to be moved.

I can anticipate the incredulous questions of the readers who have made it this far into my column. "Why in God's name does he need all those rocks?", or "why would anyone want to move all of those rocks (twice)?" Here is my explanation:

About 25 years ago, after looking at the Michigan bedrock maps and stratigraphic lexicon, I thought, "how many people have ever seen all of these different bedrock formations?" The answer I came to was "probably no one." So, I set about obtaining samples of each individual bedrock formation from Michigan. I wanted enough of each formation to be able to cut it down into a few cubes that could be easily put into an exhibit. The four blue 55-gallon barrels contain sample bags full of those rocks; there are other larger pieces that have not yet been cut down for the exhibit, and pieces of some of them that are left over. This project accounts for quite a bit of the rock. There are quite a few piles of loose rock in the photo. The largest pile is in the front left and is a pile of slate from a quarry

Continued on p. 5





Thank you to everyone who has donated to the book drive for the universities in Hermosillo, Sonora, Mexico. I'm shining a spotlight on a group that had a great response to the call for donations.

To celebrate Hispanic Heritage Month, colleagues at Horsley Witten Group, Inc., in Sandwich, MA, organized a book drive in the office. Tom Noble was the ringleader, and he was particularly enthusiastic about the effort because he had done his master's thesis work in Guanajuato, Mexico. Many thanks to Tom and the good folks at Horsley Witten for the books and the fun photo!

Dawn Garcia, CPG-08313

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Adam,

Thank you for listing the new CPGs and the time period received. I think it is a nice acknowledgment for the new CPG members and for TPG readers to see who some new CPG members are.

I also appreciated Aaron Johnson's article about receiving his CPG.

Barb Murphy, CPG-06203
2024 Chairperson
AIPG National Screening Chair

In the AIPG's last issue of *THE PROFESSIONAL GEOLOGIST*, while reading the LETTERS TO THE EDITOR, I read the one dealing with the terms Petrology and Petrography. I wish to add my two pennies.

Dear Editor:

The term petrology is derived from the Greek term petrologia, i.e., the study of rocks. The term petrography is derived from the Greek term petrographia, i.e., the description of rocks. Petrography involves the use of both transmitted light (in air) and reflected light (in air and in oil) microscopy. Reflected light microscopy is also commonly known as ore-microscopy. The father of that discipline is considered to be Professor Dr. Paul Ramdohr of the University of Heidelberg, Germany, affectionately known as "Erzvater," i.e., Ore-Father. Having earned my Doctorate in Geology-Mineralogy at the University of Heidelberg's Institute for Mineralogy & Petrography in 1973, where Professor Ramdohr, in his late seventies and early eighties, was still conducting research as well as working on his detailed and comprehensive treatise on ore-microscopy "The Ore Minerals and Their Intergrowths," I got to know him and was honored to be invited to his lovely home in Dossenheim, site of the "Dossenheimer Quarzporphyr" quarried for use in the construction of roads and railroads. Professor Ramdohr exposed me to lunar rock samples and to Australia's Mundrabilla II meteorite at the Max Planck Institute, located on Heidelberg's Koenigstuhl.

Sincerely,

Dr. Erik H. Schot, PhD, MEM-2189

Editor's Corner, continued from p. 3

in the Upper Peninsula. While this is one of the formations I have for the project, I collected this slate to use as building material for a fireplace and possibly as a tile floor in the home we plan to build. Much of the rest of the rock is mineralized: banded iron formation and native copper bearing basalt from Michigan and lead from Missouri. There are fossils (Potoskey Stones, Kona Dolomite, and stromatolites from Michigan and Petrified wood from Arizona) and decorative rocks. And of course, rocks from all over the country (and Canada) from various field trips that we've participated in since our college days.

The other thing is that I'm a collector at heart; combine that with being a geologist, and it spells trouble. I thought while growing up that there wasn't much that is heavier than paper (I collect stamps and have quite a collection of science fiction reading material – and all that paper weighs a lot), but I was quickly disabused of that notion once I had a pole barn to put all my geological treasures.

So, the moral of the story for you students (and even some like-minded professionals) is this: give serious thought to what rocks you collect (and how many of them), preferably before you put them in your sample bags and bring them home. Don't make the same mistake I did – know exactly what you are collecting, where it came from, and what you want it for. I swear that all those rocks will reproduce themselves while in storage in your garage or wherever you put them!

Huh; 10,000 pounds I said? There may well be a lot more than that...

Above Right Photo Contest Entry:

Runner Up: 2025 Photo Contest - Geologists in the Field - A teacher in his element.

Description: A teacher in his element – Dr. Arthur Snoke (Emeritus Professor) of the Department of Geology and Geophysics of the University of Wyoming, Laramie, explains the stratigraphic column of the Snowy Range during a field trip to the Paleoproterozoic formations of the Medicine Bow Mountains in Wyoming. Notable geological exposures visited during the field trip included the folded, re-folded, kinked and crenulated French Slate, and the world-class outcrops of domal stromatolite bioherms in the Nash Fork meta dolomite.



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Getting your first job after graduation:

Networking and Internships are the key

Chris Gellasch, Ph.D., CPG-10964, Associate Professor, Department of Geography and Geology,
Eastern Michigan University

April Calkovsky, Career Coach, University Advising and Career Development Center,
Eastern Michigan University

At the end of each academic year, we see many excited students at Eastern Michigan University (EMU) going through commencement ceremonies and celebrating the end of this phase of their life. When asked about what comes next, some students tell us about their new full-time job or their graduate school plans. Unfortunately, other students seem unsure how to answer and will say something like, “I don’t know, next week I am going to start looking for a job.” In general, the latter group did not spend much time in college thinking about how they will use their degree to pursue a career or even what type of work interests them. This can result in more than six months trying to find a job and hoping that it is something they find rewarding. Which group would you rather be in: those who start a full-time geoscience job right after graduation or those taking months searching for a job that may not be a good fit?

Although the focus of most students in college is to take courses to earn their degree, it is important to also look ahead to the future. Students need to start thinking about this early on and not just when they are about to graduate. Two methods to learn more about future career opportunities and to lay the groundwork for landing that dream job are networking and internships. Many students are unfamiliar with these methods and their faculty may not discuss these topics inside or outside of classes. Our goal is to help you better understand the benefits of networking and internships and leverage them to jump start your career.

Networking

Networking is a simple and effective way to learn more about what life is like after graduation and what career opportunities exist. This can be accomplished informally as a chance meeting

while out and about or formally at a networking event. It can sound intimidating to go up to a stranger and ask them questions about their current job and career path, but the reality is that most professionals love talking with students and sharing their experiences. All of them were students at one time and know how difficult it can be to learn about careers. Most professionals also like talking about themselves and their jobs so it does not take much prodding to get them to share.

It is never too early to start networking and learning about your future profession. Start your networking preparation by creating your “elevator pitch”. This is a short (30-60 second) speech you prepare that tells someone about who you are and your goals. There are many resources online that provide more information on how to craft one. Once you have developed and practiced your elevator pitch you can quickly introduce yourself and make a connection with a geoscience professional. If you are at the stage where you are actively looking for an internship or post-graduation position

Although the focus of most students in college is to take courses to earn their degree, it is important to also look ahead to the future. Students need to start thinking about this early on and not just when they are about to graduate.

you also want to have a polished resume prepared. For some events like job/internship fairs paper copies are beneficial, in other settings you can just have electronic copies to share.

Where can you network? One great place is at a professional organization meeting, like AIPG. Many of our students at EMU attend Michigan Section AIPG professional development meet-



Eastern Michigan University students, recent graduates, and Professor Chris Gellasch (right) at the AIPG/MAEP Joint Meeting, September 2024.

ings where they can network with geoscientists in a variety of sectors. Other professional organizations that are relevant also host networking events. Our students frequently attend Michigan Association of Environmental Professional (MAEP) events as well. These professional development meetings are typically free for students and include dinner (free food!) so they are accessible. There is usually a “social hour” at the beginning where people mingle and talk, which is the perfect time to network. You can also ask someone running the event to introduce you to others to help break the ice. During dinner be sure to sit with professionals and not other students so you can network more while eating. After dinner there is usually a technical presentation which is another good opportunity to learn what professional geoscientists in your area are doing. Although most of our students are nervous before their first networking event, afterward all of them tell us it was enjoyable, and they want to attend another event. After they graduate, those are some of the same people attending these events and helping the next generation of students.

Students can also be proactive and host their own networking events on campus. The EMU AIPG Student Chapter hosts a Geology Career Panel event that brings professional geologists from different sectors to campus to allow students to network. After an hour of networking in our atrium, everyone moves into a classroom where a Q&A session is held for students to ask questions and learn more about working as a professional geologist. The panel includes both recent graduates and more senior professionals who manage entry-level geologists or are in charge of hiring. Another way to network on campus is to have guest speakers come to campus and organize a pizza lunch or other event to give students time to talk with the speaker in an informal setting and learn more about life as a professional.

The more networking events you attend, the more comfortable you will become, and you will also develop contacts with several professional geologists. One former student shared that when she applied for a job, the interviewer was someone she met at three different networking events. It made her much more confident and relaxed during the

interview and she landed the job. If employers know you from networking events it will put a face with a name when you apply and put you ahead of other, unknown applicants. Some EMU students have been asked to interview for jobs and internships while at networking events without even formally applying for the position.

When students and faculty network it also increases the visibility and reputation of the university’s geology program. After several years of EMU faculty and students networking with professionals at AIPG and other meetings, employers now seek out our students and graduates for jobs and internships. Having a strong reputation among employers is invaluable for current and future students.

Internships

Employers report year after year that they prefer candidates with experience directly relevant to their industry. In the 2024 NACE Job Outlook Survey, employers made it clear that internship experience is the top factor they consider when deciding between two otherwise equally qualified candidates (<https://naceweb.org/job-market/internships/students-recognize-the-importance-of-gaining-internship-experience>). An internship is a temporary experience with an employer, lasting anywhere from three months to one year, during which a student is able to gain an insight into the career area of interest through meaningful projects under the supervision of a full-time employee.

While internships with nonprofit organizations may be unpaid, the opportunity only requires part-time hours, and the value of the experience cannot be replaced. Internships with private companies, corporations, and government agencies are usually paid and may even be full-time during a summer semester. Students may find internship opportunities by visiting employer websites, using their college career center’s career management system (such as Handshake, 1220, or Symplicity), through professional associations, their college department website, and through their personal or professional network. You can also attend internship fairs at your college to learn about opportunities. At EMU we have a STEM Internship Fair during the Fall and a separate Environmental



Students and professionals networking at the AIPG/MAEP Joint Meeting, September 2024.

Internship Symposium in January for students seeking summer internships in the environmental sector. Students must apply for internships using a cover letter and resume and must participate in an interview with the organization. Internships are competitive opportunities, so it is important for students to take the preparation of their application materials and interviews seriously.

EMU Geology and Environmental Science students obtain internships through many of the routes mentioned above. Many of these internships are with environmental consulting firms working full-time during the summer with good pay and a lot of field experience. Some of these internships turn into part-time positions during the academic year and may also lead to a permanent position after graduation. Depending on the local job market in your area, you may find more internships in other sectors such as mining, engineering geology, etc.

Students recognize the value of internships and current EMU Hydrogeology major and AIPG Student Chapter Vice President Jasmine Ross (SA-11622) summed her internship last summer:

"...my internship at GHD has been a highly enriching experience that has equipped me with valuable skills and insights into the field of environmental consulting. The blend of practical fieldwork, office tasks, and professional networking has provided a comprehensive learning experience that will undoubtedly benefit my future career. I am grateful for the opportunity to work with such a talented and supportive team and am excited to continue building on the foundation laid during this internship."

Where to get help?

There are multiple places on a college campus to obtain support for networking strategies, internship and job searching strategies, cover letter and resume review, and interview preparation. Faculty and program or internship coordinators within academic departments are also important sources of support and guidance for students seeking internship and job opportunities. Oftentimes, faculty hold memberships in professional associations and are clued into the latest trends, popular employers, and may even have relationships with local employers offering opportunities for their students. Building a good relationship with your faculty members is essential.

Every college and university across the country has a career center. These centers go by many names - Career Services, Career Development, Career & Professional Development, and so on. In large institutions, each college within a university may have their own career center, while in mid-sized and smaller institutions, there is usually one career center for the entire institution. In mid-sized and larger institutions, visiting the career center is not mandatory, so students must seek out those resources. Career centers employ career development professionals with years of experience and certifications which have prepared them to support students expertly. Career development professionals are well-trained in the most current resume standards, interviewing techniques, and connect directly with employers to discover opportunities for students. Career centers often connect employers with students through classroom visits, networking events, and career fairs where employers attend in order to recruit individuals for internships and full-time employment. Unfortunately, career centers are often underutilized - make sure you discover the career center on your campus today!

In conclusion, both networking and internships are valuable tools that students can leverage to learn more about their future career. There are both personal and professional benefits from interacting with professional geologists and other professionals outside of the academic environment. Remember it is never too early to start!

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Geoscience Gold: AIPG Members

Editors note - I've previously discussed including a member listing in *TPG* on an annual basis. The names are organized alphabetically by membership category, and this marks the first iteration of the list. While it's not quite everything I had envisioned, I'm optimistic that we'll resolve any issues for next year's version. If you don't see your name on the list, be sure to opt-in for next year to proudly showcase your membership and demonstrate what it means to exemplify the Gold Standard of the Geosciences!

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Testing the Accuracy of Polycam® 3D Scanning Software on LiDAR and Optical Photogrammetry Devices in Field Research

Abby Riggs, Matt Van Hook, Perla Romero, Erik Larson, MEM-3295, and Maurice Testa, ECP-1178

Abstract

Polycam® is a mobile app that generates 3D models of objects using high-resolution Photogrammetry or LiDAR (Light Detection and Ranging) technology. LiDAR scanning is available on Apple devices labeled “Pro,” such as the iPhone 12 Pro and iPad Pro. This project explores the accuracy of Photogrammetry scans in comparison to LiDAR scans. Testing took place on a geologic outcrop in Fort Smith, Arkansas. Scans using both methods were conducted at 1-meter intervals, extending up to a total distance of five meters from the outcrop. The internal measuring system in Polycam® was utilized to assess the geologic and lighting obstacles at each scan point. The measurements obtained from Polycam® were then compared to physical measurements to evaluate accuracy across different scanning distances.

LiDAR camera scans were conducted with an iPad Pro, 12.9-inch (5th generation). An iPhone 12 was used for the optical camera Photogrammetry scans. Field testing showed LiDAR equipped devices captured more accurate images. The accuracy for Polycam® using a LiDAR camera was within 2.5-centimeter resolution in well-lit areas, comparable to more expensive standalone LiDAR units.

Introduction

Over the past few years, low powered LiDAR (Light Detection and Ranging) has become more common on mobile devices such as mobile phones and tablets (Labsphere, 2024). The low-powered LiDAR camera, typically limited to 5W because of power consumption limitations, is primarily used in conjunction with the devices’ Photogrammetry camera for depth of field calculations and facial recognition (Lachat et al., 2015). With the popularity of LiDAR cameras on mobile devices, there has been an increase in mobile applications that allow the user to utilize these cameras more extensively. Applications like Canvas® allow the user to use LiDAR for quick room measurements and furniture placement (Canvas, 2016). The application Seeing AI is designed to help the blind and visually impaired navigate through their environment (Seeing AI, 2017). The applications Polycam®, 3D Scanner App, and Scaniverse® allow the user to capture images and create 3D scans using the LiDAR camera on the mobile device (Inal et al., 2023).

Polycam® is a mobile application (referred to as the software) that uses high resolution Photogrammetry and LiDAR to scan and render 3D models (Polycam, 2022). For this project, the Polycam® application was used because it could toggle strictly between the LiDAR camera and the device’s optical camera allowing for testing

of the accuracy of both techniques on the same device. To scan, the software automatically uses the best available camera on a device to conduct its scans and prefers LiDAR if it is available (Polycam, 2022). The software is able to scan and render images using a LiDAR camera or strictly Photogrammetry using the devices’ optical camera.

This project investigates the accuracy between Photogrammetry only and LiDAR supported devices in different field environments. Testing was conducted on measured geologic sections at an outcrop exposure called the Fort Smith Quarry in Fort Smith, Arkansas. Photogrammetry and LiDAR scans were taken at 1-meter intervals in distance from the outcrop up to five meters. The internal measuring system of the software was used to measure the geologic sections at each scan. The measurements were compared to the physical measured sections to test the accuracy of the rendered images at varying scanning distances.

Literature Review

Photogrammetry

Photogrammetry is a technique rooted in the principles of geometry and optics; it enables the extraction of precise three-dimensional information from two-dimensional images (Janiszewski et



Figure 1. Measured and imaged Atoka Formation outcrop.

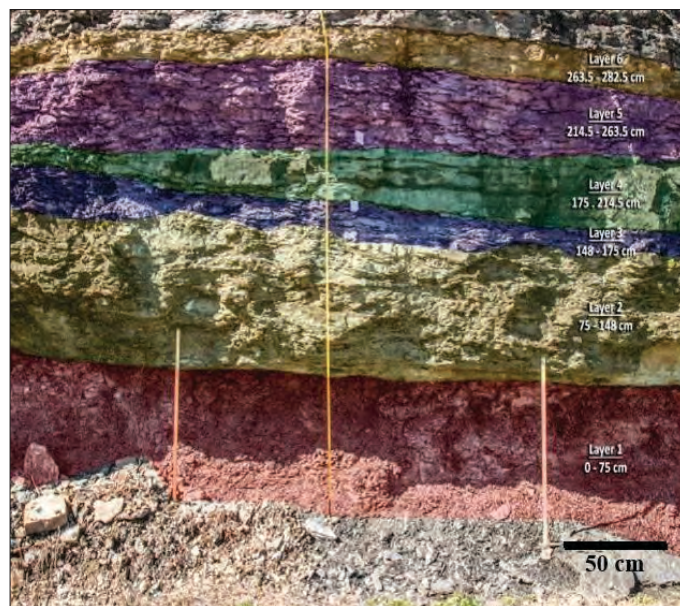


Figure 2. Measured and imaged Atoka Formation outcrop with the six bed layers identified.

al., 2022). The process typically involves capturing photographs of an object or scene from multiple viewpoints, creating an overlapping network of images (Almagro, 2002). Tie points, identifiable features common to multiple images, are then identified and used to reconstruct the spatial relationships within the scene. Through triangulation, the positions of these tie points are calculated, allowing for the generation of detailed 3D models or maps of challenging environments (Almagro, 2002, Janiszewski et al., 2022). Photogrammetry has been a useful qualitative and quantitative imaging tool that has allowed researchers from preserving historical documents to building 3D models from 2D images (Schenk et al., 2005, Brandolini & Patrucco, 2019, Dixit et al., 2019).

Low-Powered Mobile LiDAR

In recent years, the integration of low-power LiDAR technology into devices, like the iPhone 15 Pro Max and iPad Pro 5th generation, has revolutionized various functionalities, ranging from augmented reality (AR) experiences to advanced spatial mapping (Luetzenburg et al., 2021). As of 2024, only select Apple® mobile devices support LiDAR. This innovative technology, while reminiscent of traditional LiDAR systems, boasts optimizations tailored for size, power consumption, and cost-effectiveness (Wang et al., 2020).

Low-power LiDAR technology uses a low power semiconductor laser diode responsible for emitting pulses of laser light. These pulses, deftly directed outward by the microelectromechanical system (MEMS) scanner, interact with surrounding objects, reflecting off surfaces and returning to the LiDAR sensor (Wang et al., 2020). When low-powered LiDAR is used for Photogrammetry, Time-of-Flight (ToF) calculation is used to determine object distance based on laser pulse travel time (Tontini et al., 2020). This data is condensed into a dense point cloud and the three-dimensional geometry of the scene is processed within the mobile device's software (Luetzenburg et al., 2021).

The integration of low-power LiDAR technology can generate accurate environments, culminate enhanced AR experiences, enhance photographic features, and spatial mapping functionalities for users. Finding alternatives to low-cost mobile optical Photogrammetry finds its roots in Microsoft® Xbox Kinect sensors using inferred for close-range 3D modeling (Lachat et al., 2015).

This early research laid the groundwork for utilizing depth sensing technology in consumer devices, paving the way for the advancements seen in modern LiDAR-equipped smartphones and tablets.

Previous Case Studies using Polycam®

Researchers have leveraged the Polycam® application across diverse studies to advance scientific and technological applications. Janiszewski et al. (2022) utilized the software with a 360-degree camera to efficiently map tunnels through detailed 3D imaging, demonstrating its capability for complex structure mapping. Brandolini & Patrucco (2019) applied the software in Structure-from-Motion (SfM) Photogrammetry to digitize historical documents, offering a cost-effective method for preservation and study. Luetzenburg et al. (2021) explored the geoscientific potential of the iPhone 12 Pro's LiDAR sensor using the software, highlighting its accuracy in generating detailed 3D models of geological features. Tontini et al. (2020) integrated the software to validate SPAD-based LiDAR sensor models, enhancing accuracy in advanced imaging technology. Wang et al. (2020) utilized the software to analyze MEMS mirrors within LiDAR systems, providing insights into their structural dynamics. Lachat et al. (2015) investigated the software's role in evaluating the Kinect v2 sensor's capabilities for close-range 3D modeling, advancing understanding of 3D modeling techniques. Vacca (2013) employed the software with the Apple LiDAR Sensor for precise 3D modeling of architectural and cultural artifacts, improving assessments in heritage applications. Callegari et al. (2024) validated a handheld scanner's anatomical measurement capabilities with the software, capturing and analyzing 3D scans for accuracy and reliability. In each instance, Polycam® facilitated comprehensive 3D data acquisition, model validation, and enhanced insights across various scientific and technological disciplines.

Alternatives to Mobile LiDAR

There are multiple alternatives to mobile LiDAR devices that can be used for field research. Terrestrial LiDAR (T-LiDAR) such as tripod mounted devices have accuracy below 2.5 cm. However, these devices are mounted on a fixed tripod and are limited to the distance and angle from the object (Dassot et al., 2011). For aerial scans, airborne LiDAR can capture high resolution data at high speeds. Usually fixed wing or drone mounted, way points of inter-

est can be set using GPS and aerial scans with sub meter resolution (Lohani & Ghosh, 2017). Recently there has been development of handheld LiDAR devices that use Simultaneous Localization and Mapping (SLAM) algorithms to develop the scans. These devices, though not low-powered mobile devices as tested in this study, exhibit similar limitations as the scans are limited by the software algorithm’s analysis (Tribala et al., 2023).

Methodology

The Fort Smith Quarry (35.36332, -94.37930) was used as the test site for the Photogrammetry and low-powered LiDAR device. Due to its composition of interbedded layers of sandstone and shale from the Atoka Formation, the Fort Smith Quarry outcrop was ideal for image scanning (Figure 1) on the previous page.

A section of the outcrop 78 cm wide was marked and six sequential vertical beds were used to test the Polycam® measuring tool (Figure 2). Each bed’s thickness was measured manually with a tape measure to set the control. Each layer encompasses its own obstacles for the software to overcome using both Photogrammetry and/or LiDAR (Table 1). Layer 1 is set back beneath a ledge formed by Layers 2-6 and exhibits some shadowing. Layer 2 exhibited the most significant changes in textural relief across the beds, ranging from 2 to 5 cm. These textures created their own shadows and

Table 1. Imaging obstacles identified at each layer of outcrop

Layer	Imaging Obstacle
6	Direct sunlight, bleaching
5	Sun lit, limited relief
4	Structural dip
3	Sun lit, limited relief
2	Textural relief, intermittent shadowing
1	Shadowed overhang

scanning challenges, which adversely impacted both LiDAR and Photogrammetry results. Layer 3 and Layer 5 showed the least textural relief, ranging from 1 to 2 cm, and did not experience consistent shadowing. These layers best illustrate a well-lit environment, presenting minimal imaging challenges. Layer 4 features a noticeable pinch-out toward the measured and imaged section, with the bottom of the bed sloping at a 9-degree angle. Layer 6 was the most well-lit bed, with no obstacles blocking the sun and no shadowing present.

An iPhone 15 Pro Max main camera was used for Photogrammetry using the Polycam® app without LiDAR enabled. The iPhone Pro Max is equipped with a 48-megapixel main camera with a 24 mm, f/1.78 aperture lens. An iPad Pro 5th Gen equipped with LiDAR scanner was utilized for testing. The LiDAR scanner was forced on and the tablet was not allowed to revert to Photogrammetry. No zoom was used to keep the primary camera lens in use.

Scanning distances from the outcrop were taken every meter for up to five meters in distance away from the outcrop. Apple® advertises the LiDAR sensor’s scanning range is up to five meters away from the object (Luetzenburg et al., 2021) To assess the imaging capabilities under various conditions, three flags were placed at difficult to identify bed contacts. Each scan per device was taken 10 times at each metered distance for statistical analysis. The device was always held parallel to the outcrop with no tilting of the camera. Each scan was conducted by Polycam® and then uploaded to the software’s point cloud service to analyze and create the image. The measuring tool provided by the software was used to measure each of the 6 vertical bed thicknesses for each image scan. The 10 Polycam® measurements for each bed thickness at each meter in distance was then averaged and compared to the manual measurement at each meter in distance. Further analysis calculating the Root Mean Square Error (RMSE) of each distance and device was used to measure the differences between the true manually measured valued and the software’s measurements. Besides different distances on the outcrop, other challenges such as light variation, shadow presence, vegetation obstruction, and depth perception were noted (Table 1).

Table 2. Measured section data. Each control, Photogrammetry, and LiDAR measurements are averaged across the ten measurements.

Measured Bed Thickness in Centimeters							
Distance from Outcrop (meters)	Measurements (cm)	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
1	Measured Control	75.0	73.0	27.0	39.5	49.0	19.0
	Averaged Photogrammetry	60.0	43.0	18.0	20.0	43.0	12.0
	Averaged LiDAR	82.0	59.0	22.0	26.0	46.0	19.0
2	Measured Control	75.0	73.0	27.0	39.5	49.0	19.0
	Averaged Photogrammetry	42.0	28.0	26.0	13.0	23.0	9.0
	Averaged LiDAR	87.0	60.0	26.0	28.0	48.0	20.0
3	Measured Control	75.0	73.0	27.0	39.5	49.0	19.0
	Averaged Photogrammetry	30.0	21.0	8.0	13.0	12.0	6.0
	Averaged LiDAR	80.0	61.0	8.0	29.0	44.0	19.0
4	Measured Control	75.0	73.0	27.0	39.5	49.0	19.0
	Averaged Photogrammetry	23.0	16.0	6.0	8.0	12.0	6.0
	Averaged LiDAR	94.0	55.0	25.0	27.0	47.0	19.0
5	Measured Control	75.0	73.0	27.0	39.5	49.0	19.0
	Averaged Photogrammetry	18.0	12.0	5.0	6.0	10.0	4.0
	Averaged LiDAR	62.0	62.0	23.0	28.0	47.0	19.0

Results

Each measurement using Photogrammetry and LiDAR was taken 10 times. The 10 measurements per layer were averaged and compared to the measured control (Table 2).

Upon data collection, the Photogrammetry with the iPhone Pro Max optical camera showed a drop in accuracy as distance from the outcrop increased. The LiDAR equipped iPad Pro 5th Gen tablet averaged more accurate measurements when close to the outcrop with multiple sub-centimeter differences. At the maximum distance of five meters, Layer 6 showed the highest accuracy of the layers tested across both the Photogrammetry and LiDAR devices (Table 3).

RMSE analysis showed increased accuracy for LiDAR scans across each layer versus Photogrammetry (Figure 3 and 4). LiDAR also showed to have a higher precision than Photogrammetry at each layer except for Layer 1 (Figure 3 and 4).

Discussion and Conclusion

During testing of both Photogrammetry and LiDAR scans, the bed layers each challenged the devices in different ways. Layer 1 exhibited a cliff shelf overhead and heavy shadowing. Layer 2 had the largest textural relief causing shadowing throughout bed. Layers 3 and 5 had the least amount of textural relief or shadowing throughout. Layer 4 had the greatest slope with the bottom of the bed sloping at a nine-degree angle. Layer 6 was in direct sunlight and had no shadowing (Figure 5).

In each test, LiDAR outperformed Photogrammetry in its accuracy (Table 2 and Figures 3 and 4). This is because the LiDAR emits a pulse and is able to measure the distance from its objects. In multiple tests, the LiDAR averaged below a two cm averaged difference from the control values (Table 2). Polycam® is using software to best determine the distance and size of the objects when imaging with only Photogrammetry. However, both LiDAR and Photogrammetry exhibited similar flaws that caused inaccuracy. Shadowing exhibited from Layers 1 and 2 caused poor accuracy from Photogrammetry where it averaged a 19–61 cm difference from the actual thickness. LiDAR performed more accurately and for Layer 1, a five to 19 cm difference from the actual thickness (Figure 4). LiDAR struggled with Layer 2's topographic changes. This is possibly caused because the

device was held perfectly parallel to the outcrop. In normal use, the operator could scan at multiple angles and potentially capture the topographic relief more accurately.

A low amount of textural relief in a well-lit area allows both Photogrammetry and LiDAR on the software to perform as expected. Layers 3 and 5 had the least amount of textural relief and were well-lit. This represented the normal testing environment with no specific obstacles. LiDAR accuracy measured difference from the actual thickness ranged from zero to 5 cm and outperformed Photogrammetry's 6–37 cm. Distance from the outcrop did not seem to have an influence on either's performance (Tables 2 and 3).

Bed dip and structural changes had a negative influence on the Polycam® scans. Layer 4 exhibited a nine-degree slope on the bottom of the bed. LiDAR and Photogrammetry struggled with its bed thickness accuracy. LiDAR ranged from 10.5–13.5 cm measured differ-

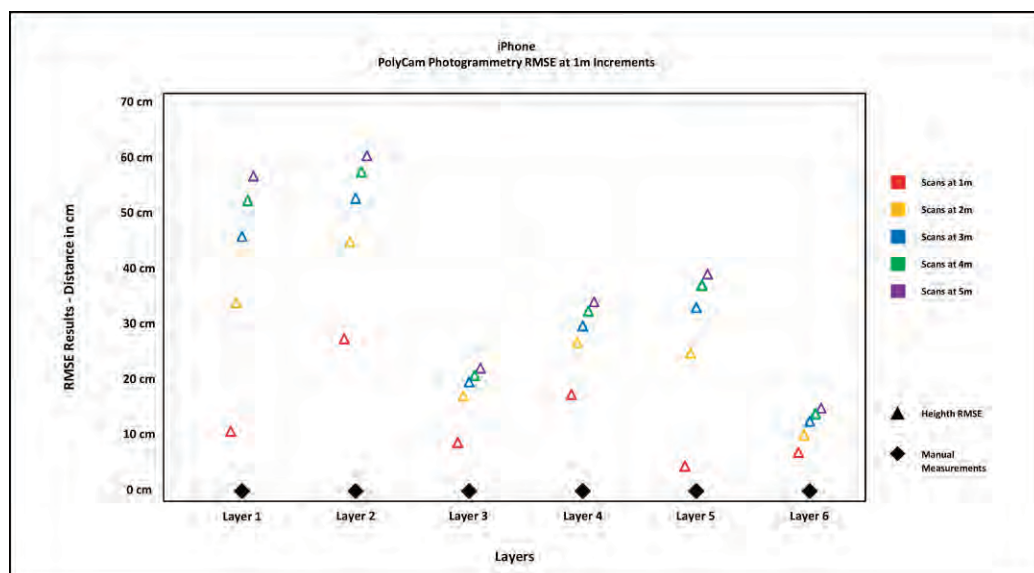


Figure 3. Root Mean Square Error (RMSE) calculated the average differentiation of the iPhone Photogrammetry scans versus the controlled measurements.

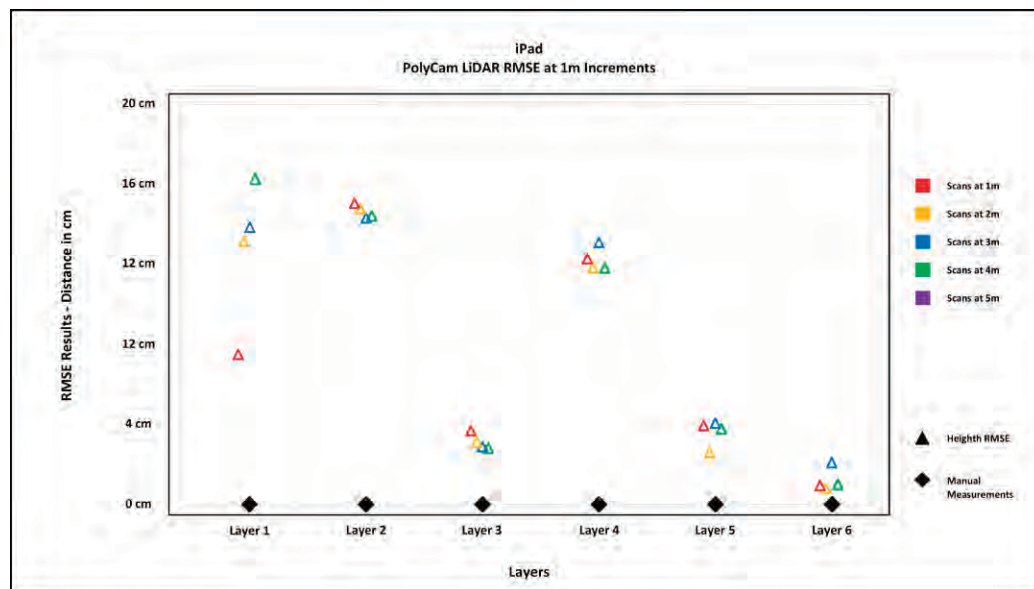


Figure 4. Root Mean Square Error (RMSE) calculated the average differentiation of the iPad LiDAR scans versus the controlled measurements.

Table 3. Measured section data. Difference in centimeters calculated from the control measurements.

Measured Difference from Control per Device in Centimeters							
Distance (meters)	Device	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
1	Photogrammetry	25.0	30.0	9.0	19.5	6.0	8.0
	LiDAR	7.0	14.0	5.0	13.5	3.0	0.0
2	Photogrammetry	33.0	45.0	10.0	26.5	26.0	1.0
	LiDAR	12.0	13.0	1.0	11.5	1.0	1.0
3	Photogrammetry	37.0	52.0	19.0	24.5	26.0	0.0
	LiDAR	5.0	12.0	5.0	10.5	0.0	0.0
4	Photogrammetry	52.0	57.0	21.0	31.5	37.0	13.0
	LiDAR	19.0	18.0	2.0	12.5	2.0	0.0
5	Photogrammetry	57.0	61.0	22.0	39.0	33.5	15.0
	LiDAR	11.0	11.0	4.0	11.5	2.0	0.0

ence and Photogrammetry ranged from 19.5–39 cm measured difference from the actual thickness. It is possible scanning at multiple angles close to the object might have helped improve the accuracy, similar to Layer 2’s topographic challenges. However, holding the device parallel to the layer’s structural textures caused a noticeable decline in the ability of the software to analyze the layers from either camera.

The outcrop exhibited a layer at the top of the measured section (Layer 6) that was directly receiving a high amount of sunlight. Originally, this bed was tested to see if the software would receive a bright white out from the amount of sun. This layer was the most accurate for both the LiDAR and Photogrammetry tests. LiDAR consistently tested below one cm measured difference from the actual thickness. This is the only layer that Photogrammetry also measured equal to LiDAR at zero to 15 cm measured difference from the actual thickness. The increased light seemed to help the software distinguish the thickness of the unit accurately using either camera, sun angle may also affect this depending on time of day. The most difficult obstacle for Layer 6 was not casting a shadow over the unit while testing. Similar to each layer, distance from the outcrop did not affect the accuracy.

As technology in LiDAR, mobile devices, and even batteries that can sustain more powerful cameras evolve over time, the accuracy and limitations will only improve. Having the ability to scan using Photogrammetry or LiDAR directly and make rapid 3D models is impressive and useful in the scientific field. However, while using either camera produced scans that look accurate (Figure 3), this project demonstrates that there are issues with taking the images at face value. Shadowing, textural relief and even structural changes as beds dip caused inaccuracies in both Photogrammetry and LiDAR using the software. If close to an object, scanning the relief at mul-

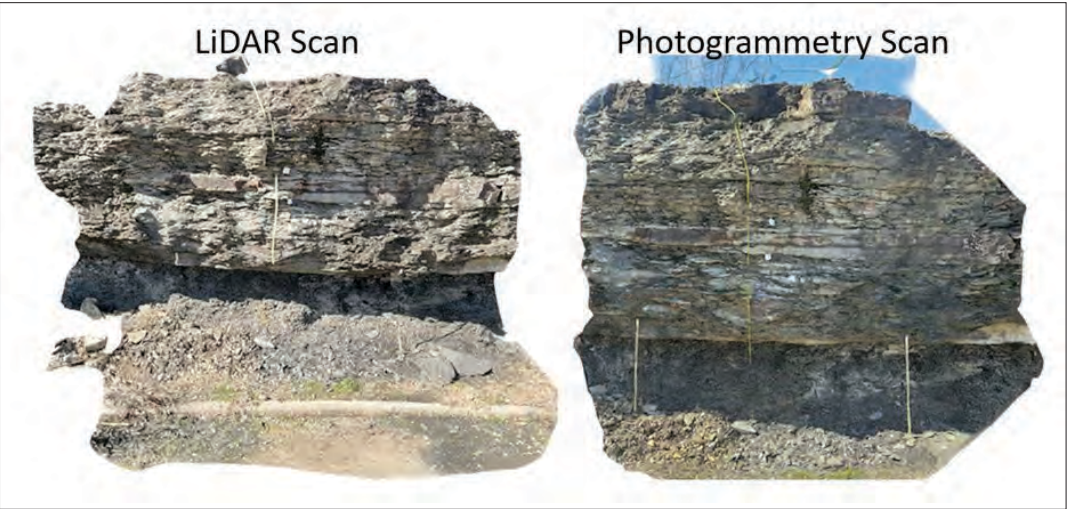


Figure 5. LiDAR scan with 19 cm variance at Layer 1, distance 4 meters (left). Photogrammetry scan with 52 cm variance at Layer 2, distance three meters (right). Both scans appear to represent the outcrop, but using the LiDAR and Photogrammetry data demonstrates that the LiDAR results are more accurate overall in terms of using the data for measuring across the scans. The sun angle and shadows did cause some effects on the accuracy of the images, especially between Layers 1, 2 and 6.

tle angles may increase accuracy. But if in an environment where scanning a lithologic bed that is not easy to access, the camera will likely be parallel to the beds and shadowing, relief changes and structural obstacles will affect the accuracy. Polycam® is a suitable low-cost choice for field research as long as the user is aware of its limitations. Ultimately, using a LiDAR equipped device with Polycam® will result in more accurate measurements compared to only using Photogrammetry.

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About the Author

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Geological Society of London awarded "Best Professional or Learned Society 2024"

John Berry, CPG-4032

The Geological Society of London has been awarded the 'Best Professional or Learned Society 2024' Memcom award. The judges commended the Society for "business improvement, public interest contribution, raising standards of professionalism, inspiring the next generation, collaborative thought leadership, sustainability and other far-reaching impacts on the economy and society at large." The Memcom Excellence Awards are a British institution that "recognizes and celebrates the very best of the 'membership sector.'" With multiple awards across different categories, the Awards highlight everything from strategy to leadership, engagement to publications, and individual and team achievements. These awards are open to all professional bodies, trade associations, membership charities, trade unions, and the wider not-for-profit membership sector.

In addition to winning the award, the Society this year has also BOUGHT its own Headquarters, which were (and my knowledge may be inaccurate) "Grace and Favor Apartments" for which only nominal rent was paid to the Government. These were in Burlington House just off Piccadilly Circus in the heart of London. The Royal Academy (of Arts) had the main part of the building, and the remainder was shared by the Geological Society of London (Piccadilly/east wing), Linnean Society of London (Piccadilly/west wing), the Royal Astronomical Society (west wing), the Society of Antiquaries of London (west wing) and the Royal Society of Chemistry (east wing). The Government, strapped for cash, wished to kick out the learned societies and sell the building.

I attended many Society meetings here when I was a graduate student in London, getting to know such admirable people as Brigadier Ralph A. Bagnold, author of "The Physics of Blown Sand and Desert Dunes" (1941), then in his late 70s and a regular attendee at the weekly meetings, which were followed by drinks at a pub across the road. These meetings were my introduction to the world of learned societies, and I became addicted to the free and easy exchange of ideas that took place after the formal presentations, and especially in the pub. It was in the pub that the society for Chartered Geologists (now merged back into the Geological Society) was conceived, and you will perhaps remember that the Royal Society itself was founded in a coffee shop: The Geological Society is now 217 years old and winning awards: perhaps there is a lesson here for all of us about the benefits of mixing science and sociability, as well as about the benefits of outreach to the public! I have now been a Fellow of the Geological Society of London (as well as a member of the GSA) for 59 years and am prouder of that fact than ever!

YOUR CAREER PATH WILL PROBABLY CHANGE;

MINE SURE DID

Peter Dohms, CPG-07141

*This was a
dream come true,
and I happily
planned to spend
my entire career
doing mineral
exploration in
the Southwest.*

This is an article about career paths after graduation, and in this case the description of a career path extends from first professional employment through retirement. It is based on my own experience and is presented as a “case study” of how your best laid plans can go in wildly different directions.

I graduated from Michigan Tech in June, 1967 with a bachelor of science in Geological Engineering. My senior year engineering courses included Hydrology, Rock Mechanics, Soil Mechanics and Elements of Structural Design – those may not sound too connected to Geology but in the course of the next 43 years I used the training from all of them. About November 1966, I had interviewed with a recruiter from The New Jersey Zinc Company (NJZ) and received a job offer to join the exploration staff in the Tucson, Arizona office. This was a dream come true, and I happily planned to spend my entire career doing mineral exploration in the Southwest.

From 1967 to 1980 I was based in Tucson, working for NJZ. In the first two to three years of that time, we were engaged in exploration for porphyry-type copper deposits. We used a combination of outcrop examination coupled with gravity surveys and time-domain induced polarization surveys of buried pediments discovered by the gravity surveying. Prior to my joining the group, that combination had resulted in the discovery of a 100 million ton copper deposit that was given the name Vekol (it remains unmined; the location was on what was then called the Papago Reservation (the reservation name has since been changed to “Tohono O’odham”) west of Tucson; the tribe received revenue from the Hecla copper deposit across the valley, but later learned that owning a casino was a better revenue source than copper mining revenues.) (but I digress). About 1970, the office significantly downsized, and the copper exploration came to an end.

In the next 10 years, our office went through several “target” transitions, and I spent significant time in exploration for fluorite deposits, silver deposits, Mississippi Valley-type lead-zinc deposits, polymetallic base/precious metal deposits, and eventually gold deposits. Work was conducted all over the western USA. The gold program, initiated in 1978, was crowned with success, and in 1980 I moved to Jamestown, California to manage the drilling of a series

of five gold deposits along a five-mile stretch of the Mother Lode. The total endowment of the deposits came to an aggregate of over 1 million ounces. My employment status during this period was modified a bit; instead of New Jersey Zinc our project was directly under the direction of the Natural Resources Group of Gulf + Western Industries.

After drilling was completed in early 1982, I worked on the "baseline environmental studies" for project permitting. At the time, it seemed but a short step from development drilling. Those studies included overseeing noise, archeological (prehistoric and historic), surface water quality, and an intensive hands-on education in hydrogeology. We conducted pump tests of 30- to 45-day duration in the dipping, hard-rock formations, with tracking in ground water recovery extending beyond 140 days in some cases. During and following that period I self-educated myself on the beauties of the Cooper and Jacob Method of hydrogeologic evaluation (versus the USGS-preferred Theis Method). This was a larger step away from mineral exploration, but it still involved working with drill holes and subsurface conditions.

Everything changed in 1983. The top-level management of Gulf + Western went through a drastic revolution, and G+W became an entertainment conglomerate. The pension I now receive (for my 15 years from 1967 to 1983) comes from CBS (yes; THAT CBS – an illustration of corporate evolution). I went into the consulting business with two partners from the Gold Project, and for about two years we made a living consulting for exploration companies who had an interest in the Mother Lode (as well as some other California gold deposits). OOPS; the "gold boom" came to an end and we had to transition our business model.

About that time, interest and funding for dealing with leaking underground storage tanks arose, and with our hydrogeological background, we were able to get into that business. We still did some mineral consulting, mostly non-metallic and aggregates, and had a couple of assignments working on landfill ground water quality. One very interesting project was helping our client obtain the operating permit to convert their exhausted open pit asbestos mine into an "asbestos waste-only" landfill. My principal contribution was to oversee the work to "prove" to the State of California that the asbestos that had been mined was chrysotile - that little assignment led to several assignments for defense attorneys in asbestos litigation as an "expert witness" for about 15 years off and on. As you see, there was still mining-related and other underground work going on, and the transition was not greatly unsettling.

In 1988 I moved my family to Pensacola, Florida and opened a branch office of the firm I had helped co-found. Initial work was still related to chasing leaking underground storage tanks (LUST) in the unconsolidated sands of northwest Florida. I managed to get a long-term assignment with a good-sized municipal solid waste landfill where I designed and implemented a wholly new ground water monitoring array. Owing to an unintended consequence of an environmental agency demand, significant ground water contamination occurred. I oversaw and implemented the investigation and initiated the cleanup; it was a point of pride that our work in defining and containing the plume, with piping the contaminated ground water back to the landfill property for treatment, cost the same as the typical northwest Florida gas station cleanup. While working on that assignment, a closed facility that had been previously operated by the same government entity, was listed as a "candidate" Superfund site. My office obtained the assignment to oversee the investigation of possible off-site and on-site impacts. Our program was a success and the facility was removed from the National Priorities List. In hindsight, this had moved my career well away from mineral exploration, but each transition had seemed logical at the time.

In about 1993 the State of Florida began to regulate construction and demolition debris (C&D) landfills. I became "Mister C&D" for northwest Florida, having as many as 10 such facilities simultaneously under the care of my office. Our work took us from "cradle to grave" for some C&D facilities, including initial permitting, re-permitting, ground water monitoring and corrective action, closure oversight, and post-closure care. I also had to good fortune to be engaged by two of the largest solid waste management companies during this period, on assignments related to permitting and re-permitting solid waste transfer stations, subsurface investigations of "previous sins" on properties (that pre-dated their then-current use), ground water site assessments, and other related work. This activity continued through my retirement in 2011.

All through the 1988 to 2007 period I had been active in Pensacola with respect to two very notorious wood treating facility Superfund sites (Escambia Treating Company [ETC] and American Creosote). That effort bore fruit when I obtained an assignment to provide "affected-community oversight" of an EPA-led cleanup (Escambia Treating) and detailed pre-cleanup assessment (American Creosote). Boy, was that fun! I got to evaluate and critique EPA! They didn't like it one little bit. To give them credit, the ETC cleanup was very professionally done and I had little to criticize. At American Creosote, I found a potential flaw in their site geologic model and urged evaluation. A bit later, the funding for the "community oversight" quietly dried up (I cannot prove "cause and effect," but I believe it to be true). This also coincided with my retirement in 2011 and, after my heart surgery in April 2012 (and move to Payson, Arizona in October 2012) I lost track of later developments there. What is Vapor Intrusion?

Lessons

When I first arrived in Tucson in June 1967 I was prepared to spend my entire career in that office, searching for new copper deposits in Arizona. Parenthetically, new copper deposits are still being found over 55 years later; one of the largest recent discoveries would have been uncovered by the exploration model we were using in 1967, had it continued. I sometimes wonder how my career might have evolved if the program had been extended.

The next lesson is to pay attention to your undergraduate and graduate courses. "Elements of Structural Design"? I used those skills to look over the shoulder of a structural engineer when our assignment included digging out a LUST plume adjacent to a building with heavy machinery operating. My review ended with a question that caused the structural engineer to realize he'd misplaced a decimal point. Hydrology? More than once, I had to evaluate possible road flooding in the desert Southwest; along the road we used to access our project site. Soil mechanics? The placement of final cover on a closing landfill or backfilling an excavated underground tank site – I could talk to the engineers in their own language. Rock Mechanics? How does rock break?

Don't be afraid to try new things. In my case, each "new thing" seemed like a logical step from what I'd been previously doing. The most jarring transitions, on the other hand, included the advent of personal computers, followed closely by computer-based subsurface modeling. As I mentioned, my hydrogeology training was mostly gained via "in the field" experience under the guidance of a salty, senior hydrogeologist, supplemented by some short courses and much self-study.

The most important lesson, however, is to be flexible. When I graduated, "Superfund" wasn't even a word, let alone a major government program. If your career is anything like mine, you don't have a clue right now where it might take you in the next 40+ years. Gird your loins and tighten your seat belt; it's going to be a fun ride.

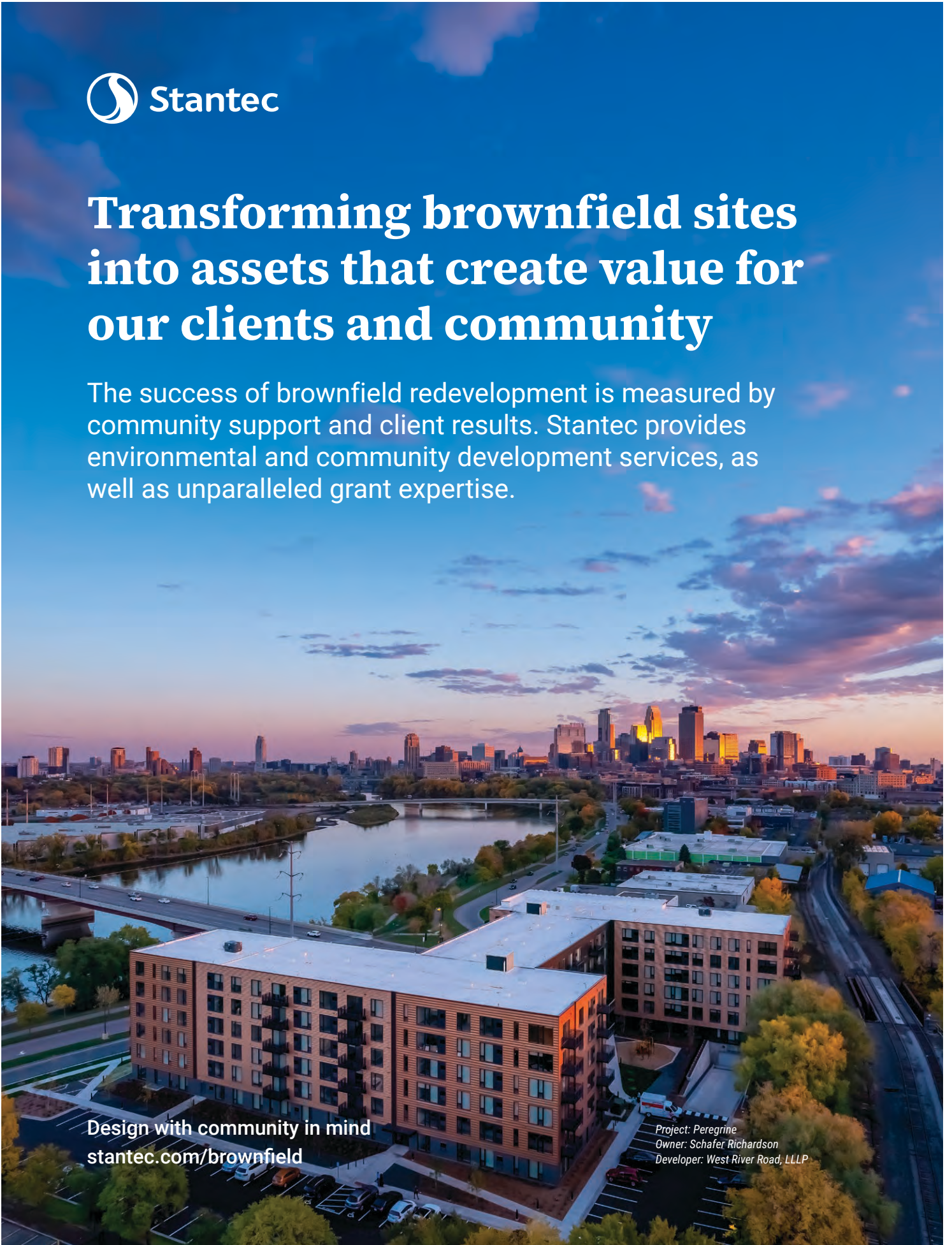


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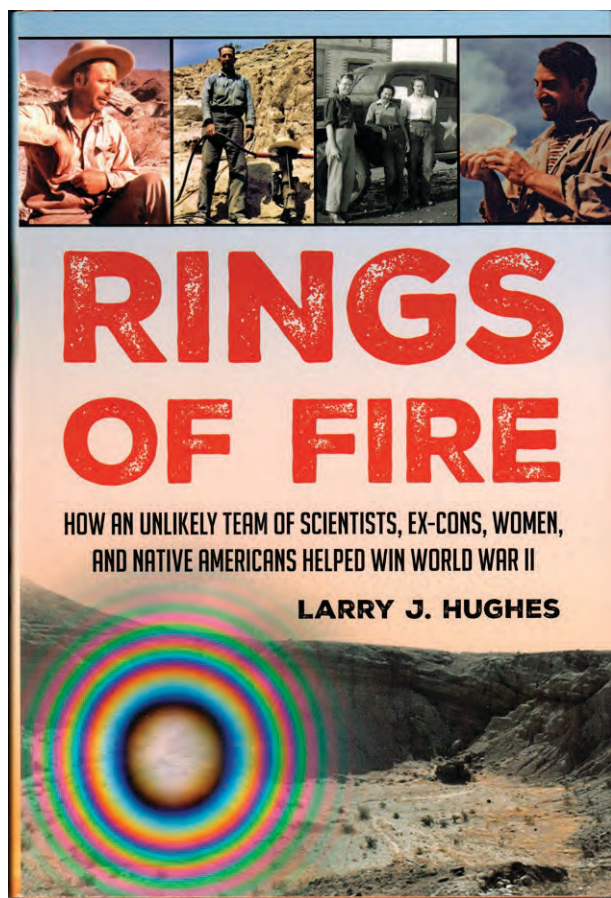
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Book Review



Rings of Fire:

How an unlikely team of scientists, ex-cons, women, and Native Americans helped win World War II

by Larry J. Hughes

581 pp. 21 Chapters. Five appendices. Notes. Index.

ISBN 978-0-8117-7389-8

\$34.95 US

**Review by: David M. Abbott, Jr., CPG-4570
Mining Geologist**

The lengthy title of *Rings of Fire: how an unlikely team of scientists, ex-cons, women, and Native Americans helped win World War II* is an introduction to variety of topics covered within this book. The book begins with Pearl Harbor where anti-aircraft guns expended an average of 9,809 rounds per kill, which was four times the acceptable ratio. The problem was a combination of gun caliber (too small) and gun sights.

The book next introduces teenage Edwin Land who was fascinated at summer camp with polarization using a Nicol prism that employs the high birefringence of calcite. Geoscientists generally are exposed to polarizing microscopes using Nicol prisms as part of their petrologic training and so the technical terms “Nicol prism,” “birefringence,” and “calcite” are immediately recognizable. Land later developed a method of producing a polarizing sheet that led to producing polarized sunglasses in the mid-1930s by Land’s Polaroid company.

Early in WWII, Land was asked by the Navy’s Bureau of Ordnance for a bombsight for dive bombers that wouldn’t fog up during dive bombing runs. During Land’s flight home to Cambridge, MA, from Washington, DC, Land recalled that if light passed through the optical axis of calcite, a series of circular-colored rings is produced that could be used as a bomb sight. Assisting Land in his polarization studies were Harvard mineralogy professors Harry Berman, Esper Larsen, Clifford Frondel, and Cornelius Hurlbut.¹ The problem is that while calcite is

a very common mineral, hand-sized optically pure calcite is very rare. “Iceland spar,” a rare deposit of optically pure calcite in Iceland (the Hegustadir quarry) became in the early nineteenth-century the source of calcite for Nicol prisms. By 1907, surface mining at the Hegustadir quarry was approaching depletion and a worldwide search for alternative sources was undertaken. A less optically pure source was found near Greycliff, MT (east of Big Timber on the Yellowstone River) but the available tonnage was too small to support economic extraction. Soon after WWI, the newly independent Icelandic government hired a mining engineer to initiate underground mining and the Hegustadir quarry was back in business for a few years. By the time Land wanted to produce the Optical Color Ring (OCR) sight, Berman recognized that suboptical grade calcite would work for the OCR. Then Berman recalled receiving some suboptical calcite plates for the Harvard museum’s collection from a southern California prospector, John Hilton.

John Hilton was a prospector, singer, raconteur, desert rat, day-job worker, etc. who started a curio shop in the Coachella Valley of California selling rock and mineral specimens, cactus, old rugs, and items scavenged from local dumps. The shop provided an income during the cooler winter months, but tourists were rare in the summer. Up in Palm Wash in the Santa Rosa Mountains, Hilton found agate geodes with calcite crystal vugs. A prospector friend,

1. Charles Palache, Harry Berman, and Clifford Frondel were the authors of *The System of Mineralogy*, v. 2, *Halides, nitrates, borates, carbonates, sulfates, phosphates, arsenates, tungstates, molybdates, etc.* the well-known mineralogy reference.

Harry Heather, found calcite veins with vugs containing big, plate-like calcite crystals. One vein yielded over 1,000 pounds of calcite crystals. Around 1939, Hilton tried expanding his market for calcite crystals by sending samples to various museums, including to Harry Berman at Harvard. When Land, with Berman's help, was developing the Optical Color Ring sight in 1942, Berman contacted Hilton offering to buy every big calcite crystal Hilton had. Berman traveled to California, met Hilton, and went to the "mine" site, which was really a bunch of small excavations along a series of veins. Hilton agreed to sell Polaroid Corp. calcite crystals at \$2 per pound.

In late 1942, Berman contacted his friend, Robert Hoffman, a Harvard-trained geologist and mining engineer. Robert Hoffman and his younger brother, Arnold, had spent the 20s and 30s prospecting and promoting properties in Ontario and Quebec that Arnold described in *Free Gold: The Story of Canadian Mining*.² Berman hired Robert and Arnold Hoffman to examine Hilton's California property and also to investigate another potential calcite source in Montana.

The Hoffmans' initial examination of the Palm Wash property demonstrated that capital was required to obtain the mining equipment and infrastructure needed to develop the property. Even with this capital, the mining was still of the artisanal type with 2-3 men working on an opening and exploiting individual vugs of calcite located along more massive calcite veins. Seeking a proper geologic investigation, Arnold Hoffman secured the assistance of US Geological Survey geologist and Associate Professor at UCLA, James Gilluly.³ Gilluly recognized that the calcite veins were distributed over 40 acres in four clusters. Each vein had vugs of the suboptical calcite needed by Polaroid for the OCRs. There was no road to the Palm Wash property; access was by foot over several miles of rough terrain. Eventually, two four-wheel drive trucks and drivers were contributed by the Marines to help the Navy get the gunsights it wanted. The trucks delivered the supplies needed to establish a camp for an eclectic mix of workers, one of whom described the mix as "seven hobos, two millionaires, a surrealist artist, three sons of college professors, a baker, a rancher, and an Indian fire eater." By the Hoffmans' account, the roster included "a highwayman, a murderer, a wife-beater, three robbers, and two draft dodgers." Some of these men's colorful stories comprise significant parts of the book.

In March 1943, Harry Berman was following up on the earlier calcite discovery near Greycliff, MT. Berman was introduced to a card-shark, ex-moonshiner, and rancher named Al Hansen, who had located calcite veins containing vugs of suboptical calcite shaped like eggs in Brackett Creek near Clyde Park, about 10 miles north of Livingston. Hansen had sent samples to Polaroid. Hansen's initial opening was 3 feet wide, 30 feet deep, and 70 feet long filled with 2- to 10-pound crystals. Berman got Robert Hoffman to go to the property to set up a more comprehensive mining operation. The oddly shaped crystals of the Montana calcite were locally called "eggs" or "potatoes" and presented a problem. The California calcite plates had their optical axis perpendicular to the plate face. The "eggs" or "potatoes" had to be processed by cleaving to uncover the crystal faces. A building in Clyde Park was converted into a crystal processing and shipping office. A group of women were hired and trained to be the "Crystal Crackin' Mamas" to process the "eggs" or "potatoes." This processing also materially reduced the weight of the shipped calcite. As with the California crew, the stories of the characters at the Montana operations contribute significantly to the stories told in *Rings of Fire*.

For various reasons, the Optical Color Ring sights were never the technical success envisioned. Because polarization blocks 70% of the incoming light, the OCRs could not be used in low-light situations. Various production problems at the two mining properties and others sought in Mexico, and difficulty in assembling the sights resulted that only a fraction of the OCRs ordered were ever produced. After the end of WWII, Edwin Land redirected his inventor's efforts to instant photography. However, several OCRs were used in the Apollo Space program including the Christmas 1968 picture "Earthrise," the iconic picture of the space program.

As suggested by its lengthy full title, *Rings of Fire* addresses numerous interesting stories and topics only tangentially related to OCR sights, some of which are told with lyrical language. For example, the view from a cross-country plane trip is described as scenes from Copeland's Appalachian Spring traveling west to the country of Rodeo. The early mentions of Nichol polarizers and similar terms will delight geologists. Older geologists, like me, will remember Jim Gilluly, who wrote some excellent papers in the late '60s and early '70s that are worth digging up and reading. So, despite the meandering character of the stories, *Rings of Fire* is worth reading.

2. I received a copy of *Free Gold* from SME when I upgraded from student to regular membership. It is a wonderful book full of interesting stories of life in the Canadian bush. It includes the story of how Flin Flon, on the Saskatchewan-Manitoba border, got its name.
3. Later Gilluly was President of the Geological Society of America, a Penrose Medalist, and author of important papers on the structure of western North America.

Review by: Jason B. Price, PhD, CPG-11382

Upon handling this hard-back book for the first time, I was immediately impressed by its heft, at least an inch thick, including a 34-page appendix dedicated to the physics of circular polarization. I was thoroughly intrigued by the title and color photographs on the cover but also had a slight misgiving: A book this dense could easily lose the reader if the thread of the tale is not carefully woven through so many pages. But, by page ten, that misgiving had been converted to a curious hunger to see how the story would unfold. Larry J. Hughes, CPG, had me hooked starting with Ensign Tausigg's incredulous observation in recounting the horrors of Pearl Harbor on December 7, 1941: "We couldn't hit the broad side of a barn except at point-blank range!" This was apparently not just a

problem for the US military at the beginning of WWII, for Hughes tells us that even during the American conventional bombing campaign of Japan during 1944-1945, it was observed that only 2% of American bombs landed within 1,000 ft of their intended targets, leading the Japanese to joke that the Americans were apparently trying to starve them out by bombing all the sea life in Tokyo Bay. Clearly, efficient and precise aiming and targeting was problematic throughout WWII on both sides.

Much has been written and filmed with respect to American technological advancements and superior achievements in the midst of WWII, everything from domestic manufacturing and elevated

energy production to the novel centrifuges behind the Manhattan project, to the improved artillery used on the battlefields, to the grit of our military personnel. But largely overlooked in the popular narrative because of its short-lived fame coupled with its classified status until after the war was over, and excellently uncovered herein by Hughes, is the role that calcite optical ring sites (ORS) played in the improvement of American aim during WWII. Hughes weaves a compelling tale from how Polaroid's founder, Edwin Land, recognized the utility of circular polarization for making gunsights to how calcite prospectors and miners in the Salton Sea region, southern California, Shields River valley, southern Montana, and Sierra Madre Occidental, northwest Mexico, struggled to find and then mine and refine enough high-quality calcite crystals to meet the ravenous demand for gunsights for literally anything that Uncle Sam could shoot: from the Navy's 3"/50 gun, to the Army Air Corps' bombing sights, to the Army's vaunted bazookas. Hughes, a geophysicist by training, does a nice job of providing mining and military facts-on-the-ground and data in the appendices but softened throughout by the human touch, especially the stories of those involved with the ORS effort and an estimated 150 photographs or reproductions of

them and the historical artifacts they worked on. He even displays a few maps, including one bona fide geologic map of Camp Wilson, just W of the Salton Sea (in what is now Anza Borrego Desert State Park), salve for a geologist's soul!

Importantly for the modern era, this book gives a revealing glance at the way in which "critical minerals" seem to be arbitrarily designated largely for military use during conflict (viz. during WWII, calcite wasn't "critical," then was, then wasn't; it currently is not) and then almost as soon forgotten as the demand for such minerals is significantly modified by new technology—an important reminder for our own current geopolitical reality.

Hughes spent the better part of thirty years doing the research and writing this book. It is clearly a labor of love, and I hope it will attract wide attention, for it is well written and particularly interesting for any of those, like myself, who have a penchant for niche mining, military, technology, geology, and physics applications and also those who are WWII enthusiasts or just general history buffs. This book belongs on your shelf.

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Student Chapter Showcase

Every year, AIPG's student chapters submit reports showcasing the incredible activities they've organized throughout the school year. These reports are a window into the vibrant, dynamic world of our student organizations—filled with creativity, collaboration, and a shared passion for geoscience. From hosting campus-wide events and creative fundraisers to planning networking opportunities with professionals, these chapters exemplify the perfect blend of fun and career preparation.

Whether they're selling rocks, organizing bake sales, or holding engaging science events, AIPG student chapters bring their campus communities together while building valuable networks within the geoscience profession. Many chapters go a step further by addressing the all-important question: "What happens after graduation?" They organize networking events where students can meet professionals, learn what employers look for in a resume, and gain tips for successful interviews—practical knowledge that provides a head start on career preparation.

These student-led efforts don't just benefit chapter members; they create a ripple effect, inspiring others on campus to explore the geosciences and connect with the broader professional community. It's no surprise that these activities make AIPG student chapters such a vital part of our organization.

In the pages ahead, we highlight some of the fantastic initiatives detailed in this year's student chapter reports. We also shine a spotlight on the Student Chapter of the Year Award, which recognizes one chapter for its outstanding contributions based on their submitted report.

If your school doesn't yet have an AIPG student chapter, let this serve as your inspiration. With a little initiative and a lot of enthusiasm, you, too, can start a chapter, build connections, and contribute to the future of the geoscience profession.

Student Membership

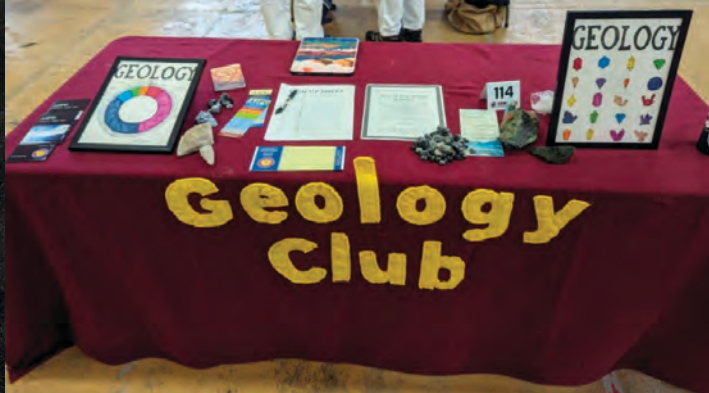
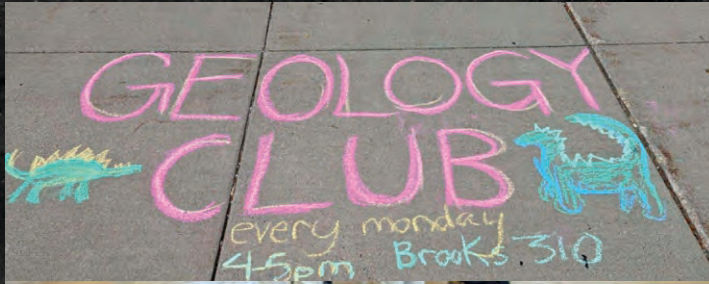
AIPG student chapters employ a variety of innovative strategies to attract members, engage their campus and community, and connect with professionals. We are highlighting their activities reported by student chapters in 2024 from Eastern Michigan University (EMU), University of Houston (UH), Youngstown State University (YSU), Western Michigan University (WMU), Central Michigan University (CMU), Western Kentucky University (WKU), Michigan Technological University (MTU), and Wayne State University (WSU).



MTU students, alumni, and Michigan Section Early Career Professional, Sienna Meekhof, at the 2023 AIPG National Conference.

Campus Involvement

✕ Campus Events and Festivals: Chapters participate in events like Eagle Fest (EMU), Bronco Bash (WMU), and FestiFall (Wayne State), setting up engaging booths with rock and fossil displays and interactive activities. Photos from submitted reports, club web pages and social media.



Team Building

✕ Social Media Engagement: Leveraging platforms like Instagram and Discord, chapters such as the University of Houston create vibrant online communities to promote events and foster connections.

✕ Collaborations: Partnering with other student organizations or departments, chapters host creative events like the Bonsai Rock Tree project (WMU) and the Canned Christmas Tree Competition (University of Houston).

✕ Creative Advertising: Eye-catching chalk art and flyers help chapters stand out, as showcased by CMU and Youngstown State University.

✕ Maximizing Campus Resources: Chapters utilize student centers, departmental orientations, and other campus facilities to connect with prospective members, exemplified by WMU's outreach efforts.



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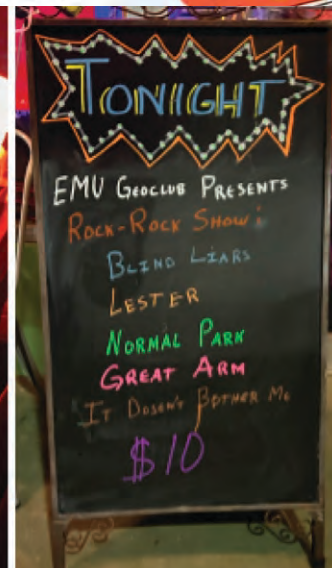
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Professional Connections

✕ Guest Speakers and Workshops:

Chapters host presentations by alumni and industry professionals, covering topics like career paths, resume building, and interview skills, as seen at CMU, WMU, and the University of Houston.

✕ Networking Events:

Chapters attend conferences and meetings, like the AIPG National Conference (MTU) and the AIPG Michigan Section Annual Meeting (EMU), to connect with professionals and learn about career opportunities.

✕ Resume Roasts:

Chapters organize events where professionals review and provide feedback on student resumes, as seen at MTU.

✕ Field Trips and Workshops:

Chapters participate in field trips and workshops led by professionals, such as the Ireland trip (WMU) and the Texas-Hydro Geo Workshop (University of Houston), to gain practical experience and knowledge.

✕ Mentorship Programs:

Chapters offer mentorship programs connecting students with professionals for guidance and support, as seen at the University of Houston.





Community Outreach

✕ Educational Outreach: Chapters engage with K-12 students through presentations, workshops, and events like "Rock Your School" (MTU) and STEM Day (WMU), fostering interest in geoscience and providing educational resources.

✕ Community Service: Chapters participate in volunteer events, such as the Success on the Spectrum event (University of Houston) and the Galveston Bay Foundation Houston Oyster and Seafood Festival (University of Houston), contributing to local causes and demonstrating social responsibility.

✕ Fundraising for Community Causes: Chapters organize fundraisers, including rock sales and events like the Rock-Rock Show (EMU), with proceeds benefiting local charities and non-profit organizations.

✕ Collaborations with Professional Organizations: Chapters work with professional organizations like the Michigan Geological Repository for Research and Education (CMU) and NASA (University of Houston) on workshops and events, connecting students with professionals and community initiatives.

Building the Future of Geology

Support the Foundation of the AIPG

The Foundation of the AIPG supports a variety of programs including student scholarships, student and young professional workshops, educational programs aimed at practitioners, the public, and policy makers, and some special needs requested by AIPG or other professional organizations. In 2024, the Foundation provided grants to AIPG in support of the undergraduate scholarships awarded by AIPG. Additionally, the Foundation has awarded its own William J. Siok Graduate Student Scholarship. The Foundation is proud to be able to serve AIPG and the geosciences by providing financial support for these programs. Another grant was awarded to the American Geosciences Institute (AGI) in support of building a field experience program for K-12 geoscience teachers. These grants are only possible through your generous donations. Every donation helps the Foundation to contribute toward building the future of geology. If you have any questions or comments about the Foundation, please contact me or any of the other Trustees of the Foundation for additional details and check the AIPG web site for more information about the Foundation. Your continued support is greatly appreciated. Stay tuned for information on 2025 fundraising activities. Thank you.

Mike Lawless

Michael D. Lawless, CPG, PG
Chairperson, Foundation of the AIPG
540-557-1319 office phone



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Early Career Professional Spotlight: Hannah Weaver



Brigitte Petras, ECP-0851

I would like to recognize Hannah Weaver, ECP-1014, from the AIPG Ohio Section, in the ECP Spotlight this quarter. She was selected for this honor because of her engagement with AIPG and enthusiasm to serve its members, and her passion for resource management. Additionally, she was nominated to serve as the 2025 National ECP Representative so this ECP Spotlight for Hannah is also a timely introduction for members that don't know her yet.

I first got acquainted with Hannah as she answered our Call for ECPs to become more involved in AIPG's events. Since then, she has moderated for our Student ECP Webinar Series and volunteered as a technical session chair on a national level, and she is also active in the AIPG Ohio Section.

My intention is that this spotlight series provides a platform to recognize outstanding early career professionals, inspires students and other new professionals to find their own path to success by learning from others, and that other professions gain more insight on the talent and the ideas of early career professionals.

Tell us about yourself.

My name is Hannah Weaver (ECP-1014), and I am a Physical Scientist and Financial Assistance Officer Representative for the Orphaned Wells Program Office (OWPO) within the Department of the Interior (DOI). I received my B.S. in Geology in 2019 from Wittenberg University and my M.S. in Geology and Geophysics in 2021 from Purdue University. After graduation, my passion for energy resource management and stewardship led me to work at the Bureau of Safety and Environmental Enforcement as a geophysicist, and later to my current role at the DOI. My experience includes near surface and exploration geophysics, subsurface geologic modeling, offshore geotechnics, and grant management. I work remotely for the Department of the Interior and reside in Columbus, OH.

Tell us more about your current role.

My current role at OWPO is a Federal Program developed through the Infrastructure Investment and Jobs Act (IIJA) whose mission is to provide federal financial assistance to federal, tribal, and state entities to inventory and properly plug and remediate orphaned wells and wells sites. I work directly with the agencies that have jurisdiction over orphaned wells on state or private land in their given state. In this role, I assist states with the grant management process for the federal grants that they're receiving through the IIJA. This involves reviewing and monitoring the progress of the activities conducted under the grant; such activities include plugging orphaned wells, quantifying methane emission reductions, remediation and restoration of well sites, and identifying undocumented orphaned wells.

Do you have any professional achievements/awards you'd like to mention?

- Guest Moderator for Student ECP Webinar: Creating Successful Application Materials – 2023
- Member-at-Large, Ohio Section – 2024
- Student Chapter Liaison, Ohio Section – 2025
- Superior Performance Award (FY23 & FY22) – BSEE
- National Membership committee 2023 – present
- Daniel J. Tearpock Geoscience Certification Program, Subsurface Consultants & Associates
- Purdue University EAPS Department Teaching Honor Roll
- Graduate Research Fellowship Program Honorable Mention, National Science Foundation

How did your education and student opportunities help you in your career?

I was fortunate to have a geology class in high school in my junior year (which is not too common in Ohio), and my enthusiastic teacher helped me to discover my passion in the subject. If I hadn't had that class, it would have been more difficult finding the geology major in college.

During undergraduate and graduate programs, my field experiences were particularly numerous and helpful. My undergraduate program had a fall field seminar which was five days of field work with varying field and geologic settings. Some of these locations were to West Virginia, Missouri, and Kentucky.

For graduate school preparation, my undergraduate program offered assistance, and I was also fortunate to have family members who have also attended a graduate program who were familiar with the process.

Between programs, I attended the Summer of Applied Geophysical Experience (SAGE), which was an eye-opening experience that combined geology and geophysics for me for the first time.

During my graduate courses, besides my technical growth and conducting additional field work, I also developed more of my soft skills, such as how to better manage my time and projects. These skills are particularly important for managing projects and delivering work products on schedule – which can take time to perfect in the workplace!

Public speaking is also an essential skill that has immensely helped in my career. I started small by getting out of my comfort zone by presenting posters at conferences, then gave oral presentations and later my thesis defense. Although the covid pandemic made it more challenging to get in-person public speaking experience, I encourage students and ECPs to continue to hone their public speaking skills as much as possible in-person and virtually.

What's one of your favorite AIPG experiences?

One of my favorite experiences was engaging with others at the 2023 National AIPG Conference in Covington, as this was my first time meeting many other AIPG members in-person. Joining any professional or conference meeting can be intimidating to both students and ECPs, but I found that AIPG members were so friendly and enthusiastic when meeting me, despite my being a newer member of the community. It was a pivotal moment for me to be welcomed into the AIPG community so warmly.

Do you have any advice for professionals (early career and/or mid-to-senior professionals)?

I would emphasize that networking and making connections is essential to your success. I have personally tried to do well with networking, and this has led to a lot of opportunities. Every job opportunity I've had started with a personal connection first. I encourage ECPs and students to reach out, make connections even if you must initiate the contact; schedule a call, come prepared, be ready to lead the meeting, and be respectful of the time of the person whom you are meeting. "Cold calling" does not have to be an actual call, but can also be an email, LinkedIn message, or other means of communication, and is sufficient to make an initial connection with someone. AIPG can help immensely with networking.

For mid-to-senior professionals, I would like to encourage you to continue communicating the benefits and value that AIPG provides within your company (to management, peers, and ECPs), and bring your colleagues (especially ECPs) with you to the meetings.

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International	Wing Sang Vincent Choi	CPG-12232
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Michigan	Benjamin D. Hinks	CPG-12238
Michigan	Daniel A. Hirvi	CPG-12239
Michigan	Joseph F. Klumpstra	CPG-12236
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GSA Society Fellowship Awarded to Dr. Chris Gellasch, CPG

AIPG extends its heartfelt congratulations to Dr. Christopher A. Gellasch of Eastern Michigan University for this well-deserved recognition. This award is a testament to Dr. Gellasch's unwavering dedication to the geoscience profession and his extraordinary efforts in preparing students to become future leaders in the field—embodying the true spirit of what it means to be a Certified Professional Geologist (CPG).

Dr. Gellasch's significant contributions to the Geological Society of America (GSA), along with his commitment to training and mentoring early-career geoscientists, exemplify the highest standards of professional service. As Christopher P. Carlson noted, Dr. Gellasch has proven to be an exemplary representative of the geoscience community through his volunteer work and professional achievements.

Society Fellowship, conferred by the GSA Council during its spring meeting, is a distinguished honor reserved for those who have demonstrated a sustained record of excellence in advancing the geosciences. Nominees are recognized for their significant contributions to areas such as scholarly publications, applied research, education, administration, public outreach, leadership, and service to professional organizations. This accolade reflects the profound impact Dr. Gellasch has made on the profession and the community.

Additionally, Dr. Gellasch was recognized for his commitment by the AIPG Michigan Section as the Outstanding Educator of 2024.



Dr. Chris Gellasch (left), receiving his award of GSA Society Fellowship from GSA President Chuck Bailey.

NGWA Honors Dr. Richard Laton, PG, CPG, CHG, EG with Two Awards

AIPG proudly congratulates Dr. Richard Laton, PG, CPG, CHG, EG, on being honored by the National Ground Water Association (NGWA) with their 2024 Awards of Excellence and Fellow Designation. These prestigious awards were presented during Groundwater Week in December in Las Vegas, Nevada.

Dr. Laton received the **Robert Storm Intersectional Cooperation Award**, recognizing his outstanding contributions to fostering collaboration, enhancing cooperation, and building community among groundwater professionals. This award highlights his dedication to advancing mutual interests and promoting the importance of Earth's water resources through both action and advocacy.

In addition, Dr. Laton was granted the **Fellow Designation Award**, an honor that reflects recognition by his peers and NGWA of his exceptional credentials, professional accomplishments, and commitment to increasing the understanding of groundwater science and water well system technology.

NGWA's **Fellow Designation** is awarded to members who exemplify professional excellence, achievement, and integrity. Candidates must demonstrate substantial contributions in areas such as water well technology, groundwater science/engineering, education, research, consulting, public outreach, and leadership. These qualities align closely with the core values of being a Certified Professional Geologist (CPG).

Dr. Laton, a geoscience professor at California State University, Fullerton, and owner of Earth Forensics, Inc., has mentored hun-

dreds of students, many of whom have gone on to successful careers in the water industry. His work underscores the importance of training the next generation of geoscientists and groundwater professionals.

Congratulations, Dr. Laton, on this well-deserved recognition! Your dedication and leadership inspire the geoscience community and advance the understanding and stewardship of water resources.



Dr. Rich Laton with his Fellow Designation award from NGWA.



The Case for Continuing Education

Aaron W. Johnson, CPG-12229
awj@aipg.org

Since its inception in 2022, the AIPG Lunch and Earn webinar series has become an excellent resource for AIPG members and non-members alike. Each year, the series has a theme with such topics as 'economic geology,' 'water and the environment,' or 'natural hazards.' This coming July we will begin a year-long focus on 'critical and strategic raw materials.' The series is offered on the last Tuesday of every month (save December) at 11:00 am Mountain Time. As of this writing, the series averages around 80 attendees each month. A big part of the success of this series is that we offer continuing education credits (CEU's or PDH's depending on the requirement) to those who attend the webinar and, for those who need CE credit for registration in New York, if they complete the post-webinar assessment.

More than one-third of states with professional geologist licensure and/or registration programs require continuing education to maintain licensure. These programs vary to some degree, but most require at least 12 hours of continuing education on an average annual basis (1.2 CEU's based on a 10 contact-hour per CEU conversion) to maintain licensure. Several states require that annual continuing education includes at least one hour of ethics training. In New York, continuing education providers must be recognized by the New York State Education Department (NYSED) and must meet specific education and record-keeping requirements to maintain their recognition as Continuing Education providers. I'm pleased to say that AIPG has been approved by NYSED and that we work diligently to ensure that all requirements are met.

Continuing education is required by many professional organizations. We (AIPG) have mutual recognition of credentials with The Geological Society of London (Chartered Geologist), The European Federation of Geologists (EuroGeologist), and The Institute of Geologists of Ireland (Professional Geologist or PGeo). (Quick note: If you are interested in pursuing any of these titles, please reach out to Dorothy Combs in Member Services for further information.) Each of these organizations requires continuing education to maintain their credential. The continuing education requirements vary within each organization, but the common theme is that to maintain your certification, you must participate in the continuing education program outlined by each organization. For each organization, a small number of members are audited annually to ensure compliance.

One of the primary applications of our Certified Professional Geologist credential is to be recognized as a CP (competent person) or QP (qualified person) for purposes of making reports under NI 43-101 (Canada), PERC (Europe), JORC (Australasia), SAMREC (Africa), or any of the other codes that are part of the CRIRSCO (Committee for Mineral Reserves International Reporting Standards) family of reporting codes. Currently, for a person to be recognized as a CP or QP under these instruments or codes, they must possess specific relevant experience and be certified by a recognized professional organization that requires or encourages

its members to participate in continuing education or continuing professional development. At this time, none of the major reporting codes require continuing education. Rather, these codes require that recognized professional organizations, at a minimum, encourage their members to pursue CEU's.

You may be asking, 'why the column on continuing education if it's not required?' That is a good question, and one that I will try to answer. Over the past decade or so, our profession has seen an increase in the number of entities that require continuing education for geologists. This requirement is backed by some studies that show that participation in a continuing education program has numerous benefits for the professional. A 2022 study in the *Journal of Adult and Continuing Education* found that people who participate in CE programs tend to have a higher earning potential than those who don't. A 2008 paper by David Schejbal and David Wilson at the University of Wisconsin noted that those who pursue continuing education suffer fewer periods of unemployment. A 2014 study in the *Review of European Studies* noted that continuing education is one of the most important factors in building intellectual capital. As more studies identify and quantify the value of continuing education, it is only logical that more entities will require continuing education.

As of now, AIPG has no plans to require that our members participate in a continuing education program. We will continue to strongly encourage each of you to pursue continuing education as a means by which to stay abreast of the rapidly changing technologies that are available to geologists. I anticipate that sometime in the near future, one of the major reporting codes will require that all recognized professional organizations require their members to participate in a continuing education program. While that time is not now, I believe that in order to be proactive, we at AIPG must start talking about mandatory continuing education now. Implementing a continuing education program takes time. Time that the reporting codes may or may not give us. By starting the conversation now, we can put AIPG in a position to successfully meet those requirements if, and when, they become reality.

I wish each of you a warm, happy, winter.

Aaron W. Johnson, CPG-12229

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Educating, Advocating, and Inspiring for 2025

Sara Pearson, CPG-10650
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As we step into 2025, I want to start the year by reflecting on our shared mission as geoscientists and members of AIPG. Together, we hold a unique responsibility not only to practice our profession with excellence but also to educate the public, advocate for our field, and inspire future generations to join us. This year, I challenge each of us to embrace these roles with renewed passion and purpose, and even students, it's never too early to start to sharing your passion and knowledge.

Educating the Public: Sharing the Wonders of Geoscience

The geosciences touch every part of daily life—from the water we drink and the minerals in our smartphones to understanding and mitigating natural hazards. However, many people remain unaware of our profession's critical contributions to society. Educating the public is essential for fostering appreciation for Earth's resources and the work we do.

We must engage citizens, students, teachers, and community groups by telling compelling stories about our discoveries and the real-world applications of geoscience. Think about the impact of explaining how LiDAR technology helps map areas prone to landslides, how geophysics reveals groundwater resources, or how 3D mapping improves critical mineral exploration. These stories make our work relatable and exciting, capturing the imaginations of young minds and community leaders alike.

Education is also about accessibility. Today, many people turn to Google or YouTube for answers to their questions about the natural world. Let's meet them where they are by sharing accurate, engaging content on these platforms. AIPG members have the expertise and passion to be trusted voices in these spaces. Building trust requires more than credentials—it's about how we connect with people and the values we exemplify in every interaction.

Advocating for the Profession: Being Ambassadors for Geoscience

Advocacy begins with us. Each of us has a role in raising awareness about the importance of geosciences in resource management, environmental protection, and public safety. Whether you're mentoring a student, presenting at a community meeting, or simply talking with friends, every conversation is an opportunity to share your passion for geoscience and inspire someone to see the value in what we do.

We should strive to transform geoscience from a "discovery" major into a dream career that even an eighth grader can envision pursuing—just like aspiring to become a doctor, firefighter, or teacher. By explaining how geoscientists solve critical challenges such as flood mitigation, contamination tracking, and securing essential minerals, we can inspire the next generation to see our profession as vital, impactful, and attainable.

AIPG members also have the added advantage of representing a community that upholds the highest standards of integrity and professionalism. Take pride in the "CPG" designation and what it stands for, but remember that trust ultimately comes down to how we conduct ourselves. By being approachable, knowledgeable, and ethical in our interactions, we can build the public's confidence in our work and the geoscience profession as a whole.

Inspiring the Future: Stories That Matter

People learn through stories, and stories are what they remember. As geoscientists, we have incredible narratives to share—tales of discovery, innovation, and resilience. Consider the impact of recounting the time your work helped prevent a community from suffering a landslide, uncovered a vital groundwater resource, or revealed a pathway to remediate contamination. These are not just technical achievements; they are stories of how geoscience improves lives.

When we share these stories, we not only educate and advocate but also inspire. Every story we tell has the potential to spark interest in someone who may become the next geoscientist, teacher, or policymaker. So, let's tell our stories often and with pride.

A Call to Action

This year, I encourage you to:

1. **Educate** the public by sharing your knowledge with clarity and enthusiasm. Whether it's through presentations, social media, or informal conversations, find ways to explain how geoscience impacts their lives.
2. **Advocate** for the profession by being an ambassador for geoscience. Mentor students, engage with community groups, and demonstrate the importance of our work in resource management, hazard resilience, and environmental stewardship.
3. **Inspire** others by telling your story. Share the moments that define your career and the passion that drives you. Show others the rewarding and impactful nature of what we do.

As members of AIPG, we are united by our dedication to advancing the geosciences and upholding the values of professionalism and integrity. Let's make 2025 a year of connection, inspiration, and growth—not just for ourselves but for the profession and the world we serve.

Together, we can build a stronger future for geoscience and ensure that our work continues to make a difference for generations to come, and be sure to extend an invitation to colleagues who share this desire to advance the profession to join AIPG too.

I invite members to share your stories of how you educate, advocate and inspire. Here's to a successful and inspiring 2025!



Robert G. Font, CPG-03953
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1. In geophysical work, what is the meaning of a “Bouguer anomaly?”
 - a) A gravity anomaly given by the formula: $F = G M_1 M_2 / R^2$.
 - b) A gravity anomaly equivalent to the “third harmonic” in gravity harmonics.
 - c) A gravity anomaly calculated from a theoretical model and corrected (added) for elevation at recording stations above sea level.
 - d) A gravity anomaly calculated from a theoretical model and corrected for elevation, the effect of rock density between the recording station and sea level (subtracted for points above sea level), and topography.
 - e) Anomalous amounts of nasal discharge that you may experience while performing geophysical calculations.
2. Malachite is a copper-bearing mineral with the following chemical composition:
 - a) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.
 - b) $\text{Cu}_2\text{CO}_3(\text{OH})_2$.
 - c) Cu_2O .
 - d) $\text{Cu}_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4$.
 - e) Ay R nut a keemeekal injuneer, dude!
3. In well drilling operations, a “drilling break” is indicative of:
 - a) The presence of hydrocarbons.
 - b) A tear in a drill collar or joint.
 - c) A sudden change in the drilling rate.
 - d) A crack in the kelly near the rotary table.
 - e) A collective coffee break taken by the toolpusher, driller, derrick man, and roughnecks at the rig.
4. Dinosaurs can be classified as either ornithischian or saurischian. In saurischians, the hips have forward-oriented pubic bones (as in lizards). In contrast, in ornithischians, the hips have backward-oriented pubic bones (as in birds).
 - a) True.
 - b) False.
5. In two dimensions, the siliceous pebbles in a conglomerate are approximated by an elliptical shape. The average pebble size is 38 mm along the x-axis and 25 mm along the y-axis. What is the eccentricity of the average pebble and what significance does this have?
 - a) $e = 0$; The pebbles have not travelled far from their source.
 - b) $e = 0.75$; the pebbles have been transported a good distance from their source.
 - c) $e = 0.95$; the pebbles have travelled a long distance from their source.
 - d) $e = 0$; the pebbles are very far from their source.
 - e) An eccentric pebble? Dude, now I’ve heard it all!

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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

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DEI in AIPG

In her TPG Jul/Aug/Sep '24 President's Message, **Shanna Schmitt** urged members to get involved in AIPG through becoming a National or Section officer or becoming a member of one of AIPG's national committees. The fifth national committee on her list was the DEI Committee, which Schmidt described as "Diversity and Inclusion - help promote a supportive and welcoming Institute in which geoscientists of all backgrounds and demographics can work together to strengthen and advance geoscience professions." This request to join the DEI Committee prompted some members to comment as follows:¹

- "However, be advised that DEI is based on Critical Race Theory, a Marxist agenda which substitutes social class with race. DEI is inherently racist and must be opposed."
- "I am not interested in anything labeled DEI. It is un-American, racist, sexist, and totally misses the mark for what AIPG is all about."

Unfortunately, in some right-wing circles, DEI is viewed as a version of political correctness that is viewed as a woke agenda. Letitia Meynell of Dalhousie University observed that objections to DEI and wokeness "tend to share the same kinds of motivations. They boil down to the following three claims about the targeted practice that justify the woke intervention:

1. The practice is *offensive* to the members of a group to which it pertains;
2. The practice implies something that is *false* about this group and reflects and reinforces this inaccuracy;

3. The practice implicitly endorses or maintains unjust or otherwise pernicious attitudes about the group that facilitate *discrimination and various other harms* against them."²

A number of companies and institutions have terminated their DEI programs because they have been found, at least in some cases, to have focused on identifying "offenders" and "offended groups."

The comments AIPG received regarding DEI reflect these three claims despite the fact that the claims and their assertions about AIPG's intent are untrue. There are 15 articles on "diversity" in the PE&P index.xls that date back to December '97. I've never received any comments like those quoted above regarding any of these articles. Standards 4.3 and 4.4 of the AIPG Code of Ethics reflect the purposes and goals of AIPG and the DEI Committee. These comments miss the point that DEI, at least for AIPG, and many others, simply stands for "diversity, equity, and inclusion." Those, who like Florida Governor Ron DeSantis believe that DEI stands for "discrimination, exclusion, and indoctrination"³ reflect their own bigotry.

When I joined the geoscience profession in the 1970s, the great majority of geoscientists were outdoors-oriented white males. Since then, the percentage of females in geoscience in general and in leadership positions in geoscience societies has dramatically increased, but the geoscience profession in the US remains largely white, although there are increasing numbers of non-white members. These demographics reflect success in efforts to increase the diversity of geoscientists and the inclusion of non-whites in leadership positions in the

professions. There never has been a race- or gender-based quota system in AIPG.

When I grew up in Colorado in the '50s and '60s those engaging in camping, hiking, and skiing were white and were the most likely to become geologists. Heck, we get paid to take hikes. As I pointed out in PE&P column 175 (Jul/Aug/Sep '20), "The established rock hammer and field boots culture of geology is exclusive and marginalizing for those who cannot or do not go on hikes over rough terrain." Other groups that have been marginalized during field trips and other geoscience activities include the physically disabled, those with color vision deficiency, blindness and low vision, learning disabilities, cognitive deficiencies, social and behavioral disorders, hearing impairment, and those with food allergies or religious food obligations. As the needs of these various groups have been recognized, efforts to make appropriate accommodations have occurred. The purpose and goal of the DEI Committee is to work toward identifying and amending this past culture of exclusivity and marginalization.

A *New York Post* article posted on-line on 10/20/24 pointed out that the *New York Times* stating, "Wow: It seems even the *New York Times* is wising up to the truth of DEI, namely that the policies that claim to promote "diversity, equity and inclusion" actually do the opposite—with disastrous consequences. ... In a mammoth piece published Wednesday [10/16/24], the *Gray Lady* reports that the University of Michigan's uber-woke program, 'the largest D.E.I. bureaucracy of any big public university,' has not only "helped fuel a culture of grievance" that has boosted racial tension and deepened division, but it's also made the entire campus *miserable*." Clearly, when

1. I received these and other collected comments from Executive Director Aaron Johnson having specifically requested that identifying information be removed prior to transmission to me.
2. Letitia Meynell, <https://theconversation.com/heres-what-woke-means-and-how-to-respond-to-it-219588>, 12/20/23.
3. "DEI in AIPG—what it is and what it isn't", PE&P column 187, Oct/Nov/Dec '2023.

such situations develop, DEI programs are no longer useful and should be dropped. However, AIPG has not developed any such bureaucracy. Instead, as summarized above, efforts to recognize and correct unrecognized biases are positive.

Ethics, safety, and other reporting systems

Shannon Walker's article, "Ethics reporting systems to create safer mining sites," in the October 2024 *Mining Engineering* is worth reading. Walker observes, "For mines to remain compliant, they of-

ten rely on a speak-up culture, as employees are often the first to notice unsafe or unethical practices and have the inherent responsibility to report them. However, without the right mechanisms to do so, unsafe conditions can go unchecked, and mines can become increasingly hazardous workplaces." A reporting system that encourages employees to "report ethical, wrongdoing such as misconduct, harassment, fraud or suspicious behavior, usually anonymously, to help management intervene when needed and prevent further issues" is required. Specific reporting systems vary, although anonymity principles

are required to reassure employees that they will not be adversely affected by making reports. Walker's observations extend well beyond the mining industry.

Qualification for participation in public affairs

The article, "Qualification for Participation in Public Affairs" appearing below in this issue of *TPG* is an extension of this column.

Qualification for Participation in Public Affairs

David M. Abbott, Jr., CPG-4570

Jim Lehrman, CPG-8744, PG, CHG, PG

Jim Lehrman sent me a question regarding the AIPG Code of Ethics, Standard 2.3, "Members should participate as citizens and as professionals in public affairs." Lehrman wrote, "Over the past several months some colleagues and I have gotten involved with a local issue involving our local water wholesaler and city's plans to drill new water supply wells in relatively close proximity to a

recently discovered large regional plume of PFAS in our drinking water aquifer. I've attached a message to local geoscientists that I, along with George Reid, CPG-7597, PG, CHG, CEG and geologist Erik Sommargren prepared to raise awareness of this situation and gather support."

Message to Geologists, Hydrogeologists and Environmental Engineers Residing in the Tri-Valley

Re.: PFAS Contamination in the Livermore Valley Groundwater Basin

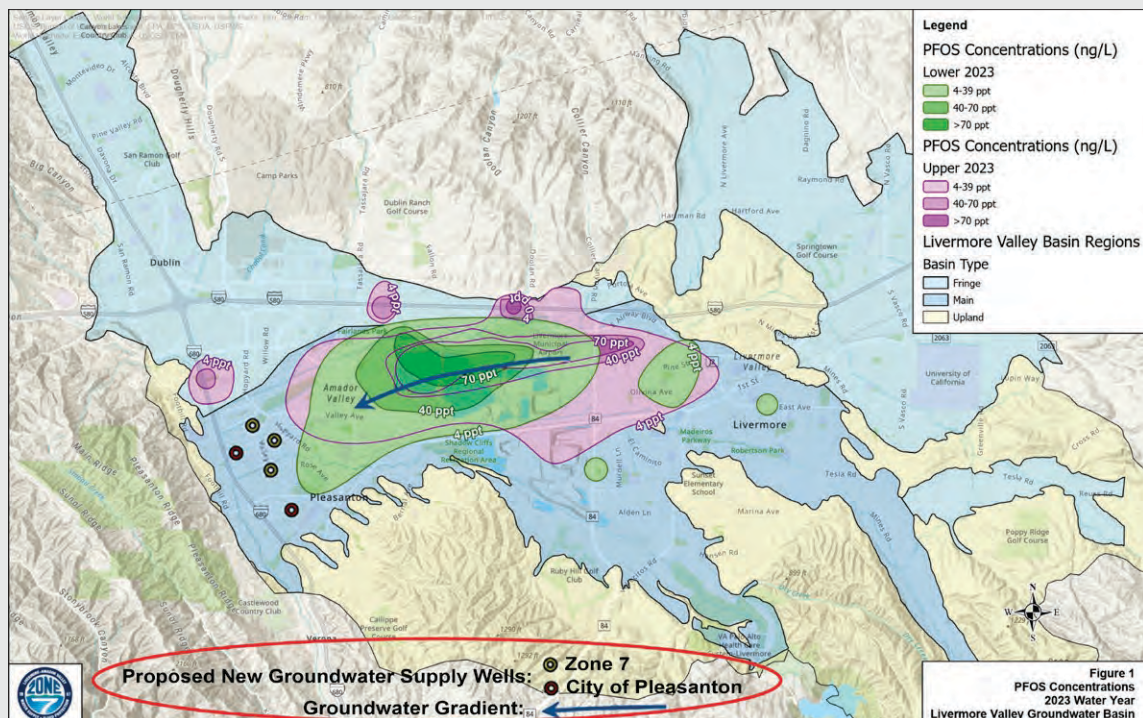
Jim Lehrman, PG, CHG, CPG, Pleasanton, CA

George Reid, PG, CHG, CEG, CPG, Pleasanton, CA

Erik Sommargren, Livermore, CA

Unbeknown to many, there's a large regional plume of per- and polyfluoroalkyl substances (PFAS) in the drinking water supply underlying the Tri-Valley, where groundwater provides 20% of our water on average and 50% in 2022. Both the upper and lower aquifers of the Livermore Valley Groundwater Basin (totaling ~1,000' in thickness) are severely impacted by PFAS. The PFAS plume is approximately six miles long and two miles

wide, as defined by concentrations exceeding the USEPA's recently promulgated maximum contaminant levels (MCLs) and data from the Tri-Valley region's water wholesaler, Zone 7 Water Agency (Zone 7). Three local geologists (the authors) are advocating for actions to prevent further degradation of the Basin, and seek your support.



Source: The Independent, June 13, 2024. https://www.independentnews.com/news/pleasanton_news/local-geologists-oppose-city-s-pfas-plans-for-new-wells/article_7e7ff684-2921-11ef-996c-e789a77a8480.html.
Annotated to show proposed well locations and general groundwater gradient.

PFAS are a group of synthetic chemicals (including PFOS / perfluorooctane sulfonate) that have been used in consumer products since the 1950s, known as "forever chemicals" because they don't break down easily over time and are highly soluble in water. Health risks from PFAS include increased risk of some cancers, thyroid disease, reduced ability of the body's immune system to fight infections, including reduced vaccine response, interference with the body's natural hormones and increased cholesterol levels and/or risk of obesity. While PFAS are contained in many consumer products, including water-resistant fabrics, nonstick cookware, cleaners, and personal-care products, one of the main routes of human exposure is consumption of drinking water. The suspected prime source of PFAS in our groundwater is spent and/or leaked fire-fighting foam, which can infiltrate soil and leach to groundwater.

Some good news: Before legally required, Zone 7 and the City of Pleasanton shut down about ten water supply wells that exceeded new PFAS MCLs. Zone 7 started wellhead treatment at one well to remove PFAS concentrations, plans to start wellhead treatment at three more wells this fall and has additional plans for wellhead treatment at even more wells in the next few years. Also, the San Francisco Bay Regional Water Quality Control Board (Water Board) is at long last requiring investigations into potential sources of PFAS, including Livermore-Pleasanton Fire Department sites and the Livermore Airport, where PFAS containing fire-fighting foam may have been used for decades. For these investigations, the Water Board has been given a technical memorandum on potential PFAS sources prepared for Zone 7 by Jacobs Engineering in 2020.

The bad news: Zone 7 and the City of Pleasanton plan to drill up to five new water supply wells just downgradient and west of the known PFAS plume to increase water supply, rather than pursuing more wellhead treatment in the short term. Millions

of gallons of water per day would be pumped from each of the proposed new wells. This action would undoubtedly accelerate the migration of PFAS and spread these hazardous substances into yet unimpacted areas of the groundwater basin. Zone 7 and the City of Pleasanton seem to be justifying these plans based on (1) short-term cost savings over wellhead treatment and (2) old groundwater modeling, which is without doubt inadequate to predict the exact rate of plume movement. Zone 7 has apparently claimed that: (a) the plume is contained, and (b) a geologic groundwater barrier exists between the proposed new wells and the plume, which will restrict further plume migration. We find no credible evidence for these claims.

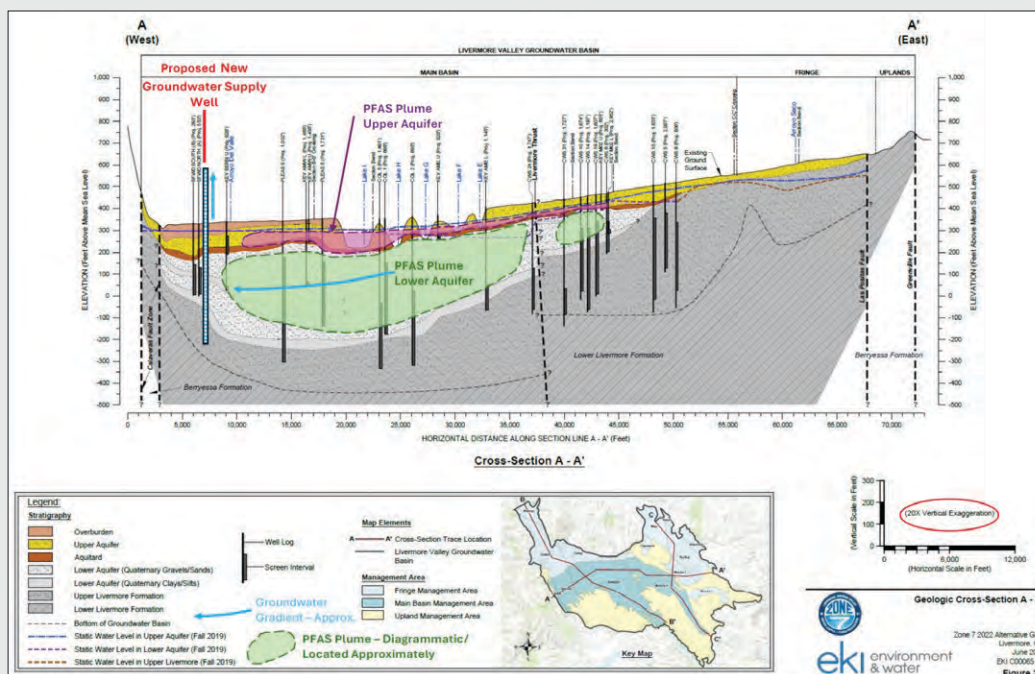
Prior to drilling expensive new test/pilot wells, adequate spatial and temporal data should be collected from existing monitor wells to establish statistically reliable PFAS trends. The new data could be used to calibrate transport in an updated groundwater model to better assess the risks of new production wells.

What you can do:

- Sign this petition as a knowledgeable professional demanding that the City of Pleasanton and Zone 7 stop their plans for the proposed new wells or delay those plans until adequate PFAS data is available to make better informed basin management decisions. Please click the link to sign: <https://chn.g.it/9ZMBBrGK6T7>. Include your professional registration (e.g., PG, CHG, CEG, PE).
- Ask Pleasanton City Council members, the Pleasanton City Manager, and Zone 7 Management and Board of Directors to stop their current plans for the proposed new wells before spending up to \$2MM on test/pilot wells this fall. Other agencies to contact include Alameda County Supervisors, the Water Board, CalEPA-DTSC, and USEPA.

Your professional expertise is important to prevent further contamination of our aquifers. Your education, knowledge and experience with similar projects, subsurface geology and fluid flow in porous media qualifies you as an expert whose judgement on such matters should be highly valued by our elected

officials. Please contact us at trivalleygroundwater@gmail.com to share your knowledge and advice. We are facing an uphill battle with highly funded agencies that can move quickly and often disregard local experts and their concerns.



Annotations added by authors to show PFAS plume(s), proposed well location(s) and general groundwater gradient; based on Zone 7's maps and cross-sections.

"Unfortunately, we've found few fellow professionals willing to speak up on this issue and support us, though none have disagreed with our analysis and concerns. We've also reached out to local professional societies to get their support and help in contacting local geoscientists, but most ultimately declined to get involved. We've reached out to a number of individual geologists, some from industry and some in academia, but most declined to get involved or publicly show support. We've had meetings with State regulatory agencies, but they apparently feel they cannot oppose water providers, seemingly putting economics over the environment."

Lehrman asked, "Do geologists with the education, background, experience, and knowledge to recognize potential harm related to the subsurface have a duty to speak out in an effort to prevent or minimize the potential harm? I reviewed the AIPG Code of Ethics and noted that Rule 2.1.3 may apply here. But most of the geoscientists that we've been in touch with on this issue are not AIPG members, though many are licensed by the State of California." Rule 2.1.3 states, "If a Member becomes aware of a decision or action by an employer, client, or colleague which violates any law or regulation, the Member shall advise against such action, and when such violation appears to materially affect the public health, safety, or welfare, shall advise the appropriate public officials responsible for the enforcement of such law or regulation." As noted above, Standard 2.3 obliges geoscientists to contribute their professional knowledge and experience in participating in

public affairs. Concern over the potential impact of drilling water extraction wells near a PFAS plume certainly qualifies under both Standard 2.3 and Rule 2.1.3.

David Abbott replied to Lehrman focusing on "the education, background, experience, and knowledge" needed to opine on the issue. Abbott is a mining geologist who has been involved in the development of internationally recognized mineral resources and mineral reserves classification systems. One of the critical parts of these systems involves the education and experience of the mining industry professionals who prepare reports describing estimated mineral resources and mineral reserves for the investing public. These professionals are required to meet the definition of a Competent (or Qualified) Person. A Competent Person is defined as one having the appropriate membership in a recognized professional association with an enforceable disciplinary process and having a "minimum of five years relevant experience in the style of mineralization or type of deposit under consideration and in the activity which that person is undertaking."¹ The Guidance to the definition of Competent Person states, "The key qualifier in the definition of a Competent Person is the word 'relevant'. Determination of what constitutes relevant experience can be a difficult area, and common sense has to be exercised. For example, in estimating Mineral Resources for vein gold mineralization, experience in a high-nugget, vein-type mineralization such as tin, uranium, etc. will probably be relevant, whereas experience in massive base metal deposits may not be." While AIPG's CPGs are members of a recognized professional association, they do not necessarily have the relevant knowledge or experience to act as a competent person and opine on a particular professional report.

Continued on p. 45

1. CRIRSCO Reporting Template, 2024, definition 3.6 and Guidance thereunder, https://crirSCO.com/wp-content/uploads/woocommerce_uploads/2024/06/CRIRSCO_International_Reporting_Template_June2024_Update_Approved_for_Release_20240627-d18515.pdf.

Answers:

1. The answer is choice “d” or “A gravity anomaly calculated from a theoretical model and corrected for elevation, the effect of rock density between the recording station and sea level (subtracted for points above sea level), and topography.” “Bouguer anomalies” result from the effect of buried rocks of greater or less than average density or from geological structures involving rocks of contrasting densities.

Choice “a” is not a “gravity anomaly.” It depicts Newton’s law of gravitation where the force of attraction (F) between two masses (M_1 and M_2) is directly proportional to their product ($M_1 \times M_2$) and inversely proportional to the square of the distance (R^2) between them. In the equation: $F = G M_1 M_2 / R^2$, the value of “ G ” or the “gravitational constant” is $G = 6.67 \times 10^{-11}$ newton m^2 kg^{-2} .

The Earth’s gravitational field is modeled using “spherical harmonics.” The first and second harmonics represent a spherical Earth and an oblate spheroidal Earth, respectively. Choice “b” or “third harmonic” gives rise to the pear-shaped Earth.

Choice “c” is the free-air anomaly.

2. The answer is choice “b” or $Cu_2CO_3(OH)_2$ (carbonate).

Choices “a”, “c” and “d” are chalcantite (sulphate), cuprite (oxide) and chrysocolla (silicate), respectively.

Malachite $Cu_2CO_3(OH)_2$



- 3.



Drill bits exhibit.
Panhandle-Plains Historical Museum
Canyon, Texas

The answer is choice “c” or “A sudden change in the drilling rate.” “Drilling breaks” are generally associated with faster penetration and may denote the presence of porosity.

In reference to the drill string, lengths of pipe (called joints) are usually 30 feet long. The bottom joints are the heaviest to give stability and constitute the drill collars. The weight of the drill string is held by a cable passing over a pulley through a traveling block into the massive horizontal winch (the draw works). Pipe can be raised and lowered controlling the weight on the drill bit.

The “kelly” is a square or hexagonal pipe making the top joint which fits into the rotary table.

Man, if every drilling break would be indicative of the presence of hydrocarbons, that would be something!!!!!!

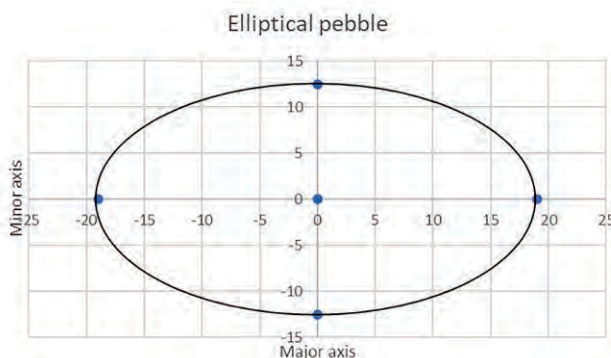
4. The answer is choice “a” or “true.”



Saurischian theropod dinosaur exhibit.
Panhandle-Plains Historical Museum
Canyon, Texas

5. The answer is choice "b" or "e = 0.75; the pebbles have been transported a good distance from their source." Please refer to the graph below highlighting the characteristics of the ellipse.

$$\begin{aligned} \text{Major Axis} &= 2a = 38 \\ \text{Minor Axis} &= 2b = 25 \\ a &= 19; b = 12.5 \\ (x - h)^2/a^2 + (y - k)^2/b^2 &= 1 \\ x^2/(19)^2 + y^2/(12.5)^2 &= 1 \\ x^2/361 + y^2/156.25 &= 1 \\ c^2 &= a^2 - b^2 = 361 - 156.25 = 204.75 \\ c &= \sqrt{204.75} = 14.31 \\ f &= (h \pm c, k) = (\pm 14.31, 0) \\ v &= (h \pm a, k) = (\pm 19, 0) \\ e &= c/a = 14.31/19 = 0.753 \end{aligned}$$



Please note that choices "a" and "d" cannot be correct, as $e = 0$ would indicate a perfectly spherical pebble and that is not our case. Also, choice "c" is incorrect, as "e" values range from 0 to 1, with $e = 0$ being a perfect sphere and $e = 1$ being a flat line. Thus, $e = 0.95$ would indicate an extremely flattened pebble and the result of some sort of drastic deformation.

Public Affairs, continued from p. 43

Abbott lacks the relevant knowledge and experience to be a co-author of Lehrman, Reid, and Sommargren's "PFAS Contamination in the Livermore Valley Groundwater Basin" report/message. But is Abbott's general geoscience education and experience sufficient for Abbott to understand that report and to sign a petition to the City of Pleasanton as requested in point one of "What you can do:" in the "Message to Geologists, Hydrologists and Environmental Engineers Residing in the Tri-Valley" advising that additional data be collected to "establish statistically reasonable PFAS trends"? Lehrman and Abbott believe that Abbott probably has the education and experience required to sign the petition. However, because Abbott resides in Denver rather than the Tri-Valley area, Abbott's signing of the petition is unlikely to count for much. But Lehrman believes that having Abbott sign the petition would do no harm and might help. The qualified geoscientists, hydrologists, environmental scientists, and engineers who live in the Tri-Valley area should be encouraged to sign the petition as encouraged by Ethics Standard 2.3.

Additional aspects: Sara Pearson, CPG-10650, commented, Lehrman, Reid, and Sommargren "are correct that [the Zone 7 Water Agency] will most likely exacerbate the migration of the plume with pumping occurring downgradient. Depending on the specifics of California's regulations, it may not be a violation of the law because [Zone 7] can treat the groundwater, but then why not treat all of the wells they took offline? It does appear irresponsible, but I am not an authority on California regulations. I can see why others are not getting involved. It would be very unpopular to oppose a new municipal supply; however, the presence of PFAS in the area should also alarm the public. If it were in Michigan, a municipality seeking permits for new wells in a contaminated aquifer would be seriously questioned by the regulatory agency pointing to the Safe Drinking Water Act. I participated in a similar case, and as a regulator, we asked the municipality to seek a better long-term solution and find an uncontaminated source that was not threatened by contamination. This case was taken before a judge because the regulatory agency stated that the municipality had not exhausted all options in finding an uncontaminated source. The best option, which the municipality did not want to move forward with, was connecting to the nearby municipality that has a clean source. The municipality appeared to not want to lose its autonomy. However, a number of their wells had already been taken offline

because of PFAS. These are complex situations as more factors need to be considered in making these decisions, and I do not have all the information. However, it's unfortunate that California does not appear to be following the same course, and their water issues are far different than our experience in Michigan. Michigan also aims to be at the forefront in work around the PFAS issue."

Lehrman provided the following clarification to Pearson's comment. The Porter-Cologne Water Quality Control Act is the clean water act of California that expanded the enforcement authority of the State Water Resources Control Board and the nine Regional Water Quality Control Boards. The act authorized the California Environmental Protection Agency to create local boards and better protect water rights and water quality. The policy states:

1. The quality of all waters of the State shall be protected.
2. All activities and factors affecting the quality of water will be regulated in order to attain the highest water quality within reason.
3. The State must be prepared to exercise its fullest power and jurisdiction in order to protect the quality of water in the State from degradation.

Regarding why the water providers don't treat all the wells they've taken offline, in a nutshell, it seems to be another case of putting economics over the environment. It's always cheaper to pollute than not to pollute. Finding the funds to do the right thing (wellhead treatment, which provides 1) clean water, 2) hydraulic control of the plume, and 3) removal of PFAS from the aquifer) is not easy, but that's not justification for degrading the quality of waters of the State.

Update: the 10/29/24 issue of the AIPG eNews contained an article, "Millions in the US may rely on groundwater contaminated with PFAS for drinking water supplies." The article states, "Approximately 71 to 95 million people in the Lower 48 states—more than 20% of the country's population—may rely on groundwater that contains detectable concentrations of per- and polyfluoroalkyl substances, also known as PFAS, for their drinking water supplies. These findings are according to a U.S Geological Survey study published in the journal Science." See www.science.org/doi/10.1126/science.ad6638.



Classic Articles as an Educational Tool: Reading the Plate Tectonic Revolution

Rasoul Sorkhabi, Ph.D., CPG-11981

Dr. Rasoul Sorkhabi is a professor at the University of Utah's Energy & Geoscience Institute, Salt Lake City.
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The pace of scientific progress is so fast that research articles published in technical journals date quickly. Nevertheless, some articles become classic because they lay the foundation of a new research field or report on highly novel and fundamental discoveries. The authors of these classic papers may be celebrated heroes in the history of their respective disciplines, but their papers are rarely read by the following generations of scientists whose research works stand on the shoulders of those classic papers. For a long time, I wondered how such classic papers in geology can be used as an educational tool for (1) teaching some aspect of geology, (2) introducing students to the historical development of geology, and (3) providing an opportunity for students to think critically by studying how a pioneering geologist discovered something novel or altered the basic thinking in geology. There are several books that have collected a large number of classic papers in geology (Mather and Mason, 1939; Mather, 1967; Cloud, 1970; Cox, 1973); although these anthologies are out of print. In this article, for the sake of brevity, I will focus on classic papers related to the plate tectonic revolution of the 1960s-70s as a pedagogical case for using classic papers in the classroom. I should also add that this kind of assignment is appropriate for upper graduate or master's students in a specific discipline (for example, structural geology and tectonics), not for basic Geology 101 courses.

Methodology

The classic paper reading assignment has the following procedure.

1. Prepare a list and pdf files of the classic papers – one paper for each student. Let each student select one article from the list.
2. Ask the student to read the selected paper, and write a brief report about the paper (or give a presentation in the class) covering three specific questions: (1) What was the novel contribution of the paper? (2) How did the author accomplish the task – theoretically, empirically, or experimentally, and (3) what new things we now know since the publication of the paper?
3. Grade the assignment providing some notes on the quality of the student's report and directions to points the student may have missed.

By adopting this method, the student will learn a great deal about the development of that particular topic and will also strengthen his or her thinking skills.

Classic Papers on Plate Tectonics

As a case, let's look at some of the most important research articles that established the plate tectonic theory in the 1960s-70s.

Sea Floor Spreading

Dietz, Robert S. (1961) Continent and ocean basin evolution by spreading of the sea floor. *Nature*, vol. 190, pp. 854-857.

Hess, Harry H. (1962) History of ocean basins. In: *Petrologic Studies: A Volume in Honor of A.F. Buddington*, edited by A. E. J. Engel, Harold L. James, and B. F. Leonard. Geological Society of America, pp. 599-620.

Transfer Faults on the Ocean Floor

Wilson, J. Tuzo (1965) A new class of faults and their bearing on continental drift. *Nature*, vol. 207, pp. 343-347.

Wilson, J. Tuzo (1965) Transform faults, oceanic ridges, and magnetic anomalies southwest of Vancouver Island. *Science*, vol. 150, pp. 482-485.

Ocean Floor Magnetic Stripes

Vine, Fred J., & Matthews, D. H. (1963) Magnetic anomalies over oceanic ridges. *Nature*, vol. 199, pp. 947-949.

Vine, Fred J., and Wilson, J. Tuzo (1965) Magnetic anomalies over a Young Oceanic Ridge off Vancouver Island. *Science*, vol. 150, pp. 485-489.

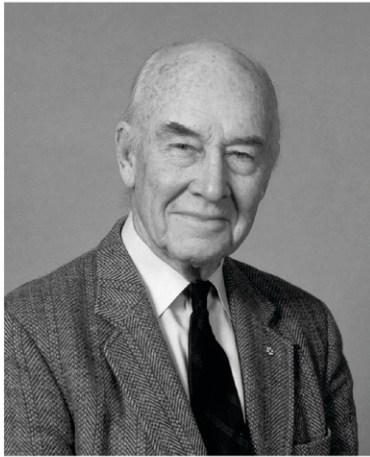
Vine, Fred J. (1966) Spreading of the ocean floor: new evidence. *Science*, vol. 154, pp. 1405-1415.

Heirtzler, J.R., Dickson, G.O., Herron, E.M., Pitman, W.C. III, and Le Pichon, X. (1968) Marine magnetic anomalies, geomagnetic field reversals, and motion of the ocean floor and continents. *Journal of Geophysical Research*, vol. 73, pp. 2119-2136.

Magnetic Field Reversals

Bullard, E. (1968) Reversals of the Earth's magnetic field. *Transactions of the Royal Society of London Series A*, vol. 263, pp. 481-524.

Cox, A., Doell, R. R., & Dalrymple, G. B. (1964) Reversals of the Earth's Magnetic Field: Recent paleomagnetic and geochronologic data provide information on time and frequency of field reversals. *Science*, vol. 144, pp. 1537-1543.



John Tuzo Wilson (1908-1993)



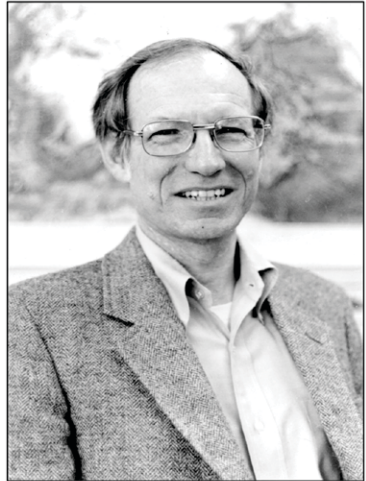
Robert S. Dietz (1914 – 1995)



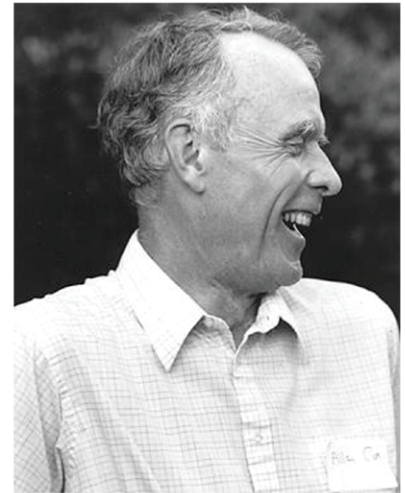
Harry H. Hess (1906 – 1969)



Left: D.H. Matthews (1931 -1997)
Right: F.J. Vine (1939 -)



W. Jason Morgan (1935 – 2023)



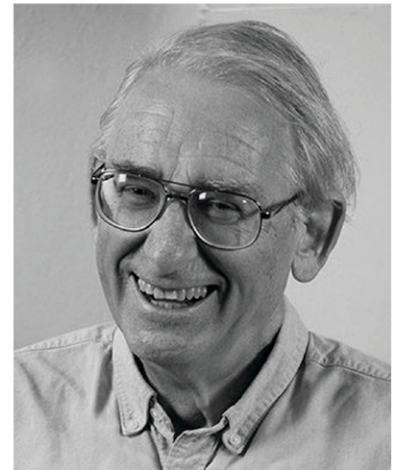
Allan V. Cox (1926 – 1987)



Xavier Le Pichon (1937 -)



John F. Dewey (1937 -)



Dan P. McKenzie (1942 -)

Figure 1. Some of the geologists who led the plate tectonic revolution of the 1960s-70s (Sources: Wikipedia, universities or professional societies).

Cox, Alan, Dalrymple, G. B., & Doell, R. R. (1967) Reversals of the earth's magnetic field. *Scientific American*, vol. 216(2), 44-55.

Cox, Alan (1969) Geomagnetic reversals. *Science*, vol. 163, pp. 237-245.

Mantle Plumes

Morgan, W. Jason (1971) Convection plumes in the lower mantle. *Nature*, vol. 230, pp. 42-43.

Morgan, W. Jason (1972) Deep mantle convection plumes and plate motions. *American Association of Petroleum Geologists*, vol. 56(1), pp. 203-213.

Triple Junctions

McKenzie, Dan P., and W. Jason Morgan (1969) Evolution of triple junctions. *Nature*, vol. 224, pp. 125-133.

Burke, Kevin, and Dewey, John F. (1973) Plume generated triple junctions: Key indicators in applying plate tectonics to old rocks. *Journal of Geology*, vol. 81, pp. 406-433.

Earthquakes and Plate Tectonics

Plafker, George (1964) Tectonic deformation associated with the 1964 Alaska earthquake. *Science*, vol. 148, pp. 1675-1687.

Sykes, Lynn R. (1967) Mechanisms of earthquakes and nature of faulting on the mid-ocean ridges. *Journal of Geophysical Research*, vol. 72, pp. 2131-2153.

Isacks, Bryan, Jack Oliver, and Lynn R. Sykes (1968) Seismology and the new global tectonics. *Journal of Geophysical Research*, vol. 73, pp. 5855-5899.

Tectonic Plates and Continental Drift

Bullard, E.C., Everett, J.E., and Smith, A.G. (1965) The fit of the continents around the Atlantic. In: *A Symposium on Continental Drift. Philosophical Transaction of Royal Society of London*, A258, pp. 41-51.

Wilson, J. Tuzo (1966) Did the Atlantic close and then re-open? *Nature*, vol. 211, pp. 676-681.

McKenzie, Dan., and Parker, R.L. (1967) The North Pacific: An example of tectonics on a sphere. *Nature*, vol. 216, pp. 1276-1280.

Morgan, W. Jason (1968) Rises, trenches, great faults, and crustal blocks. *Journal of Geophysical Research*, vol. 73, pp. 1959-1982.

Le Pichon, Xavier (1968) Sea-floor spreading and continental drift. *Journal of Geophysical Research*, vol. 73, pp. 3661-3697.

Hurley, P.M. (1968) The confirmation of continental drift. *Scientific American*, vol. 222(4), pp. 52-64.

Dewey, J. F. (1972) Plate tectonics. *Scientific American*, vol. 226(5), pp. 56-72.

Pangea Revisited

Dietz, Robert S., and Holden, John C. (1970) The breakup of Pangaea. *Scientific American*, vol. 223(4), pp. 30-41.

Dietz, Robert S., and Holden, John C. (1970) Reconstruction of Pangaea: breakup and dispersion of continents, Permian to present. *Journal of Geophysical Research*, vol. 75, pp. 4939-56.

Mechanisms of Plate Motion

McKenzie, D. P. (1969) Speculations on the consequences and causes of plate motions. *Geophysical Journal International*, vol. 18, pp. 1-32.

Turcotte, D.L. (1975) The driving mechanism of plate tectonics. *Reviews of Geophysics*, vol. 13, pp. 333-334.

Forsyth, Donald, and Seiya Uyeda (1975) On the relative importance of the driving forces of plate motion. *Geophysical Journal International*, vol. 43, pp. 163-200.

Plate Tectonics and Mountain Belts

As plate tectonics became an established theory in geology in the 1960s, geologists began to interpret the tectonic evolution of various mountain belts in light of the new theory. The following papers published in the 1970s are some examples.

Atwater, Tanya (1970) Implications of plate tectonics for the Cenozoic tectonic evolution of western North America. *Geological Society of America Bulletin*, vol. 81, pp. 3513-3536.

Bird, John M., & Dewey, John F. (1970) Lithosphere plate-continental margin tectonics and the evolution of the Appalachian orogen. *Geological Society of America Bulletin*, vol. 81, pp. 1031-1060.

Dewey, John F., and John M. Bird (1970) Mountain belts and the new global tectonics. *Journal of Geophysical Research*, vol. 75, pp. 2625-2647.

Dewey, John F., & Horsfield, B. (1970) Plate tectonics, orogeny, and continental growth. *Nature*, 225(5232), 521-525.

McKenzie, Dan P. (1970) Plate tectonics of the Mediterranean region. *Nature*, vol. 226, pp. 239-243.

James, D. E. (1971) Plate tectonic model for the evolution of the Central Andes. *Geological Society of America Bulletin*, vol. 82, pp. 3325-3346.

Matsuda, T., and Uyeda, Seiya (1971) On the Pacific-type orogeny and its model: extension of the paired belts concept and possible origin of marginal seas. *Tectonophysics*, vol. 11, pp. 5-27.

Kraig, D.E. (1974) Evolution of arc systems in the Western Pacific. *Annual Reviews of Earth and Planetary Sciences*, vol. 2, pp. 51-75.

Molnar, Peter, and Paul Tapponnier (1975) Cenozoic Tectonics of Asia: Effects of a continental collision. *Science*, vol. 189, pp. 419-426.

Plate Tectonics, Geosynclines, and Sedimentary Basins

With the formulation of the plate tectonic theory, the old (and misleading) concept of geosynclines was reinterpreted, and formation of sedimentary basins was explained according to plate tectonics.

Dietz, R. S. (1963) Collapsing continental rises: an actualistic concept of geosynclines and mountain building. *Journal of Geology*, vol. 71, 314-333.

Dewey, John F., & Bird, John M. (1970) Plate tectonics and geosynclines. *Tectonophysics*, vol. 10, pp. 625-638.

Dickinson, W. R. (1971) Plate tectonic models of geosynclines. *Earth and Planetary Science Letters*, vol. 10, pp. 165-174.

Dickinson, W. R. (1971) Plate tectonics in geologic history: New global tectonic theory leads to revised concepts of geosynclinal deposition and orogenic deformation. *Science*, vol. 174, pp. 107-113.

Concluding Remarks

The 44 above-mentioned articles are only a selection of publications from the 1960s-70s; thousands of research papers clarified various aspects of plate tectonics during the advent of this theory, spanning from mid-1950s through the mid-1970s. For a historical review refer to Cox (1973), Hallam (1973), and Glenn (1982). Classic papers in geology may be obtained from university libraries or accessed through Google Scholar, Geoscience World, Research Gate, and other online sites for scientific journals.

References

Cloud, Preston (ed.) (1970) *Adventures in Earth History*. W.H. Freeman & Co., San Francisco.

Cox, Alan (ed.) (1973) *Plate Tectonics and Geomagnetic Reversals*. W.H. Freeman & Co., San Francisco.

Glenn, William (1982) *The Road to Jaramillo: Critical Years of the Revolution in Earth Science*. Stanford University Press.

Hallam, Anthony (1973) *A Revolution in the Earth Science: From Continental Drift to Plate Tectonics*. Oxford University Press.

Mather, K.F. (ed.) (1967) *Source Book in Geology 1900-1950*. Harvard University Press, Cambridge.

Mather, K.F., and Mason, S.L. (ed.) (1939) *A Source Book in Geology 1400-1900*. Harvard University Press.

ATTENDING AIPG'S ANNUAL CONFERENCE

Article reprinted from the AIPG Arizona Section November 2024 Newsletter.

Aiden Houlgate, SA-12308, Northern Arizona University

The AIPG Annual Conference in Durango, Colorado, offered me, as an aspiring geologist, an educational and professional experience. From attending conference-sponsored field trips to networking with industry professionals, my time in Durango was critical for personal growth and development. I also participated in the poster competition, presenting my master's research on the impact of forest restoration in Arizona on shallow spring systems.

The conference began with an Early Career Professional (ECP) workshop, featuring a résumé information session and other valuable job application tips from current and former industry employers. I took the opportunity not only to network with fellow ECPs but also to absorb important job-search information presented during the seminar. One of the most valuable takeaways was the AIPG Mentoring Program. After the conference, I reached out to several industry geologists to learn more about their careers and ways to become involved as an ECP.

When in Colorado, hiking and exploring the outdoors is a must. During the conference field trip day, I joined a geologic tour through the Animas Valley, led by Fort Lewis College's Gary Gianniny. The excursion taught attendees about the region's rich geologic history and the significant role glaciers played in shaping the landscape around Durango.

A week packed with fascinating presentations from diverse geologists was ideal for a young, aspiring professional. Presenting my research poster at the conference provided a strong foundation for improving my public speaking and allowed me to gain

valuable feedback on my work. I hope to continue attending AIPG conferences throughout my career and to take full advantage of the institute's invaluable mentoring network.



In Memoriam

Eddie R. Haggard, CPG-04737

Houston, Texas

March 26, 2024

Member Since 1980

Obituary and photograph provided by Eddie's wife, and taken from the Houston Chronicle website.



Eddie Ray Haggard passed away on March 26, 2024, at the age of 78. He was born to John Yates Haggard and Betsy Bell Harrington Haggard on June 23, 1945. The Haggard family was part of the farming community in Plano, Collin County, Texas.

Eddie attended the Plano school system and in High School he excelled in the Future Farmers of America, serving as President, Vice President, and Secretary of the Chapter and District Vice President, and Area 5 Secretary. He competed in Showing his Registered Hereford cattle and Registered Suffolk sheep in the local, county, and Texas State Fair. His animals won many ribbons, and Eddie was awarded with a third, and two first place Dungan Awards in the three years of competition. Eddie was the recipient of the prestigious DeKalb Award and recognized by the National organization as a Star Chapter Farmer. Eddie received the Lone Star Farmers Degree in November 1963.

Upon graduation from Plano High School, Eddie enrolled at East Texas State University and pursued a double major Bachelor of Science degree in Technical Agriculture and Earth Science which was awarded at the end of the Fall semester of 1967. Eddie continued his education in East Texas State by pursuing a master's degree in Earth Science and Geography. He was also a proud member of Sigma Chi Fraternity and remained close with his fraternity brothers until his death.

While working towards a master's degree, Eddie was contacted by Inlet Oil Corporation and thus his career began which would span the next 46 years until he retired in June 2015.

Eddie's career with Inlet Oil began working in Mineral Exploration in Alaska and Oil & Gas Production in the British North Sea.

After Inlet Oil, he worked for De Goyler & MacNaughton, Southern Union Gas Company, H.J. Gruy and Associates, Keplinger and Associates, Natural Gas Pipeline Company of America, Challenger Minerals, Santa Fe Petroleum, and Capital Star Oil & Gas.

He also performed contract assignments for PennzEnergy, Mobil E&P, Albrecht & Associates, Arthur D. Little Inc., Ralph E. Davis and Associates, and Netherland Sewell & Associates. He evaluated producing and non-producing properties for commercial hydrocarbon production in the Gulf Coast, Mid Continent, Rocky Mountains, British, Dutch, and Danish North Sea, Indonesia, Australia and Columbia.

His expertise was geology, reservoir engineering, geophysics and petrophysics. He performed and supervised complex geological and reservoir evaluations for domestic and international oil and gas properties, including developing and evaluating prospects for lease acquisition, performing well site operations, preparing reserve estimates, fair market analysis, and appraisal reports.

Eddie was a Licensed Geologist by the Texas Board of Professional Geologists, and a Certified Petroleum Geologist through the American Association of Professional Geologists, and a Certified Professional Geological Scientist with the American Institute of Professional Geologists.

Eddie was an Emeritus Member of both the American Association of Professional Geologists and the Houston Geological Society. He was also a Senior Member of the Society of Petroleum Engineers of AIME and held active memberships in the Society of Petrophysicists and Well Log Analysts, and the Houston Geophysical Society.

Eddie is survived by his wife, Janet Elaine Haggard of 44 years. He was a devoted parent to his three daughters, Jennifer Frnka, Tara Sims, and Natalie Segovia; as well as a loving grandfather to Hannah Johnson, Romeo Segovia, Lorenzo Segovia, Sarah Moran, Laney Segovia, Lyssa Segovia, Cain Sims, Scarlett Frnka, Sawyer Sims, and Stone Sims. Eddie is also survived by his eldest nephew, Jeff Little, with his wife, Haley Little and two sons, Jake Little and Crew Little, and his youngest nephew, Jon Little.

Steven A. Chisick, CPG-06632

Carmel, Indiana

June 16, 1946 - September 3, 2024

Member Since 1984

Obituary provided by Steven's nephew Jay Sparling.

Steven Andrew Chisick, son of the late Steven and Helen Chisick, passed away September 3, 2024 in Chicago. Chisick was born June 16, 1946 in Cheverly, Maryland. He spent his formative years in Harrisonburg. He graduated from the Augusta Military Academy in 1964 and Madison College in 1968. During his college years, Chisick worked part-time as a cameraman at WSVN.

Chisick received a Ph.D. in geology from Rensselaer Polytechnic Institute. At the time of his death, Chisick was retired from an environmental cleanup firm in Chicago. He published several professional papers in his career field. Prior to earning his Ph.D., Chisick served in the United States Army in Vietnam, where he was recognized for valor in combat. After Vietnam, he taught for a brief period at Queen of Angels Catholic School in Fort Wayne, Indiana.

Chisick, who maintained close ties with his family and friends, is survived by seven siblings. A memorial service was held in Harrisonburg in October. Chisick loved Harrisonburg and its geology throughout his life, and he requested that his ashes rest in the Shenandoah Valley.

Michael B. Hoge, CPG-09368

Cincinnati, Ohio

July 9, 2024

Member Since 1994

No obituary available.

Wesley B. Dalton, CPG-09462

San Antonio, Texas

November 15, 1962 - January 14, 2024

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Obituary and photograph taken from the Porter Loring Mortuaries website.

Wesley Brandon Dalton, also known as “Wes” to many people that he grew up with, passed away at the age of 61 on Sunday, January 14, 2024 in San Antonio, Texas. He was born on November 15, 1962, in San Antonio to Juanita Ann Dalton and William Wesley Dalton. He is survived by his wife, Lesha; his stepson, Chandler Squires; his daughters, Kayci (Patrick) Sanchez and Delaney Dalton (their mother, Dana Keith); his grandson, Anthony “Tony” Sanchez, along with his mother, Ann (Walt) Dalton; his brother, Brad (Carol) Dalton; his stepmom, Kate Dalton; his stepsister, Gail (Guy) Condra; his goddaughter, Isabella Squires; and his pets, Barley and Moxie. Wesley is preceded in death by his father, William “Bill” Wesley Dalton. ...



Wesley went on to become an Aggie when he attended Texas A&M University, where he earned his bachelor’s degree in Engineering Geology. This was a big source of pride for Wesley as you could often see him wearing his Aggie ring and donning maroon and white clothing. Some of Wesley’s favorite college memories were made at the Dixie Chicken. Not one to rest on his laurels, Wesley later went on to earn his master’s degree at UTSA in Environmental Science.

In his professional life, Wesley served as an Environmental Geologist for companies like NCNB Texas, JM Waller, KEI Consultants, Chapman Engineering, AGEISS Environmental, and Booz Allen Hamilton. No matter where Wesley worked, his coworkers always referred to him as friendly, hardworking, caring, smart, and easy to get along with. Wesley often shared with his wife the importance of the work he was called to do. He felt blessed to be doing work that helped to make a difference for the environment.

Most recently, Wesley worked for the U.S. Air Force as a program manager and temporary branch chief. While Wesley did not have a long career with the Air Force, he was proud to be serving this branch of the military as a civilian. That pride shined through as he earned awards throughout his career. These awards always brought him a great sense of satisfaction that others had recognized his efforts.

Above all, Wesley was a family man at heart. Wesley loved to cook for family and his most requested dish was his brisket and beans. His mother, Ann Dalton shared that she knew that Wesley was always just a phone call away. As a son-in-law, Wesley was known to help his in-laws, Kasha and Richard Squires, with their technology and small projects around their house. Wesley and his brother enjoyed taking fishing trips with their father, Bill Dalton, to the coast or to God’s Lake in Canada. His daughters, Delaney, who he referred to as “Nay Nay” and Kayci, who he loved to call “Widget”, remember him as caring, always making the most of the time they had together, and telling them he loved them every chance he got. His stepson, Chandler, will miss his unwavering support, his gratitude for even the smallest acts of kindness, and his unmatched ability to bring out the best in all things. No matter what Wesley’s children dedicated themselves to (Chandler’s education at MIT, Delaney’s work at Toyota and role as an aunt, or Kayci’s service in the Navy and then as a stay-at-home mom), Wesley was cheering them on every step of the way. Even Wesley’s

friends often referred to him as a brother because of his genuine warmth and concern for them.

At the cornerstone of Wesley’s family life was his devotion to his wife, Lesha, over 15 years of marriage. Wesley and Lesha’s love story started 18 years ago through a dating app. To listen to them tell the story of their first date, one had to believe that these two were meant to be together no matter what. Lesha shared that what made Wesley a great husband was his belief that love never fails, his generous acts of service, the way he infused goofiness into the mundane, and the support that he always showed Lesha. He had a gift for sharing words of affirmation, always letting Lesha know that she was the “total package” and “the yin to his yang.” Lesha will remember Wesley as smart, handsome, loving, adventurous, and always protective of her soul. Anyone who knew Lesha and Wesley knew the fun that they had together and how many happy memories he is leaving her with.

A major part of Wesley’s life was his involvement with his Catholic faith. He was an active Core team member of the Christ-Centered Marriage Ministry at Holy Trinity, a proud member of the Knights of Columbus, a Eucharistic minister, and a recurring participant in ACTS retreats. Wesley and Lesha loved the Sacrament of Marriage and the opportunities it provided for them to make some of the best friends of their lives.

Wesley’s family hopes that people will remember the wonderful, multidimensional man that Wesley was. Wesley’s passion for tinkering with things showed up in his love of restoring John Deer tractors. His sense of humor could bring a smile to anyone’s face, converting many to love silly movies just as much as he did. He had a passion for music, embodied by his love for the Beatles, live music, and playing the guitar. He was an avid boater and loved to be out on the water at Lake McQueeney and Canyon Lake. Wesley’s love of nature was also evident in the time he spent out on his deer lease, the joy he found in snorkeling, the many bike rides he shared with his wife, and his still childlike awe over natural rock formations. Wesley often attempted to capture the beauty of people and nature through his photography.

While Wesley is taking his sense of humor with him to heaven, we must find ways to hold onto the happy memories he gave us, whether it be the next time we enjoy a good craft beer, hear a Beatles song, watch Napoleon Dynamite or Nacho Libre, or simply stand in awe of nature’s beauty. Wesley’s smile, his hugs, and his quick wit will be greatly missed by all who knew and loved him. May he Rest in Peace.

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