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THE PROFESSIONAL GEOLOGIST

VOLUME 62 NUMBER 3 JUL.AUG.SEP 2025

Student Scholarship Winners

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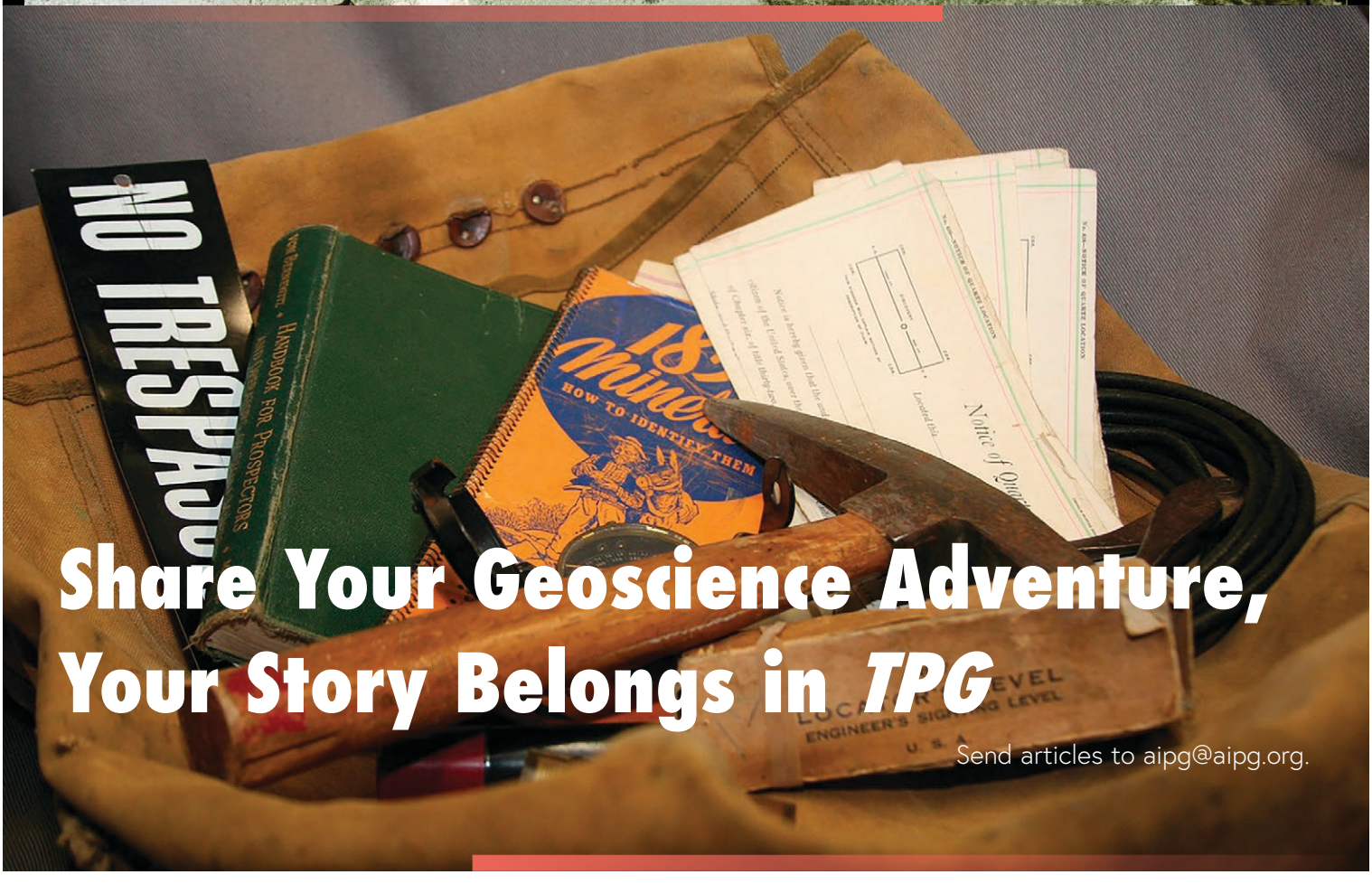
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On the Cover: 2025 Photo Contest Winner - Off the Beaten Path - Pegmatite Cascade

Description: ***Pegmatite Cascade*** – Early Proterozoic (~1800 Ma) metasedimentary and metavolcanic rocks are exposed in Rist Creek Canyon west of Fort Collins in Colorado's Front Range. The lower part of the canyon consists primarily of quartzofeldspathic gneiss and mica schist. Pegmatite veins are visible in isolated areas, and I was fortunate to discover this uniquely spectacular exposure in a side wall above the creek. The fantastically contorted pegmatite vein displayed on the outcrop mimics a waterfall splash into a pool.

*Photograph by **Carl F. Brink, AS-0057,** AIPG Michigan Section, 2018.*
2025 Photo Contest:Off the Beaten Path. Runner Up on page 5.

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Back Cover	New Certified Professional Geologists

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We Need YOU!

Adam W. Heft, CPG-10265

I hope you are all enjoying your summer, which is well underway by now. I hope all of our CPGs, ECPs, and Professional Members exercised their voting privileges to help elect next year's Executive Committee members. It is important that you vote for your choice of candidates to help direct the way our organization will move forward. Also, please consider attending this year's Annual Meeting, which will be held in St. Louis, Missouri this October. In addition to some fantastic field trips and a day's worth of technical presentations, I urge you to attend the business meetings that are held on Saturday. This allows you a glimpse into what initiatives the Executive Committee is working on but also allows the committee members and your peers to get to know you. Perhaps one day you will want to stand for election and giving other members a chance to know you will put you in good stead for their consideration.

This edition of *TPG* includes the annual undergraduate student scholarship essays on why those students want to become a geologist. Ten scholarships were funded in part by the Foundation of the AIPG at the National level, and four additional scholarships were supported by AIPG Sections (Michigan and Ohio). Be sure to check them out and see what you think of this year's group of recipients. The essay for the recipient of the Siok Scholarship for graduate students is also presented.

We have a couple of good articles for your reading enjoyment this issue. **Rita Teal**, CPG-12006, submitted an article on "Multivariate Simulations in Complex, Non-Stationary Domains," and **Mark Howell**, CPG-09563, submitted "AI Bots Joining Your Calls." In addition, we have some *Tales from the Field* submittals. Please keep the content coming! I know it is summertime, and many are enjoying vacations or are heavily involved in fieldwork as part of their regular jobs. But please make some time to become involved in AIPG's activities; whether that be by submitting content for future editions of *TPG*, or participating in one of our committees, or something else, your involvement is needed like never before.

I'm curious as to whether and to what degree you, our reader, peruse each issue of *TPG*. I know that there are a small number of members who read each edition of *TPG* cover to cover. Not all in one sitting perhaps, because that takes time, but they do make it a priority to get through it. I know this because I hear from some of them (in person or via email) and they sometimes ask about some relatively obscure piece of information contained in a particular edition. I also know that a larger number of members do not read it at all. This is unfortunate, because in addition to good technical content or opinion pieces, there is also important information that members should know about included in each issue.



Most members, it seems, read portions of each edition. Whether that be a particular technical article, one of the *Tales from the Field*, or whatever, they read what interests them and no more. Hopefully, in addition to the articles of interest that each member read the columns by the President and the Executive Director as well as this one.

If you have, you will have noticed that our President has issued a Call for Action to our members to help find a way to restore the public's trust in science by being trusted experts and communicators in our subject matter. This will help to empower informed decision making and pave the way for scientific integrity to guide national and global progress. In this issue, our President has expanded on her Call for Action; she is proposing to establish a new collaborative effort to put AIPG at the forefront of the struggle to combat misinformation in the geosciences. The geosciences are indispensable and of critical importance to our society in many ways, and yet, the general public and even our decision makers do not seem to understand this.

This is liable to be a monumental effort, but it is one of the reasons why AIPG was created in the first place. And because it will be such a large effort if we are going to be at all effective, we will need everyone's help and ideas. As an organization, we are stronger together than we are individually, and likewise, if we can enlist the help of our sister organizations, we will be stronger still. There is strength in numbers, but each is important and helps raise the bar. Please join us!

Dear Mr. Heft:

I am always amazed by the broad knowledge of the geological sciences displayed by Dr. Robert G. Font in his *Test Your Knowledge* page. It shows me pretty much each time how little I know. However, I take issue with question #1 on page 36 of the AIPG's APR.MAY.JUN 2025 issue. I thought referring in the accompanying figure to the igneous intrusive body D as a sill was a printing error. If not, the question is a silly one. Intrusive D clearly is a dike and not a sill, which all of us know is a more-or-less horizontal igneous intrusive body. Intrusive D therefore is the youngest geological rock-unit in the figure depicted.

Sincerely,

Dr. Erik H. Schot, MEM-2189

Dear Dr. Schot,

Our AIPG Editor, Adam Heft, forwarded to me a comment you had on question 1 on the latest issue of the TPG. I purposely mislabeled the youngest intrusion as a sill, knowing well that it was a dike. I wanted to make sure that people actually paid attention to the section. The mislabel made that choice the obvious answer to the question. I did my best to explain that clearly in the answer that I wrote. You are absolutely correct in your assessment of the intrusion being a tabular discordant pluton and the youngest unit in the section. Maybe I should have framed the question differently to avoid confusion. Hope that this explains my aim. In any event, thanks for your input. Feel free to contact me at any time. My best!

Robert Font, PhD, CPG-03953

Good afternoon, Robert

I am a young geology consultant with WSP who just joined AIPG this year. I just wanted you to know that I greatly enjoyed your *Test Your Knowledge* quiz on page 36. In particular, it is the first time I've been exposed to the style of legal description you covered in question 4.

Thank you very much, you've given me something new to study and put a smile on my face today.

John Timmers, MEM-3754

Hello Robert,

I'm a longtime AIPG member who greatly enjoys your quizzes ...dude, I only get 80% right most of the time! And count myself lucky at that!

Having gone to UT Austin and living there I was steeped in the Del Rio Clay and glorious stories from my profs of ground stability issues related to it. I have kept several friends from buying houses on it...and the slightly younger Taylor which behaves similarly. I have also experienced it in Big Bend and down into central Chihuahua. This all means I greatly enjoyed your recent PG piece on the formation....thanks!

Thanks to your quizzes I have grown to appreciate your attention to detail, so my knee jerked in reaction to a minor detail in your paper...As I remember (and confirmed with a cursory search on line) Exogyra arietina was renamed Il(y)matogyra arietina sometime before I started UT in 1972. Not being a paleontologist the reasons for the change seem arcane, but no weirder than more familiar renaming of mineral species.

Until they paved it over there was a spectacular roadcut exposure of DRC in south Austin where you could collect pyritized Ia by the handful...and if you got lucky 3cm pyritized ammonites and echinoderm spines. I took generations of kids out there to fill their pockets... hoping the Clay was dry enough not to swallow them whole!

Anyway, the naming issue in no way diminishes my enjoyment of your excellent study...just thought you might want to know. (I might not be surprised to learn the name had been changed back!)

Cheers and thanks for the brain teasers... they say such things stave off memory loss, so please keep it up!

Peter Megaw, CPG-10227

My thanks to Peter K. Megaw, Ph.D., CPG-10227, for pointing out to me that a key fossil in the Del Rio Clay of Texas has been officially renamed. The former Exogyra arietina is renamed as Ilymatogyra arietina.

The change reflects more detailed characteristics of the shells as well as evolutionary considerations and connection to Exogyra plexa (Stenzel, Henryk B., "Treatise on Invertebrate Paleontology - Oysters", 1971; Finsley, Charles, "A Field Guide to Fossils of Texas", 1999). The "ram's horn oyster" is a key component of the fauna of the formation.

Robert Font, PhD, CPG-03953

South Dakota Section's **Foster Sawyer, CPG-10,000** shared a photo of the AIPG Booth at the 2025 Western South Dakota Hydrology Conference in Rapid City, South Dakota.

Gary Haag, CPG-07667 (left) and **Mark Nelson, CPG-09698** (right) staffed the booth informing attendees about the importance of AIPG and our advocacy for the profession.

Thank you to Foster, Gary and Mark for representing AIPG at this well-attended event on April 10, 2025 in South Dakota!

Note: AIPG Headquarters staff will send the banner and great giveaway items for booths. Please contact them for details!



Right Photo Contest Entry:

Runner Up: 2025 Photo Contest - Off the Beaten Path: Luke Ducey, Mem-3696, Missouri Section, 2023.

Description: ***Geology Hides... But the Geologist Finds*** – This is a photo I took while working in Baltimore, MD doing some field mapping to locate the Baltimore Gneiss which is a Precambrian metamorphic formation that was created sedimentary and igneous rocks were transformed. The photo shows the 1,100 million year old gneiss with weathered saprolite on top of it in the lighter tan color.



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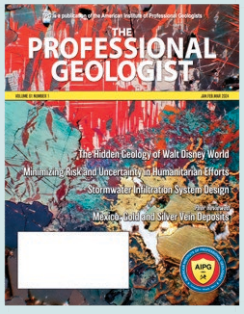
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Data Analysis for Multivariate Simulations in Complex, Non-Stationary Domains

Rita M. Teal, CPG-12006, Albuquerque, New Mexico

Abstract

Gaussian simulation quantifies uncertainty to support risk-informed decisions by generating multiple realizations at unsampled locations while accurately reproducing the statistical properties of the data. Because geostatistical simulation assumes strong stationarity, it is important to address any trends before conducting simulation. Not addressing this issue may lead to poor data reproduction, negatively impacting resource evaluation. These methods are critical for modeling complex polymetallic mineral deposits in non-stationary domains.

This article presents an overview of the required data evaluation before performing simulation, including exploratory statistics, spatial analysis, and stationarity assessment. The case study focuses on a complex polymetallic deposit in the Americas, using a breccia and quartz-sericite-pyrite (QSP)alteration domain as a representative example.

The analysis includes univariate and multivariate statistics, visual inspections, and assessment of stationarity. Tools used to evaluate grade patterns, relationships, and trends include histograms, scatter plots, swath plots, probability plots, contact plots, and experimental variograms. Finally, the standard multivariate simulation workflow is summarized to provide context on how these evaluations impact domain selection, the decision of stationarity, and simulation results.

Introduction and Background

Gaussian simulation is one of the preferred techniques used to quantify uncertainty. Simulation better reproduces sample data than estimation methods by generating multiple realizations, each representing a possible scenario of what could be present within unsampled areas. Natural phenomena such as mineral deposits have multivariate characteristics, with multiple metals that often coexist and are correlated. Multivariate simulation is critical in resource modeling, particularly in polymetallic deposits. The objective is to simulate multiple variables while preserving their relationships in the results. A reliable simulation must reproduce the histogram, variogram, and multivariate relationships. Otherwise, it might affect resource assessment and lead to misinterpretation.

Geostatistical simulation assumes stationarity, meaning the mean, variance, and variogram do not change across the domain under evaluation. However, an overall trend violates the assumption of stationarity, making geostatistical modeling more challenging (Qu, 2018). Trends in the data are common in geological phenomena, such as mineral deposits where metal zoning is typical. This can lead to undesired simulation results, including poor data reproduction. This is typically addressed by applying trend modeling followed by trend removal. Afterward, Gaussian simulation can be performed on the residuals. During the back-transformation, the trend is reintroduced into the simulated realizations.

Performing an accurate multivariate simulation starts with more than just the simulation process itself. Preparatory steps are also critical for obtaining reliable results. Some general steps for data review and preparation include examining the drill hole database along with the geological domains and identifying incongruencies, errors, and data biases, critical in this stage. Data should be located within an accurately defined coordinate system. Also, as standard practice, all numerical data, such as assays, are standardized by using the same support volume, so that compositing is completed during this stage. Grade capping is typically performed to manage the presence of outliers. This is done in the univariate space. Because spatial data is rarely collected evenly, declustering is needed. High-grade zones tend to be oversampled, and declustering assigns weights to correct this imbalance. Also, the declustered statistics will be used to compare the simulation results against the original sample data.

Once data is prepared and cleaned, data analysis can be conducted. This involves both univariate and multivariate analysis. This process helps in the understanding of variable distributions, spatial continuity, and multivariate relationships. Both categorical and numerical variables are reviewed during this process. For instance, within the deposit or project under review, the data analysis should start with a general knowledge of the statistical variations between lithology and alteration domains. Understanding the controls of mineralization should be one of the goals. Subsequently, the focus of the analysis should shift to each domain or group of domains. A key analysis goal is to determine the final domains to be used for estimation or simulation.

An important extension of data analysis is trend detection. Trends in the data are usually observed in mineral deposits. They can be recognized by first visualizing the data in 3D or 2D. However, it is critical to assess how strong these trends are within the domains under evaluation. Strong trends could significantly impact variogram modeling, trend modeling, and decorrelation methods, among some steps, before performing Gaussian simulation. Several tools can be used to evaluate non-stationarity, allowing for a well-informed decision regarding stationarity before

performing simulation. Accurate stationary assessment, along with proper univariate and multivariate data analysis, directly impacts simulation results, including data reproduction.

A large polymetallic orebody located in the Americas serves as the basis for this analysis, offering a representative example of non-stationary domains. In this deposit, epithermal-style, polymetallic mineralization occurs primarily as disseminations and veinlets containing gold, silver, lead, and zinc, hosted within a breccia complex. A series of North-South, westerly looking cross-sections of the drill hole datasets are shown in Figure 1 to highlight the relationship between geology, alteration, and grade distribution for Au, Ag, Pb, and Zn. In the top left section, the drill hole traces are color-coded according to the lithology model, they include breccia complexes shown in pink; sedimentary units represented in blue and green; and replacement skarn zones, which primarily affect the sedimentary units shown in brown. At depth, intrusive units are illustrated in orange. The top right cross-section displays the alteration, with zones of strong QSP alteration shown in an intense orange, mostly restricted in the central portion of the breccia complex. Lighter shades of orange correspond to areas of moderate QSP alteration. This alteration type, along with the main breccia complex, is a strong indicator of polymetallic grades. In the cross sections showing Ag, Pb, and Zn, higher-grade areas are highlighted in green and yellow, mimicking mineralized zones in each section. While at the same time, Au distribution exhibits a slightly different pattern.

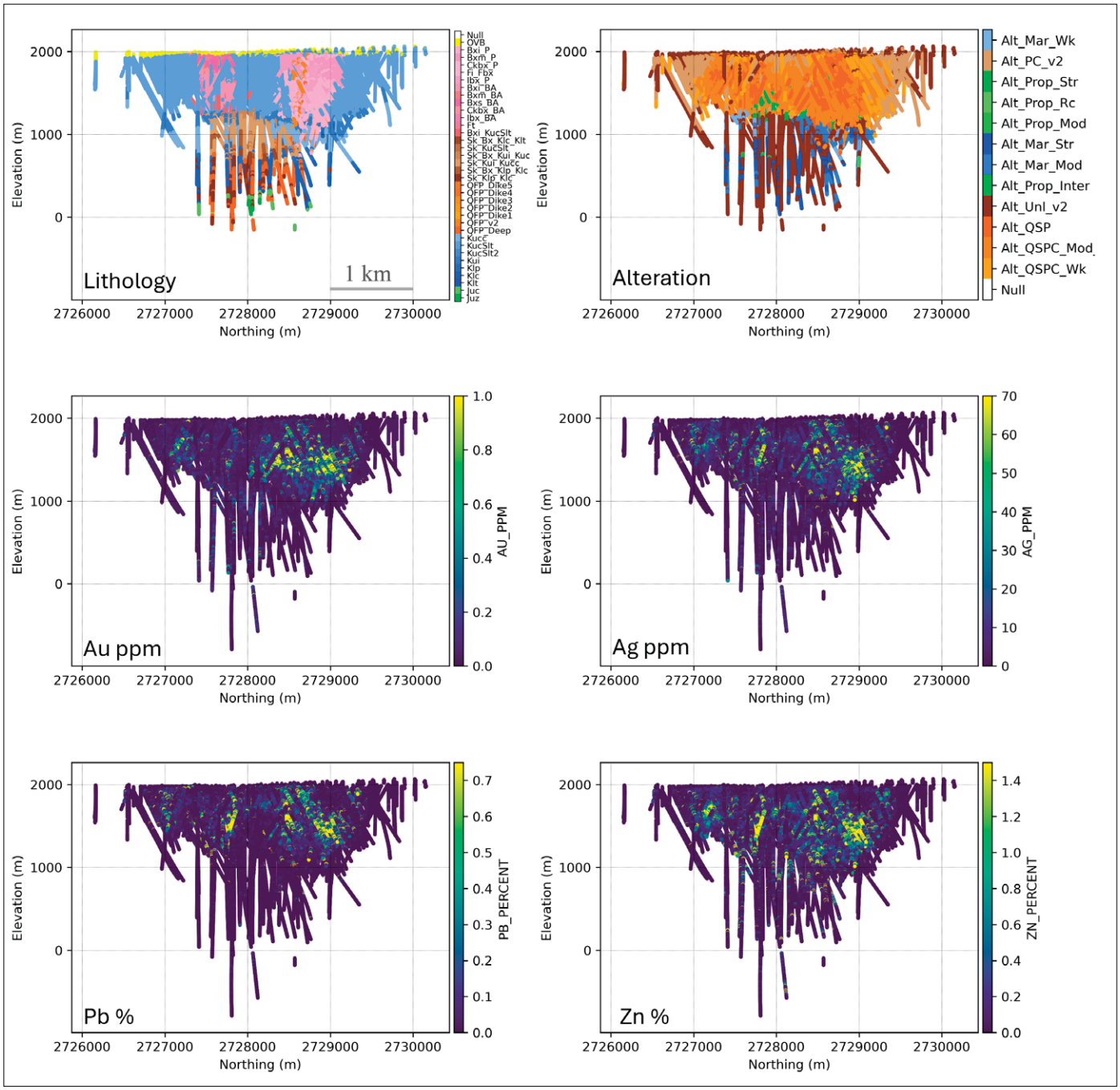


Figure 1. North-south cross sections showing lithology, alteration, Au, Ag, Pb and Zn grades for the study area.

Box plots are useful tools for comparing data sets, such as numerical and categorical variables, to visualize their relationships. Figure 2 shows box plots of lithology and Au grades. The X-axis displays the various lithology domains within the deposit, while the Y-axis shows the Au grades on a logarithmic scale. Each box plot features a red dot that indicates the average Au grade. Most breccia phases, highlighted in pink within the main breccia complex, contain the highest mean grades. The Au values are shown before capping to highlight the large number of outliers, which are displayed as gray dots, predominantly within the upper quartile. The presence of numerous outliers is a characteristic feature of this deposit. The same pattern is observed for Ag, Pb, and Zn grades.

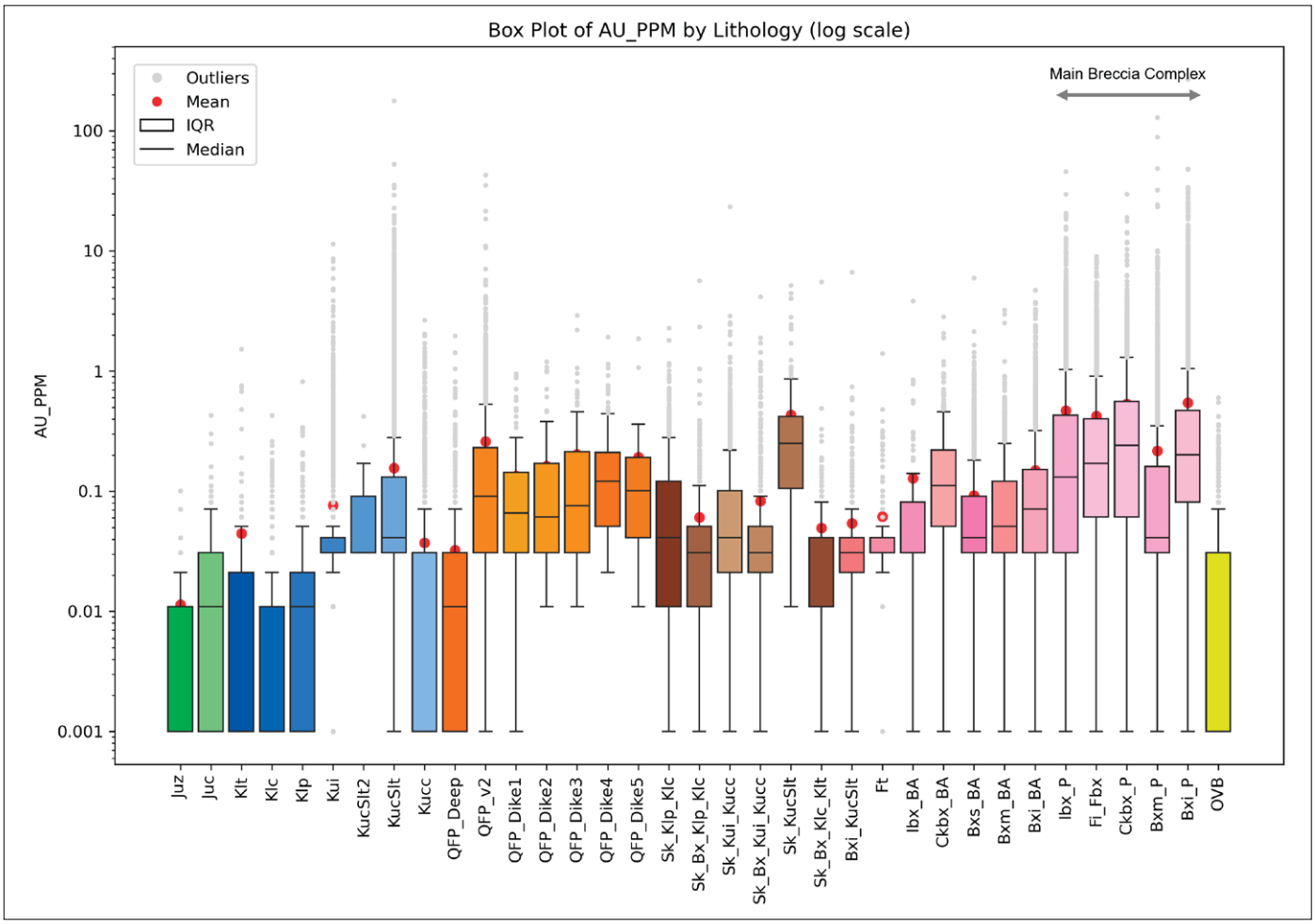


Figure 2. Box plots of gold grades by lithology domains.

Considering both grade and volume, the intrusive breccia (BXI_P) with strong QSP alteration was selected as the most representative domain for this data analysis demonstration. For the stationary assessment, the breccia complex domains will also be used.

Data Analysis

TThe BXI_P domain, with strong QSP alteration, includes 7,946 samples (4 m composites) with assays for Au, Ag, Pb, and Zn, all equally sampled (homotopic data). Au and Ag values are shown in ppm, whereas Pb and Zn are shown in percentage. Two main drilling methods were used: diamond core drilling (DDH), which was more predominant, and reverse circulation (RC) drilling, used less frequently. Drilling occurs over an area of 800 m by 800 m, extending to 1,200 m depths that include both vertical and inclined orientations. Drilling forms an irregular pattern, with an average spacing of 30 m. The domain's eastern side has a closer spacing, including a circular pattern near its boundary (Figure 3). Drill collar locations are color-coded by drill spacing (m), with dark blue representing spacing as close as 15 m. An inverse distance declustering approach was applied to obtain representative statistics for each variable.

Univariate Data Analysis

Univariate statistical analysis includes data visualization in 2D and 3D, along with important tools such as histograms, cumulative distribution functions (CDFs), probability plots, box plots, and swath plots. These tools are critical to help understand data distribution and spread, as well as to identify residual errors or spikes in the data. Outlier detection is commonly performed during this stage, when each variable is analyzed independently, and then grade capping is applied. Also, summary statistics are calculated, including the mean, median, standard deviation, and percentiles (P10, P90).

The spatial grade distribution within the BXI_QSP domain reveals some patterns across elevations. Figure 4 shows 3D views of the grade distribution for Au, Ag, Pb, and Zn within this domain, outlined in gray. These grade distributions vary significantly, particularly with respect to elevation. The highest-grade of Au (>1.0 ppm), Ag

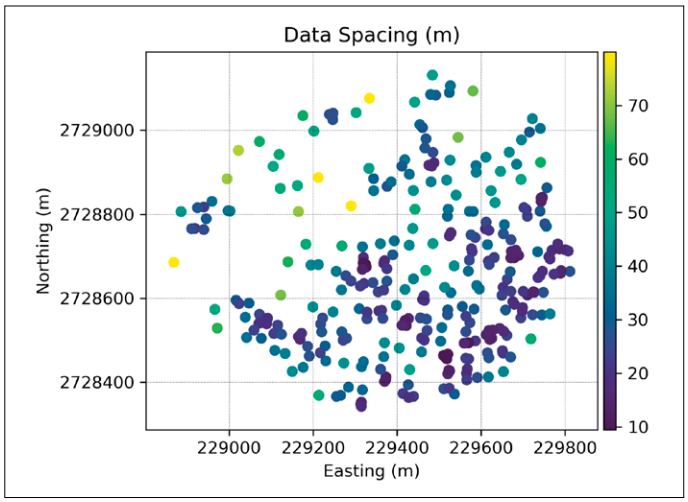


Figure 3. 2D plan view of drill collar locations, color-coded by data spacing.

(>30.0 ppm), Pb (>0.75%), and Zn (>1.0%) are illustrated in magenta and generally occur between 1,400 m and 1,650 m elevations. Silver shows the highest-grade concentration between 1,800 m and 1,900 m, while forming a cupola-shaped geometry. Outside of this cupola, grades tend to decrease significantly. Although there are some similarities in the grade distributions of these variables, each shows a distinct spatial pattern. Notably, limited sampling is observed at the base of the domain. In summary, Au, Ag, Pb, and Zn grades exhibit strong non-stationarity, with Ag showing the most pronounced trend.

The swath plots presented in Figure 5 reinforce the previously described grade distribution patterns. In these plots, the X-axis represents elevation (in meters), and the Y-axis shows metal grades for Au, Ag, Pb, and Zn. The black line indicates the mean grade within each 50 m elevation slice. The shaded pink region highlights the elevation interval associated with higher-grade values. As noted earlier, Ag exhibits a more noticeable difference compared to the other variables, while Au shows a consistent drop in mean values at higher elevations.

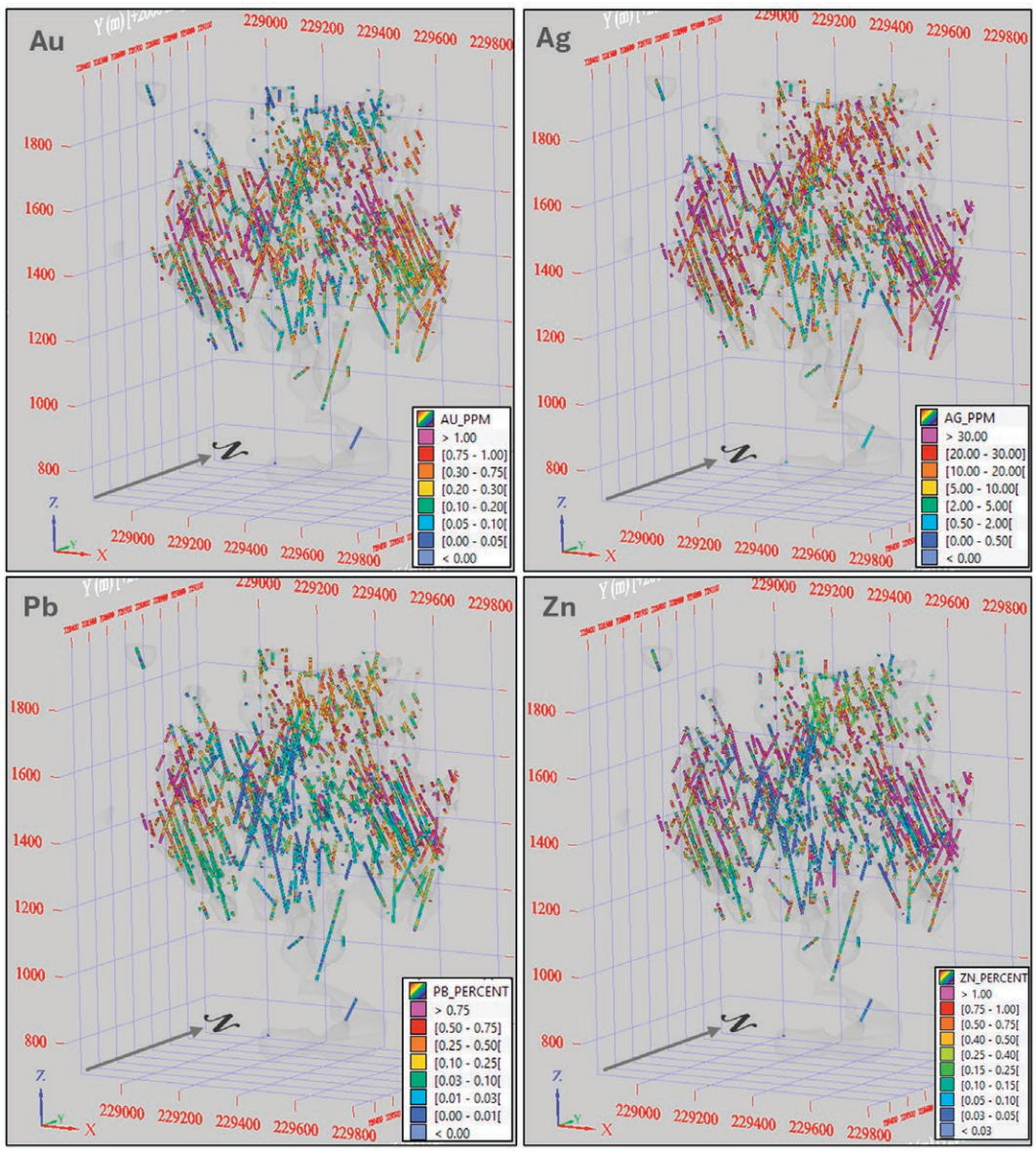


Figure 4. 3D views of drillhole assays for Au, Ag, Pb and Zn.

At a detection limit of 0.025 ppm, 238 repeated values occur within the Au dataset (Figure 6), making despiking necessary. This process addresses repeated assay values, commonly referred to as spikes, often resulting from detection limits. Spikes are common in geochemical exploration datasets and require careful transformation. These values can distort statistical analysis (Pyrcz & Deutsch, 2018).

The metal grades under evaluation exhibit positively skewed distributions, with Ag being the most skewed. Figure 7 shows the clustered and declustered histograms on a logarithmic scale. Each histogram presents key summary statistics that help interpret the distribution, including the mean, standard deviation, coefficient of variation, and percentiles, among others. The maximum values reflect the capped grades. The declustered mean values are 0.69 ppm for Au, 30.88 ppm for Ag, 0.29% for Pb, and 0.75% for Zn. However, these means do not represent the higher-grade zones (shown in magenta) or the lower-grade zones (shown in blue) in Figure 4. Using these means in Gaussian simulation would result in overestimation or underestimation of the high-

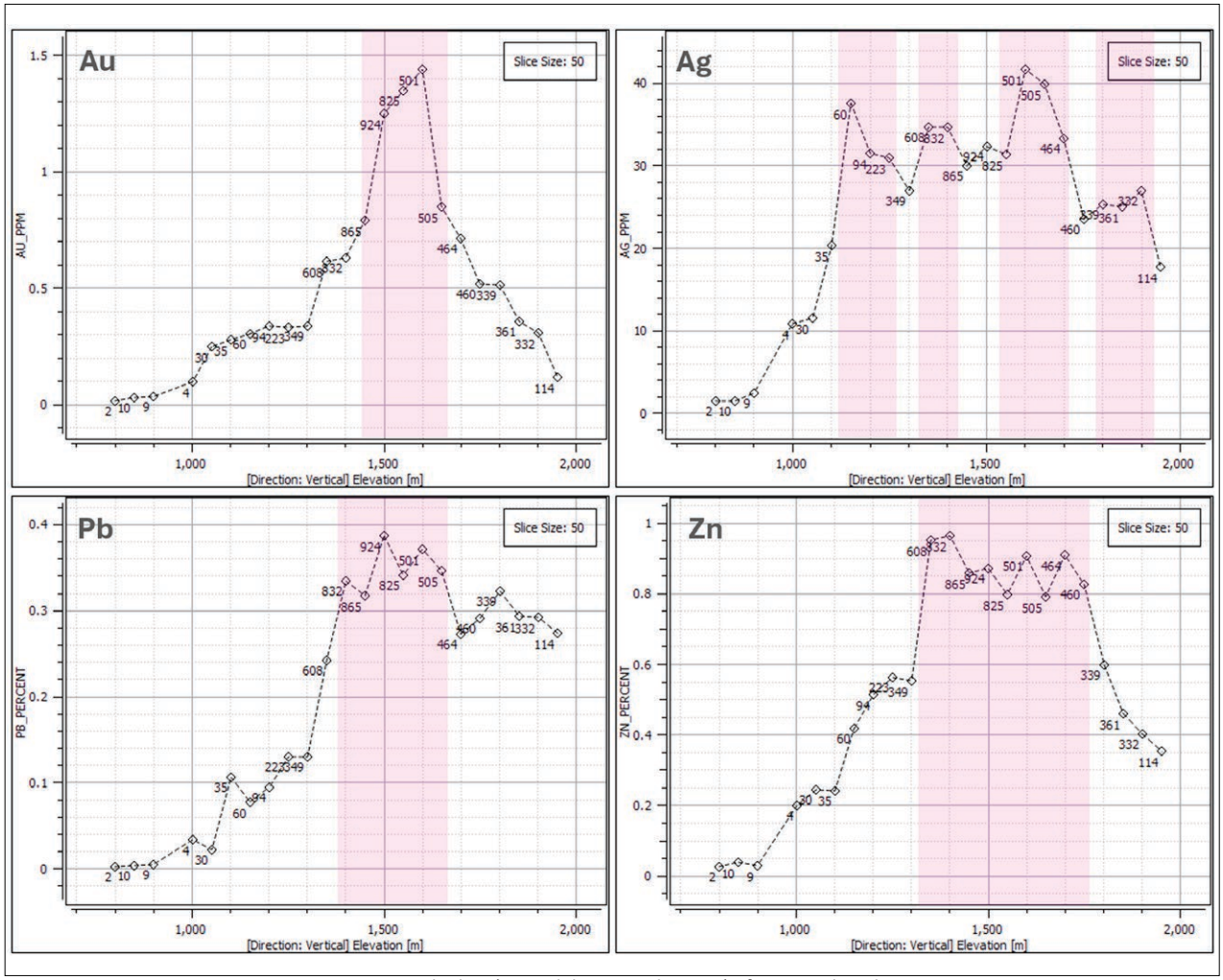


Figure 5. Swath plots (vertical direction-elevation) of Au, Ag, Pb and Zn.

grade and low-grade zones. In conclusion, trend modeling is necessary to obtain reliable results.

Multivariate Data Analysis

Multivariate statistical analysis examines the relationships between two or more variables to identify patterns, correlations, and dependencies. Most natural phenomena, such as polymetallic deposits, do not exhibit purely linear relationships; instead, they often display complex and non-linear behavior. In multivariate simulation, one of the goals is to reproduce these relationships along with the correlation coefficients observed in the sample data. Scatter plots and correlation matrices are useful tools for quickly identifying associations and patterns. Correlation coefficients primarily characterize linear relationships and may not fully capture the complexity of non-linear interactions often seen in mineral deposits. Spearman (rank) correlation is less sensitive to outliers than Pearson (Rossi & Deutsch, 2014). After capping, differences between Pearson and Spearman correlations can indicate whether any outliers remain. Principal component analysis (PCA), a dimension-reduction method, is also used to evaluate multivariate structure and redundancy in the data.

Scatter plots and correlation coefficients help to evaluate the relationships between these variables. Figure 8 illustrates scatter plots of the declustered values showing the complex, non-linear relationship. Kernel density estimation (KDE) color-codes the scatter plots to show data density and underlying patterns.

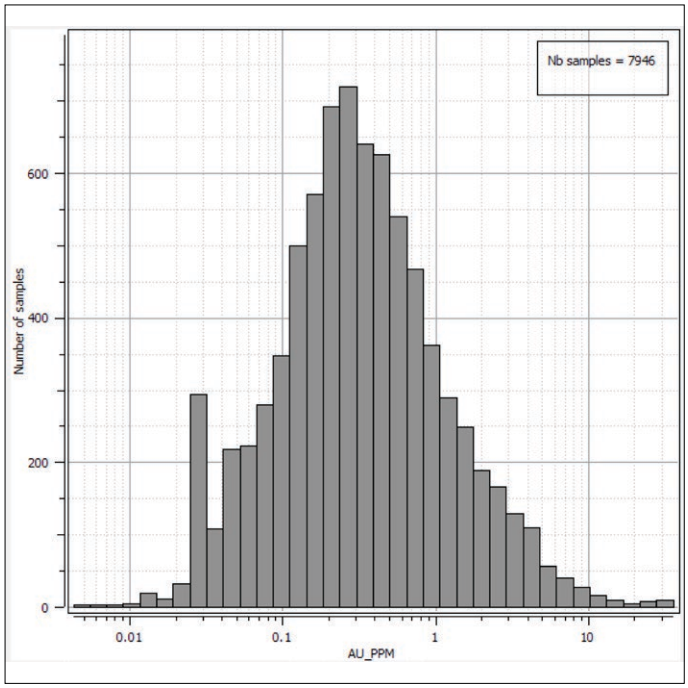


Figure 6. Histogram of Au grades (log scale) in the BXI_QSP domain.

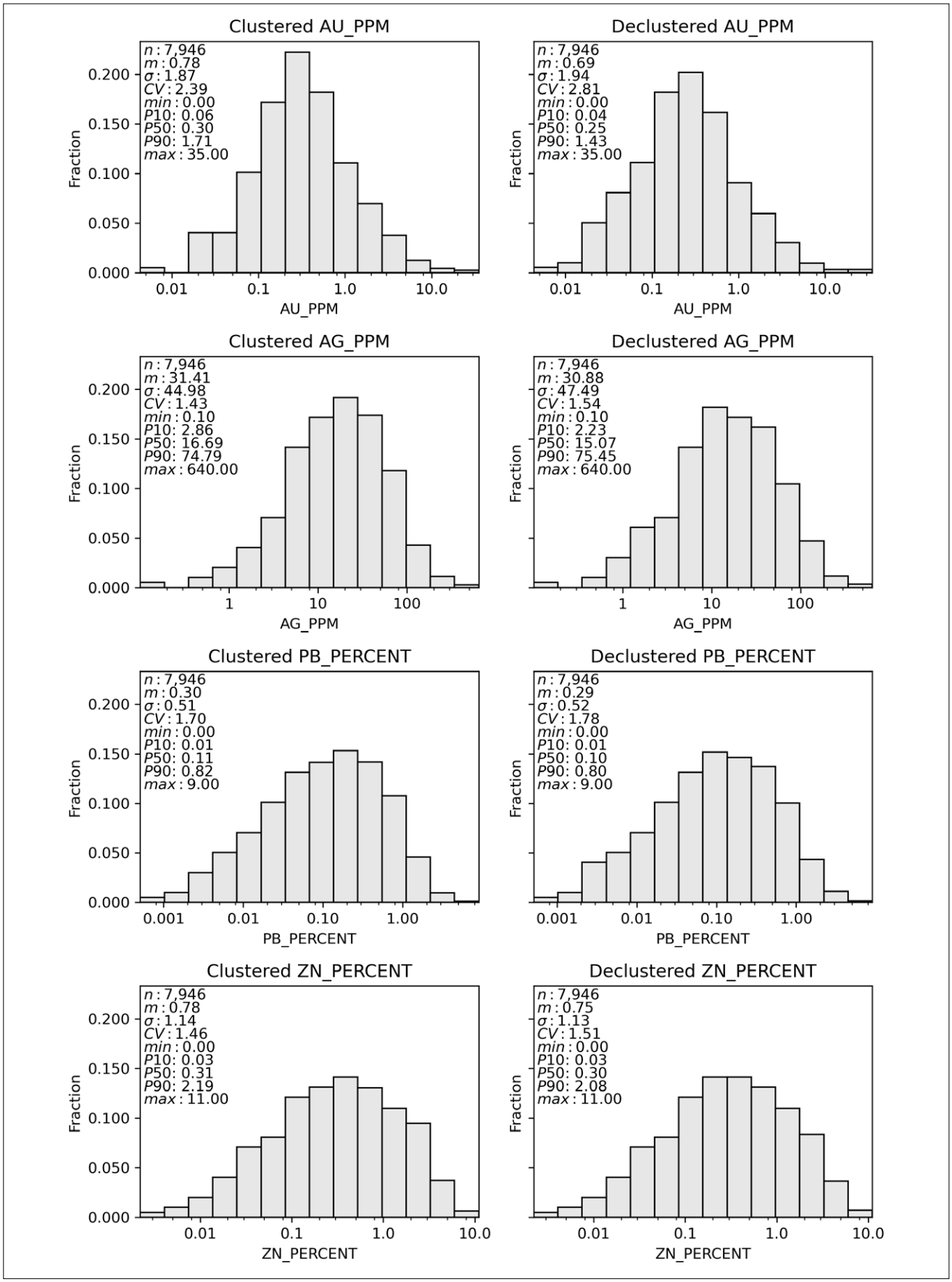


Figure 7. Clustered and declustered histograms and summary statistics for Au, Ag, Pb and Zn.

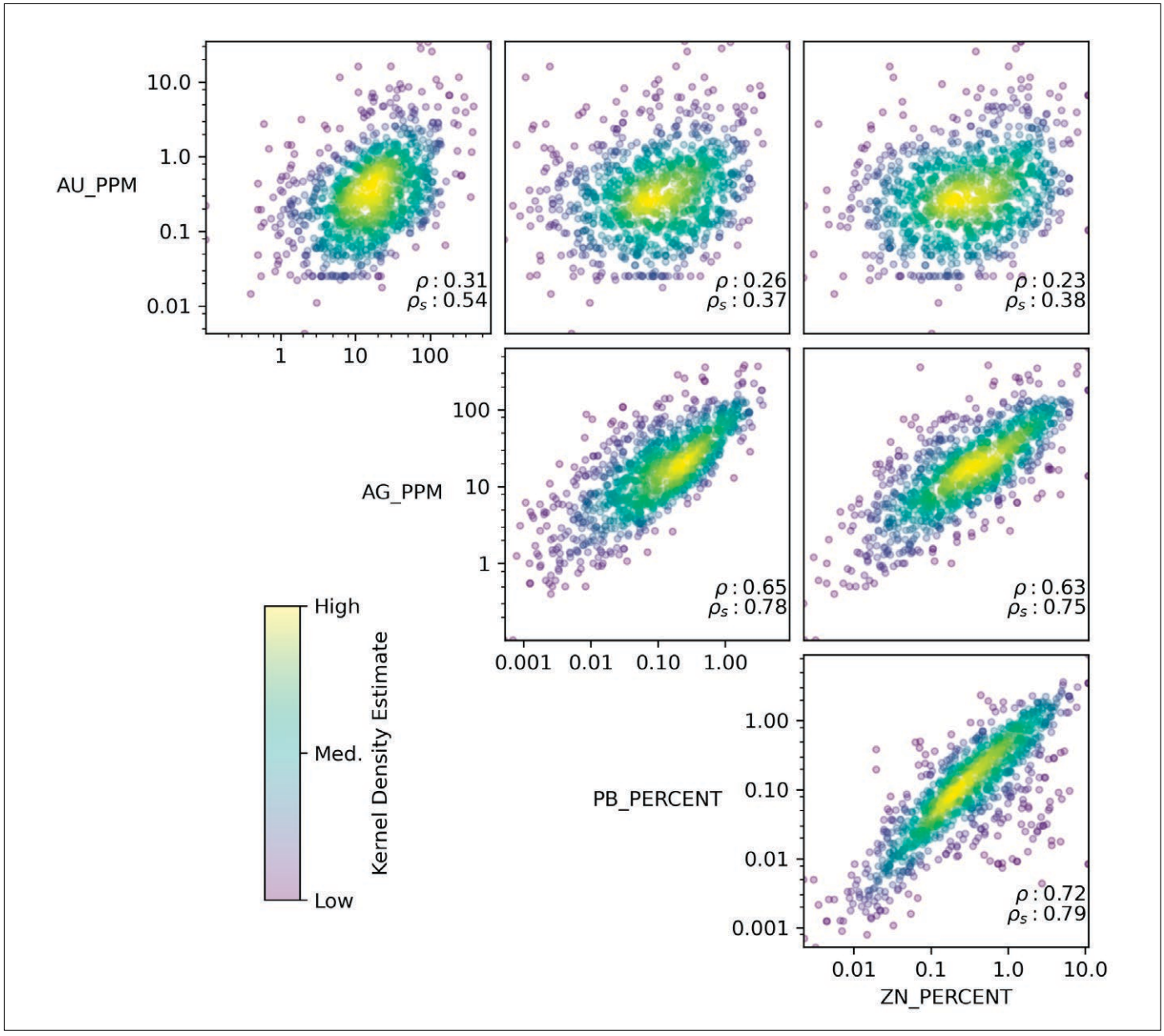


Figure 8. KDE scatter plots for declustered values of Au, Ag, Pb, and Zn.

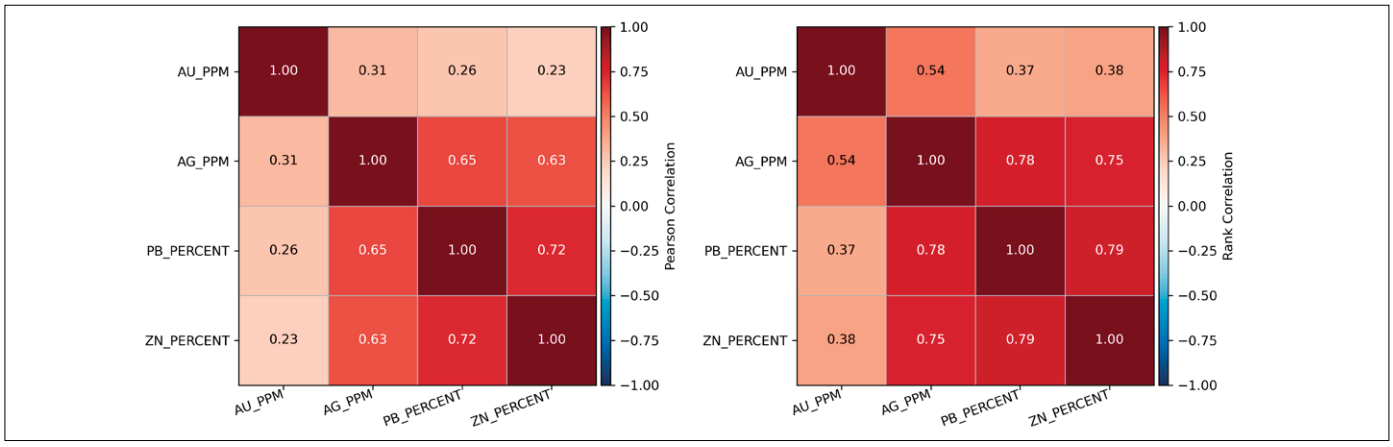


Figure 9. Pearson correlation and Rank correlation matrices.

Pearson correlation between Au and Ag, Pb, and Zn is relatively low, with values of 0.31, 0.26, and 0.23, respectively. Compared to Pearson, the Spearman correlation values of 0.54, 0.37, and 0.38 are slightly higher. On the other hand, Ag shows a moderate correlation with Pb and Zn, with Pearson coefficients of 0.65 and 0.63 and Spearman values of 0.78 and 0.75, respectively. Pb and Zn show the strongest correlation, with a Pearson correlation of 0.72 and a Spearman correlation of 0.79. Also, a few scattered points outside the main data cluster may represent outliers that were not identified through the univariate capping approach. This further justifies the use of both Pearson and Spearman correlations, as the latter is less sensitive to extreme outliers.

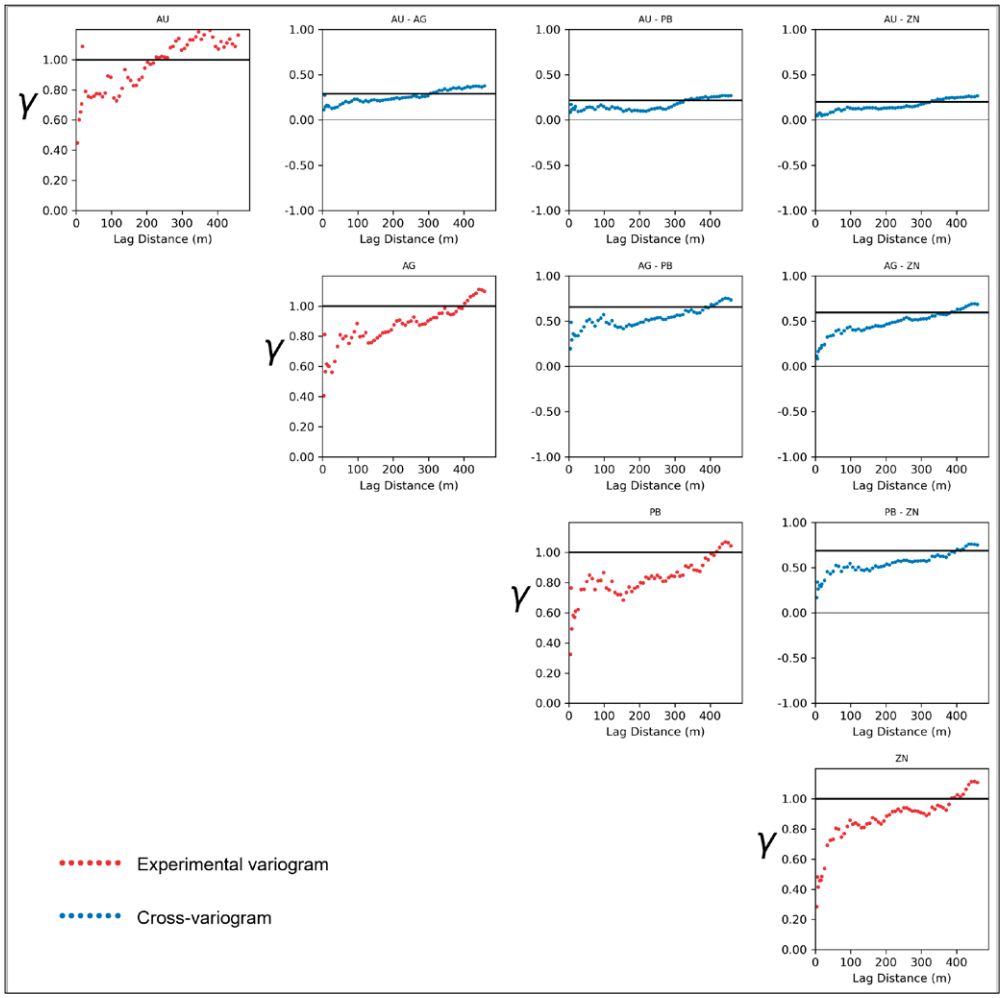


Figure 10. Variograms and Cross-variograms for Au, Ag, Pb, and Zn.

Correlation matrices for both Pearson and Spearman rank correlations are shown in Figure 9. These matrices provide a quick way to compare correlations across all variable variables.

Spatial Variability

Breccia-hosted domains typically show weak anisotropy, as seen in the BXI_QSP domain. Spatial variability was evaluated using isotropic variograms and cross-variograms for Au, Ag, Pb, and Zn (Figure 10) to understand how continuous or discontinuous the variables are. The red points represent experimental variograms, while the blue points correspond to cross-variograms. Au has the shortest range of any of the variables; the second structure reaches the sill at a distance of about 200 m. In contrast, other variables show a larger range of approximately 400 m. Higher nugget effects are observed for Au and Ag (~0.4), compared to Pb and Zn (~0.2), suggesting more short-scale variability for Au and Ag. These cross-variograms reinforce the relationships described in the scatter plots, for example, the weak correlation between Au and the other variables. Additionally, the experimental variograms for Au, Ag, Pb, and Zn show values increasing above the sill (ϒ = 1), thus clearly indicating the presence of trends.

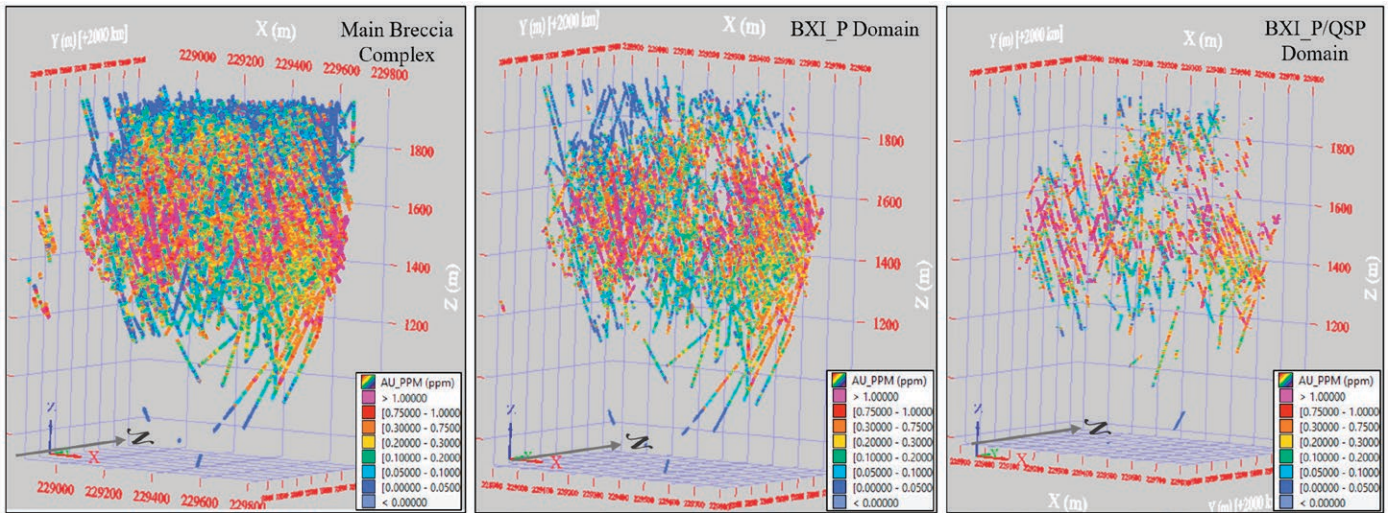


Figure 11. 3D views of gold values from drill holes across various geological domains.

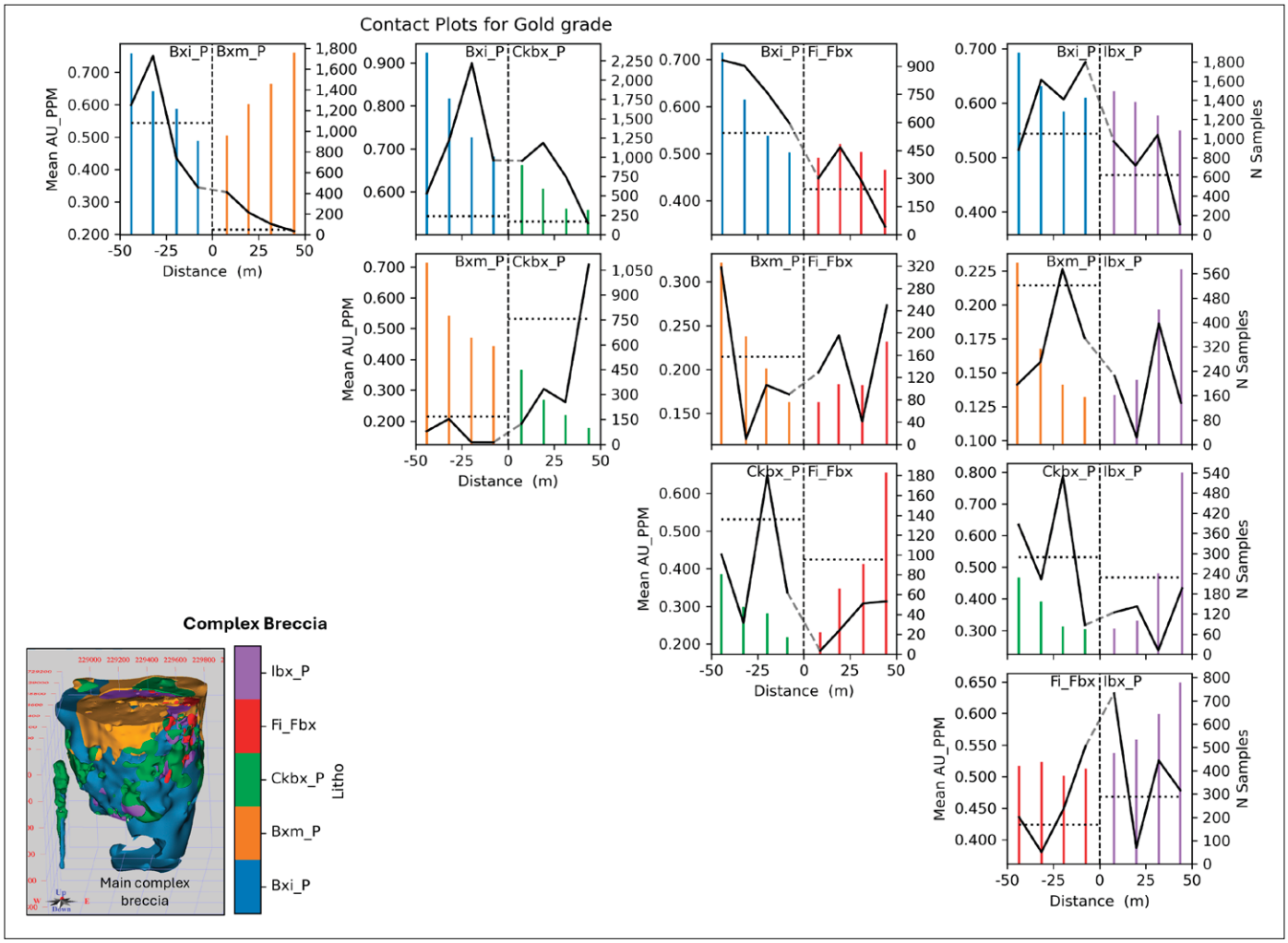


Figure 12. Contact plots (Au) of all domains within the main breccia complex.

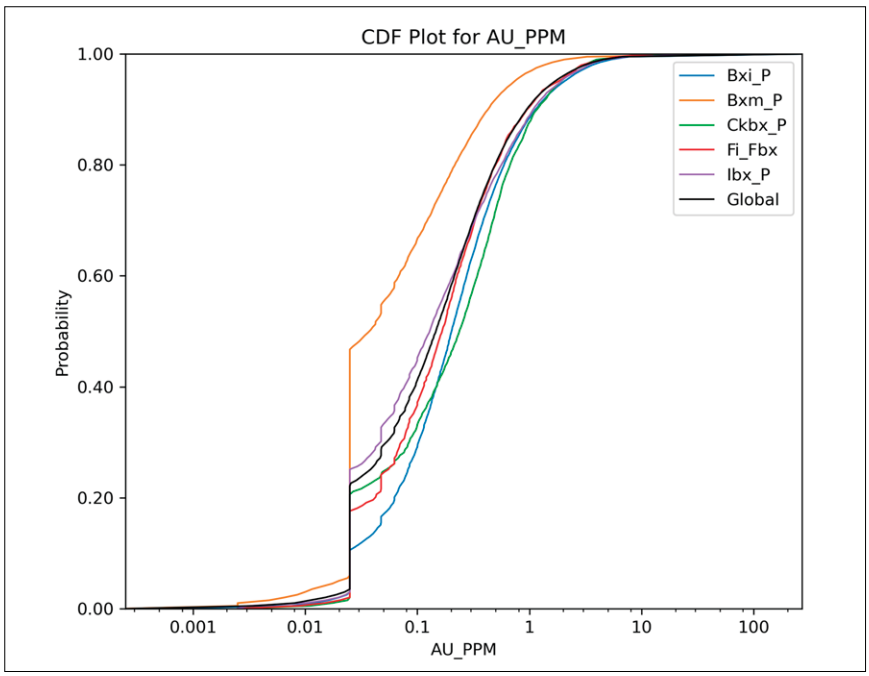


Figure 13. Probability plots (Au) of all domains within the main breccia complex.

Stationarity Assessment

The decision of stationarity should be made carefully. A combination of visual and statistical tools such as contacts plots, swath plots, probability plots, variograms, and global kriging can assist in this evaluation. Using all data values, global kriging produces smoother maps and facilitates the identification of patterns within the data (Qu, 2018), which can be beneficial with subtle trends. However, this is not the case in the present study.

Visual inspection of the data is one of the most effective approaches when analyzing trends. 3D views of gold values across different geological domains are shown in Figure 11. On the left, the main breccia complex shows high-grade Au in red and magenta (> 1 ppm Au), mainly concentrated near the top and along the margins of this domain. This forms an arc-like trend, with a significant increase in Au grades between 1,400 and 1,600 m elevation. The middle Figure illustrates the distribution within the BXI_P domain (the largest domain within the main breccia complex), which reflects a similar pattern to the overall breccia complex.

Au values within the BXI_P domain with QSP alteration are shown on the right. The trend remains consistent at this scale despite the reduced number of samples. The three sets of domains used for this demonstration exhibit non-stationarity.

Besides evaluating trends at various scales, it is also important to investigate the nature of the contacts between domains. Figure 12 illustrates the contact plots for Au grades of domains within the main breccia complex. The distance from the contact is represented by the X-axis, the change in the mean Au grade is shown by the left Y-axis, and the total number of samples at a specific distance from the contact is shown by the right Y-axis. The black curve illustrates how the mean Au grade varies with distance from the contact. The BXI_P domain, represented in blue, is the largest, followed by the mixed breccia (BXM_P) domain within the breccia complex. The other domains are small in terms of volumes and number of samples. These plots indicate a gradual change in Au grade (soft contact) rather than an abrupt change (hard contact). Such gradual changes can be managed by applying trend modeling before performing Gaussian simulation.

Probability plots show the Au distribution across breccia domains within the main breccia complex (Figure 13). The BXM_P domain displays a distinct distribution from the other breccia domains, which in contrast show similar distributions, including the BXI_P domain. A noticeable break in continuity is observed, particularly in the BXM_P domain, which reflects multiple repeated values as a consequence of the analysis detection limit. Therefore, despiking will be particularly important in this domain. Based on the evaluation of the probability plots, one approach to preserve grade continuity in the model would be to merge all breccia domains into a single domain except for BXM_P and then model a trend.

Standard Workflow for Multivariate Simulation within Non-stationary Domains

Figure 14 summarizes a schematic standard workflow representation used for multivariate simulation in complex mineral ore bodies that exhibit trends in the data, applicable to the style of ore deposit used in this analysis. All prior work shown in this analysis, including the decisions made during data analysis and stationarity assessment, will influence the variogram modeling, trend modeling, decorrelation approach, and ultimately the simulation results.

After a decision on stationarity is made, the next step includes Gaussian simulation. This requires the data to be in Gaussian units where all data is transformed to normal scores, with a mean of zero and a standard deviation of one. Then, the trend is modeled and removed. The resulting residuals show stationarity, but the variables still preserve the same relationships observed in the detrended data. A decorrelation method (linear or non-linear) is applied in order to simulate the variables independently. This can include approaches such as the Projection Pursuit Multivariate Transform (PPMT) (Barnett et al., 2016). Once the variables are decorrelated, Gaussian simulation is performed.

After simulation, the back-transformation process includes the trend being reintroduced to the simulated residuals, followed by the back-transformation of normal score realizations to original units. These simulated results are then compared against the sample data to evaluate the reproduction of histograms, variograms, and multivariate relationships.

Working with geological data presents various challenges. Multiple drilling methods may also introduce bias. Therefore, it is

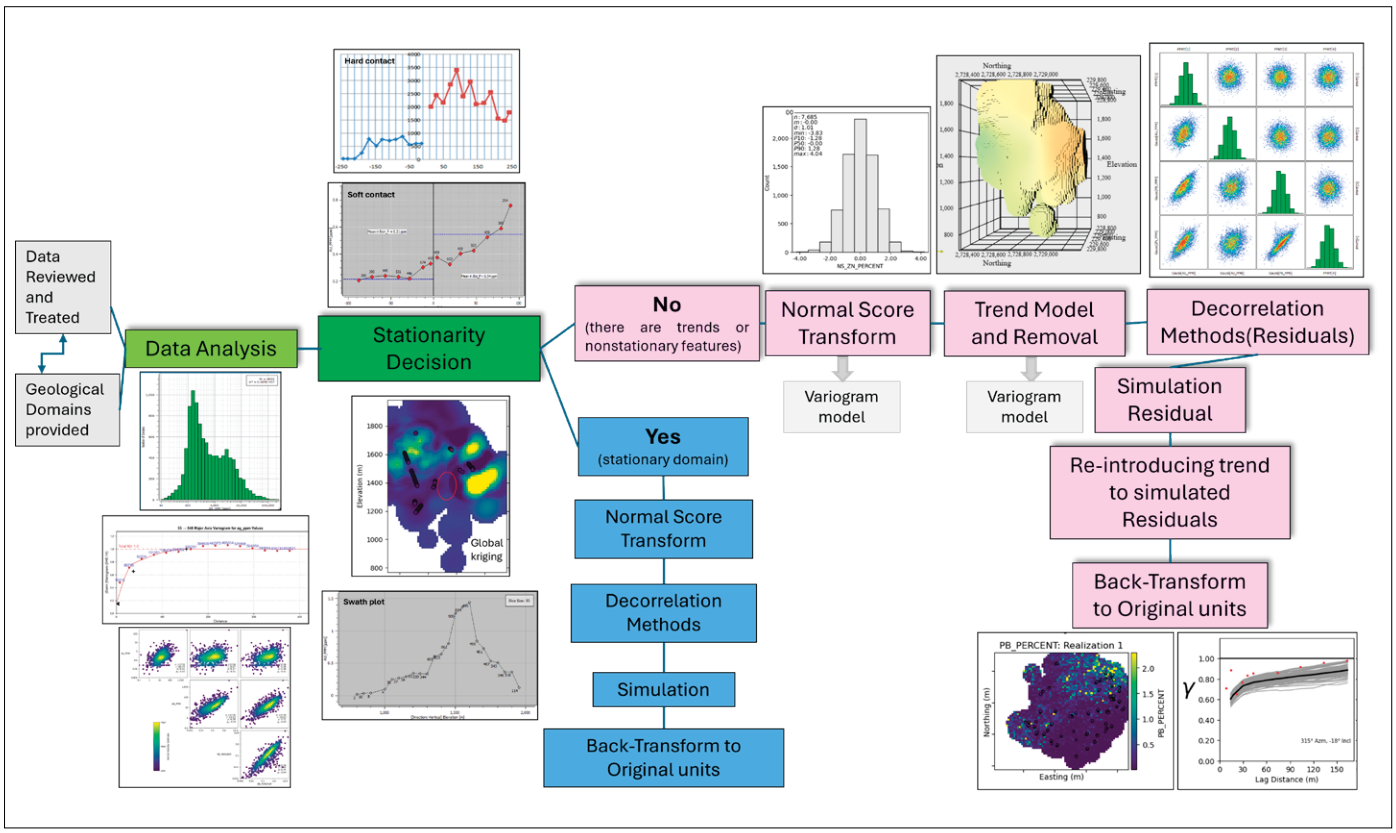


Figure 14. Standard multivariate Gaussian simulation workflow.

critical to identify and correct these issues before performing any simulation. Outliers are usually treated in a univariate context, but multivariate outliers can significantly affect variogram modeling, trend modeling, and decorrelation techniques. Thus, proper outliers' management is necessary.

In domains with strong trends and complex multivariate relationships, non-stationarity may persist despite trend modeling, resulting in poor data reproduction. As geological complexity increases, reproducing sample data becomes more difficult, even after performing trend modeling and decorrelation techniques.

Conclusion

Univariate and multivariate statistical analysis is critical for understanding variable distribution, spatial continuity, and relationships before performing multivariate simulation in complex non-stationary domains. One of the main goals is to define the final estimation domains along with the decision of stationarity. Not accounting for trends in the data can lead to inaccurate results, including poor data reproduction. Visual inspections and various tools will help to make an informed decision about stationarity.

As geological complexity increases, detailed data analysis becomes even more critical for building a solid understanding of a given ore body under evaluation, so that all the decisions made during this stage are defendable and meaningful.

Disclaimer

The views and conclusions expressed in this publication are solely those of the author and do not necessarily reflect the views, opinions, or positions of Newmont Corporation.

Acknowledgment

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Rita Teal has 25 years of international experience in the mining industry. She recently completed her PhD in Mineral Engineering at New Mexico Tech University. Rita also holds a B.S in Geological Engineering from San Marcos University in Peru and an M.S. in Geosciences from the University of Arizona, along with a Graduate Certificate in Geostatistics from Edith Cowan University. Rita lives in Albuquerque, New Mexico, with her husband and daughter.

AIPG Member Photo Challenge

Challenge categories:

- **Off the Beaten Path - Unique feature/formation.**
- **The Best Part - Capturing the Spirit of the AIPG National Conference.**
- **Geologists in the Field - People at work/field trips.**
- **Micro-Geology - Under the microscope.**

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

Awards:

First place in each category:

Image published on the cover of *TPG* in 2026. Winners will receive a personalized Estwing rock hammer engraved with their name and member number or AIPG Gear of choice up to $50.

Runners Up in each category:

Images will be published inside the *TPG*. Runners up will receive AIPG gear of choice up to $30.

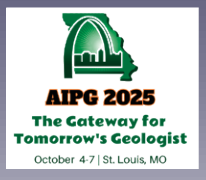
Challenge Rules:

Image requirements: digital, 300 dpi, 8.5"x11," **portrait orientation** full color.
Members are allowed one entry per category with up to four submissions (one per category).
All images must be original and taken by the member.
Submit entries via email to aipg@aipg.org.
Entries must include:

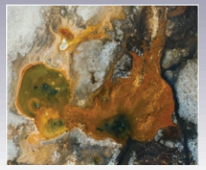
- Name
- Member number
- Section
- Title of image
- Less than 200 word description of the image
- Names of any identifiable persons in the image and permission to publish their photo
- Year photo taken

Entry deadline: **November 1, 2025**.









AI Bots are Joining Your Calls

Mark J. Howell, CPG-09563

Introduction

For the first time, I am experiencing an unwelcome visitor on some web-based meetings—the AI Bot[i]. These AI-fueled software applications perform detailed, real-time translation of phone or web conversations. The bots are adept at assigning voices to participants and recording every word uttered. While they seem highly evolved, they are imperfect, and their records are owned by third-party tech companies. The expectation is that risks associated with AI Bots will arise more from their use for convenience and less from acts of malice. Nevertheless, the risks are real, significant, and here today. Professionals have an ethical duty to reflect on how their use of AI tools aligns with their ethical obligations, particularly those related to client confidentiality and competence.

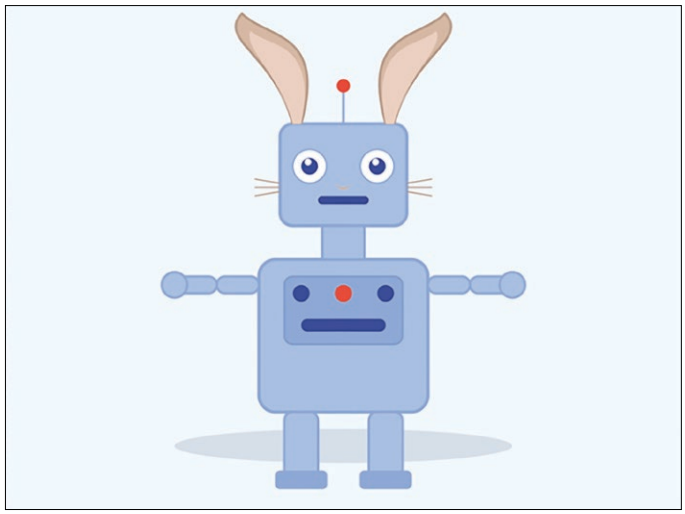


Figure 1. Robot with rabbit ears, generated by Claude, May 1, 2025.

Risks

Professional geoscientists often practice in areas where security and confidentiality are essential, often in multiple states or countries, and are challenged to keep up with evolving technology. The growing use of AI Bots is a source of legal and professional liability that has not been worked out in the professions or in law. Here is a summary of the risks I have identified in my research and discussions. No doubt you can add to this list.

AI Bots collect and store personal data of meeting participants on platforms like Zoom and Teams, which raises concerns about data privacy and compliance. Noncompliance with recording laws can lead to criminal liability and civil damages. At the same time, the legal requirements for recording conversations vary significantly with jurisdiction. In the United States, at least one party must consent to recording a conversation[ii] and some states require the consent of all meeting participants.[iii] The use of AI may violate portions of the EU's General Data Protection Regulation[iv]. This creates potentially complex legal liabilities when online meetings span multiple jurisdictions.

Some AI Bots will send a meeting transcription to all participants, including participants that were not present in some portions of the meeting. Information recorded by AI Bots are transmitted to third-party companies and can be used to train their AI technologies. This can lead to the dissemination of confidential or privileged information to the public via data service companies. If the AI platform has inadequate security measures, their deployment platforms and their recorded databases will surely become sources of data breaches.

Any single employee can put the entire organization at risk[v]. Employees can sign up on their own and invite AI Bots to meetings. This leads to a loss of organizational control over what gets recorded and who has access to those recordings. A recent article in the Wall Street Journal covers the use of wearable AI devices[vi], meaning there is now the potential for employees and others to use AI to capture and identify participants during meetings.

AI Bots can record sensitive information about meeting participants without their knowledge or consent. There are also risks that unauthorized parties will have access to records generated by an AI Bot. Third-party service providers are often used to transcribe

i. Technology purveyors seem to prefer "AI Meeting Assistant" but that sounds too human, too cute. I'm using "AI Bot" so as not to become attached.

ii. Electronic Communications Privacy Act of 1986 (ECPA)," Bureau of Justice Assistance. https://bja.ojp.gov/program/it/privacy-civil-liberties/authorities/statutes/1285.

iii. Permission to Record: Considerations for AI Meeting Assistants," Faegre Drinker Biddle & Reath LLP, February 20, 2025, https://www.faegredrinker.com/en/insights/publications/2025/2/permission-to-record-considerations-for-ai-meeting-assistants.

iv. The European Union's General Data Protection Regulation.

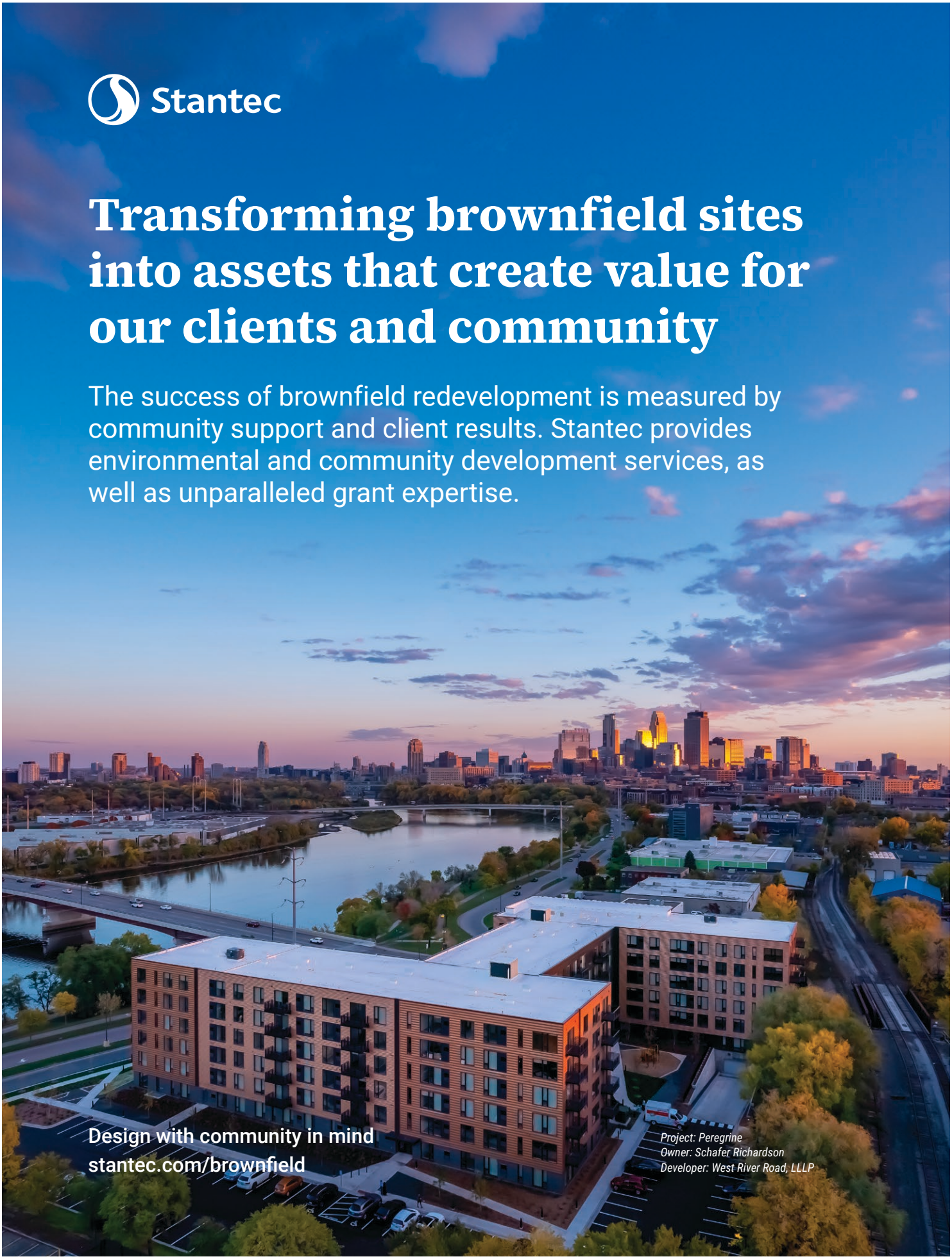
v. Strapagiel, Lauren. 2024. "AI Meeting Assistant Security and Privacy: A Guide for 2025." Fellow.App, December 10, 2024. https://fellow.app/blog/security/ai-meeting-assistant-security-and-privacy/.

vi. Stern, Joanna. 2025. "I Recorded Everything I Said for Three Months. AI Has Replaced My Memory," *The Wall Street Journal*, April 30, 2025. https://www.wsj.com/tech/personal-tech/ai-personal-assistant-wearable-tech-impressions-28156b57.

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calls, store the transcriptions, or produce textual documents. The recorded data can be used to train AI language models, possibly releasing your confidential or proprietary information.

There is also a human factor. Participants are reported to be less willing to speak freely if they know AI recordings are taking place, potentially inhibiting their candor, collaboration and creativity. People that might otherwise speak candidly about clients or projects may fear disciplinary measures if an AI transcript contains errors or is taken out of context. Their fear of how recordings might be used could also inhibit innovation and transparency. Some participants may assume they can rely on AI summaries later and pay less attention or even skip meetings entirely. This dynamic adds the hazard when the transcription contains significant errors or misrepresentations.

Best Practices

My research on best practices relied on some excellent websites from various sources and you will find many more online. While many of the practices favor large entities with the means to negotiate with technology sector service providers, smaller firms and independents can use the recommended practices to understand the various approaches to managing the technology and tailor the practices to our own practice.

Written policies are necessary tools for managing risks associated with the use of AI technologies. They should address the use, access and retention of AI recordings. Variables include the scope and nature of the meeting, the subject matter, and the laws in effect at the locations of the participants. Dedicate resources to understand your exposure in the event that confidential, privileged or proprietary information is released. Evaluate the risks of the capture of conversations and identities by automated transcription bots or devices worn by personnel. Develop a response plan when individuals do not comply with your policies.

If you are hosting a meeting, notify all participants that a meeting will be recorded by an AI Bot and get their clear consent before proceeding; give them the ability to opt out of the meeting. Inform them of the records that will be generated, who will retain them, and the possibility of transcription errors. Don't assume that someone who was present for only a portion of the meeting will not gain access to the full meeting records. If AI Bots are to be used in a meeting with a closed session, consider restarting the closed session in a separate call without the use of AI. Configure the bots to capture only what's necessary and delete recordings after they've served their purpose.

Services are evolving extremely rapidly, and participants need to plan how they will keep up. Only use AI recording tools that have strong encryption, access controls, and compliance with the data protection regulations that will apply in your geographic areas. Make a list of software that meets your data security requirements and update the list periodically. Know the software settings, for example transcriptions can be generated in Teams using Live Caption, which is not saved but can be captured by a participant.

You should assume all AI recordings, notes and transcriptions are discoverable in litigation; the use of AI recording during attorney-privileged conversations may trigger discoverability or an inadvertent waiver of privilege. This raises the significant challenge of assuring that AI Bot recordings are not used to train language models. Although due diligence and contractual language are tools to this end, the use of AI Bots by participants other than yourself is problematic. While some sources recommend having a human review of all summaries or transcripts for accuracy and correction, others warn that such changes have the potential to create their own liabilities.

Summary

Before you consider me a Luddite, know that I used Anthropic's Claude AI engine to assist with preparing this article[vii]. I adamantly resisted AI until I read that, while not perfect, AI is a vast improvement over internet searches using Google. I tried it for that reason, and it has saved me hours of effort in research, troubleshooting software and networking glitches, data handling and other tasks. AI tools are useful and powerful, and professionals have a responsibility to understand and deploy them wisely. AI is here to stay so my advice is to learn its risks and benefits, buckle up, and enjoy the ride.

vii. "Claude." Anthropic, May 1, 2025, https://claude.ai/chat/616fa3fb-37ab-4e50-a1e8-4e013510bf91.



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WHY I WANT TO BE A

GEOLOGIST

Student Scholarship Essays

AIPG National is proud to announce this year's scholarship recipients. The selection process was highly competitive, with a large number of outstanding applications from students dedicated to pursuing careers in geology. After a thorough review, 10 students were awarded $1,500 undergraduate scholarships, generously funded by the national organization ($5,000) and the Foundation of the AIPG ($10,000).

The quality of applicants was so exceptional this year that after the 10 national scholarships were awarded, AIPG reached out to its Sections, offering them the opportunity to sponsor scholarships for deserving students from their respective regions. We are thrilled to announce that the Michigan Section sponsored one additional scholarship and the Ohio Section sponsored three additional scholarships, allowing us to recognize even more of our talented future geologists.

As part of the application, undergraduate students submitted essays on the theme, *"Why I Want to be a Geologist."* Their insightful and passionate essays are presented in this issue.

We are also pleased to announce the recipient of the $5,000 William J. Siok Graduate Scholarship, supported by the Foundation of the AIPG. Graduate students were challenged to write an essay on a theme of their choice, exploring how the geology profession can best address a significant public concern over the next decade.

In this edition, we are excited to share these essays, celebrating the diverse perspectives and innovative ideas of our student members. We are immensely proud of their dedication and look forward to their future contributions to the geosciences.

Congratulations to all our scholarship recipients! Your passion for the geosciences is commendable, and we eagerly anticipate the impact you will make.

Lena Anderson, SA-12628
UC Davis
California Section



A general rule for geologists is that we treasure the outdoors. I have never met a geologist, whether a student, professor, or professional, who doesn't enjoy the sense of freedom, tranquility, and purpose evoked by the wonder of nature. An integral piece of one's humanity is to feel connected to the land that sheltered our evolving species. Geologists embrace this wholeheartedly. At my university, students flock to the outdoors, jumping on opportunities for field trips or summers in the Sierras. I also strongly identify with nature and love to get outside, whether it's two weeks in Iceland or a weekend in Bishop.

For myself, this love of nature extends into two new dimensions - the depths of Earth's interior and the depth of time. Earth's surface features are expressions of its internal strength, and it's difficult not to be awestruck and inspired by them. Even a minor feature, like a geyser or hot spring, is representative of the great forces at work beneath Earth's surface. Observing ancient processes at work in the present day also puts my life into a temporal context. To be a part of Earth's four-and-a-half billion year history and to experience this snapshot of its lifespan is very special. It also raises questions about our planet's past inhabitants and conditions. In this way, to be a geologist is to be in pursuit of humanity's ultimate mysteries, those shrouded by kilometers of solid rock and the blanket of time.

Earth's influence and long history reaches into our daily lives, too. For those of us who live in cities, it's easy to see ourselves as separate from the natural world. However, I think that humans take for granted that fundamental parts of our lives - the air we breathe, the homes we live in, every commodity we have ever used - and the things that make us human - our art, our culture, and our language - all exist because nature has nurtured them. Even with modern technological advancements, we are still vulnerable to Earth's afflictions; disease, fire, earthquakes, and other natural hazards. Our planet's systems are the dominant force dictating how we live, and so nature and natural processes are integral to every part of our lives, even if they seem separate from how we live day to day. The physical Earth has evolved to live alongside life, creating an equilibrium between our planet and the many organisms that call it home. In this way, understanding the Earth and how it works is integral to human society.

Another part of what it means to be human is to shape your environment. Human populations have always managed Earth's landscapes and shaped them into an easier place to live. However, in the last several hundred years, the equilibrium between humans and nature has been broken by the massive outpouring of greenhouse gas emissions from industrial fossil fuel burning. In the new age of climate change, environmental problems become more and more critical. In my opinion, no one discipline is as well equipped to consider complex environmental issues as are geologists. Geologists have the ability to reach far and wide into other disciplines - chemistry, physics, biology, atmospheric science, ecology, engineering, and more - that are critical to the mitigation of environmental factors and that encompass Earth processes. No other discipline considers the Earth so holistically, in its entirety and its complexity. Not only does this comprehensive approach allow for better problem solving, it allows for a unique creativity that is essential for addressing increasingly difficult and complex issues.

As a geologist, I want to be a part of the force that redefines human relationships with nature and edges them back towards equilibrium. Protecting the world that we live in is one of the most important tasks of the modern world, and the field of geology has a critical role to play in that endeavor.

Raffay Chaudhry, SA-12658
UW-Green Bay
Wisconsin Section



Driving under merciless clouds with rain pouring on the windshield of our rented van, I looked out toward the farmlands of upper Michigan. My professor, for the third time in the last hour, asked, "Why do you think that hill is there?" while pointing at the hill road in front of us.

"The glaciers advanced and retreated there," I replied. A smile appeared on his face, revealing the same level of surprise I felt in the moment. This was during my first semester in college. I had come on this weekend-long field trip to explore what my friend described as "the most fun science," a field I had never even heard of in my third-world country, where parents only approved of Business, Engineering, and Doctoral programs as appropriate fields of study.

Thus, that moment when I understood my first-ever concept of Geology became etched in my brain. When we returned from the field trip, I observed my professor's class for the remainder of the semester.

"This is how we peeked into the volcano!" exclaimed my professor as he commando-crawled on the table in a humorous attempt to show the class his field trip experience at a volcano. Recognizing how intuitive the science of Geology was, listening to my professor's hands-on experiences in nature, and seeing how active they were on trips even in their seventies, a new passion to pursue Geology formed within me.

"Huh? Geo… what?" was my parents' reaction when their youngest child in America told them he wanted to study Earth Science. They were nervous until I told them about the five percent job growth in the coming years, the healthiness of outdoor work, and the potential work opportunities closer to home in the Middle East. These prospects excited them enough to let me pursue a field they did not understand.

Three semesters later, I have taken three Geology courses alongside Chemistry and Calculus. With every class, I find myself a little more excited to learn something new about the processes of the Earth. Why I want to be a Geologist is a question I get asked by all my friends back home.

It is because this major brings me closer to nature, which is scientifically proven to calm the nervous system. It keeps me on my feet and allows me to explore parts of nature other people don't get to, like looking at the largest piece of Emerald in the U.S. or beautiful pieces of Azurite Malachite. I can observe something like the Himalayas and explain how the Indian continental plate collided with the Eurasian continental plate to form those.

With Environmental Geology, I can work for the planet. With Petroleum Geology, I can have one of the highest-paying jobs in the world. As a Mineral Explorist, I can travel and explore the world. As a Hydrologist, I can channel my love for water. With so many different options, all involving working with nature and not sitting at a desk, Geology has become the field I wish to work in.

If younger people in Pakistan were exposed to fields like these, they would not have to choose between the only three fields considered acceptable in our community. Through my work, I will bring Geology to Pakistan. One day, it will become popular alongside the numerous other fields that remain hidden from students there.

One day, everyone shall fall in love with Azurite Malachite, the greatest rock!



Zoe Dodd, SA-12445
South Dakota School of Mines & Technology
South Dakota Section

Every kid dreams of growing up to have extravagant careers such as being a doctor, a vet, or even a superhero. However, for me, this wasn't the case. Ever since I can remember, I have been fascinated with the way the Earth works and the world around me. The idea that the Earth and its processes can create so many different beautiful and unique rocks has always captivated my mind. Being able to hold a piece of history in your hands and having the challenge of figuring out how it formed, where it formed, etc. has always been something I have been fascinated by. I would pick up rocks everywhere I went, which, unfortunately for my father, led to many rocks ending up in the washing machine. While most kids were having princess or superhero themed birthday parties, I insisted on having a Geology themed party instead. Like most children, I started a small rock collection. I would walk with my grandpa to the railroad tracks and collect rocks I found interesting and add them to my small collection I had back home. This collection, however, never stopped growing, and to this day, my career as a Geologist is also my hobby, and going out and collecting rocks is something I still love to do today. When I found out my love for rocks and minerals could be turned into a career, I never looked back. While looking into the different branches of Geology that I could pursue, I discovered Field Geology. Traveling has always been something I have strived to be able to do in my life, and this career choice allows me to do just that. Now a sophomore in college, I am pursuing my dreams that I have worked towards for many years.

While growing in my knowledge of Geology, I have discovered that Geology is so much bigger than just pretty rocks, unlike what most people see this career as. Geology can be used as a tool to help people in many ways. For example, Geologists can help in natural disaster situations by making individuals aware of the foundation their houses and businesses are built upon, and what can be done to ensure the stability of the house or business to be able to secure the safety of the public. Geologists also study hazards such as volcanoes, and if activity starts to ensue within the volcano, they can help the community near the eruption site know when to evacuate and provide knowledge on the danger of the location. Being apart of something bigger than myself and helping people is a daily goal, and this career allows me to not only pursue what I love but also get to help individuals who aren't as knowledgeable in this field understand possible dangers and ensure their safety.

Overall, becoming a geologist is something I have been striving towards for most of my life. Being able to travel, possibly discover new specimens, challenge myself daily, and do what I love all while being able to help others is why I work hard every day to achieve this goal of mine. College can be tough, especially at a STEM focused university, however, if I ever lose track of what I am working so hard for, I think back to that little girl walking to the railroad tracks with her grandpa to collect more rocks for her collection because she loved doing so. Thinking back allows me to remind myself of why I am here and why I should continue to work so hard, because I am doing it for that little girl and all the other little girls who don't want a princess themed birthday party.



Matthew Garcia, SA-12637
California State University, Fullerton
California Section

Originally, I'd have to say that my interest in studying geology, and ultimately becoming a geologist, was based almost entirely on my curiosity about the natural world. Of course, there are multiple fields of study within the natural sciences that would fit that description, but geology, being such an interdisciplinary science, logically seemed like the best option to satisfy said curiosity. I've always been particularly interested in geologic time, wondering how the hills behind my house came to be, what the area would have looked like a million years ago, and what the area will look like far into the future. Also, I could easily see myself being happy working in the capacity of a geologist, whether it meant spending time in the field, analyzing geologic data in an office, or acting as an interpreter for the public at large, to whom geology is akin to a foreign language.

However, the longer I've spent learning about the different aspects of geological science and the world at large, the more I've realized how important a role geologists play in modern society, in ways that affect us all in one way or another. The evolving matter of climate change, over the past few years especially, has worked to highlight how very important the job of a geologist really is, from monitoring and modeling geologic hazards, to managing and protecting the precious groundwater in our aquifers. While I'm genuinely interested in virtually all aspects of geology, hydrogeology has gradually managed to capture my focus and stand out among the multitude of fascinating subfields that geology has to offer.

I learned early on in my education, in an ethnic studies class no less, that water is life. Water is by far the most important natural resource on the planet, as it is essential for all life on Earth and thus humanity, not to mention the rest of Earth's flora and fauna, including the critically important agriculture that sustains our society. The vast majority of the accessible fresh water on Earth exists as groundwater, without which humanity as we know it would surely be in dire straits, to say the least. This is why the responsible use and management of the many aquifers in the world is one area in which we simply cannot fall short, both for ourselves and for the future generations that will rely on them. I could halt my formal education at the bachelor's level of geology,

but I feel that would make it difficult, though certainly not impossible, to be a part of the group of scientists that help to ensure that this does not happen in our time. That is the main reason that I am applying to graduate school, to acquire the knowledge, skills, and connections, that I can then apply to the field of hydrogeology, even if only in some small capacity. My goal as a scientist and as a person is to build myself up so that I can personally help meet the challenges that these groundwater systems will inevitably face in a future of great uncertainty.

I want to bear my portion of this responsibility, especially in the southwest, which is now and will always be my home. The coastal aquifers in my region are being squeezed between saltwater intrusion from rising sea levels on one side, and the ongoing threat of pollution from society and agricultural practices on the other. There's also the very real possibility of mismanagement of our most vital resource by shortsighted individuals or policies, which is admittedly less of a scientific issue and more of a people issue. In either case, I feel that I have the capacity and strength to be successful in the capacity of a geologist, and more specifically as a hydrogeologist, to help the southwest weather whatever climate change may send our way.

I feel that the vast majority of people don't realize how very important water, especially groundwater, is, or how vulnerable it is as a system and as a resource. I predict that this view will shift in a changing climate where water availability becomes more unpredictable for many parts of the world. And if that is not the case, it will only serve to further justify the tremendous importance of hydrogeologists in managing and protecting this most vital resource for us all, and the reason why I want to be a part of that battle.

Casper Graham, SA-12660
Eckerd College
Florida Section



Unearthing a Deeper Understanding

I first looked through a petrographic microscope to see the mineral muscovite. I was mesmerized as the normally pearly white mineral became a speckled rainbow of color. Electric blues, hot pinks, and brilliant yellows rippled across the surface as I rotated the microscope stage. The sight was truly remarkable. During the term, I was fascinated to learn how light interacts with a mineral's crystalline structure to create unique optical properties. Using these characteristics to identify rocks and minerals in thin sections remains some of the most engaging work in my degree program.

I gained a greater appreciation for our world by studying mineralogy. It gave me a new perspective on the rocks and minerals I had only observed on a surface level. For example, under cross-polarized light, an unsuspecting gray rock becomes a matrix of clouded quartz, stripped plagioclase, and plaid microcline. Cutting across the shades of gray are colorful shards of muscovite and biotite. Seeing this showed me something new and exciting. Geology continues to surprise me, and learning more about the Earth is part of why I am a geologist.

The other half comes from the positive impact I can have by researching geology. In my first years of college, I worked on an independent research project on the sedimentological effects of



the Deepwater Horizon oil spill. For the project, I collected sediment core samples in the Gulf of Mexico while aboard the Research Vessel Weatherbird II. My time on the boat was wonderful. The night sky and creatures I saw are still some of the most stunning sights I have experienced. Once I returned to the lab, I analyzed the samples and mapped the spatial distribution of sediment properties to identify which areas would be most susceptible to oiled sediment accumulation. In the case of a future spill, my findings could inform clean-up efforts making them more cost-effective and time-efficient. During this project, I felt for the first time the significance of my geological research. It made me realize that as a geologist I have the power to conserve and protect the natural environment.

After completing my project, I continued researching anthropogenic impacts on the environment. Currently, I am researching the effects of dredge and fill operations on seagrass meadows. I am discovering how past operations may have affected coastal marine ecosystems through sedimentological, elemental, and paleontological analysis of sediment cores. I will soon publish these findings so they can be used to understand the potential consequences of dredge and fill projects, helping to write more effective environmental policies.

By being a geologist, I have gained a greater understanding of how our world functions, which is crucial in our work to protect and restore the natural environment. I share my research and observations with people outside of my field through symposiums and volunteer outreach. I enjoy breaking down complex scientific topics into engaging stories that spark curiosity. It is incredibly rewarding to share my experiences as a geologist and have my fascination for our wonderful planet reciprocated.



Nalini Grover, SA-12670
University of Georgia
Georgia Section

My research focus is to understand and predict the Earth's natural processes, particularly natural hazards, to develop sustainable solutions for communities facing their devastating impact. I hope to work as a research geologist in the long term, contributing to solutions that help communities adapt to and mitigate the effects of natural hazards.

I grew up in New Delhi, India, one of the world's most affected and vulnerable cities to the impact of climate change and natural hazards. I have experienced firsthand the socioeconomic devastation that natural hazards and climate change can inflict on a community. I vividly remember the aftershocks of the 2015 Nepal earthquake affecting Delhi—being evacuated from school and panicking because I couldn't spot any familiar faces in the restless crowd. After returning home, I couldn't stop thinking about the people closer to the epicenter and how they were coping. My world was still intact, but theirs wasn't. These experiences have taught me to empathize with and relate to similarly affected communities. Some of my lived experiences are those that other researchers have only read about, and these experiences made me realize that I wanted to study geophysics and contribute to reducing the impact of natural hazards. I aim to understand the mechanisms behind such destruction in order to help prevent it.

One of the aspects I love most about geology is its interdisciplinary nature and the breadth of its applications. Through my classes, I have explored topics ranging from plate tectonics and climate change to water pollutants and ArcGIS. This realization guided my academic path—I am majoring in Geology, minoring in Geography, and pursuing a Certificate in Climate Change Geographies. These courses provide me with a holistic understanding of the Earth's mantle, crust, and atmosphere while also highlighting the intricate relationships between climate change and natural hazards.

My research experiences at Harvard University, the College of Wooster, and the University of Georgia reinforced my love for research in geology. Each of my research project has been aimed towards creating a positive impact and improving community resilience, especially in highly vulnerable areas to natural hazards such as Iceland and Japan. During my REU at Harvard University, I also discovered a genuine passion for research, from problem identification and literature review to data collection and analysis. I was motivated by the intellectual challenges of each stage and the knowledge that my work could contribute to making scientific findings more accessible. This experience solidified my desire to pursue research as a long-term career.

Ultimately, I want to be a geologist because I am fascinated by how the Earth works. Whether working on geochemical data, interpreting seismic data, or conducting field research, I enjoy the process of piecing together evidence to understand natural systems. Geology is inherently hands-on, and I am excited to travel and apply everything learned in the classroom to real-world environments. I also love that geology is everywhere—I don't need a specialized lab to experience it. Some of the most valuable insights come from simply being outdoors, looking at random rocks, or watching a stream flow and understanding how it erodes and deposits sediment in its surroundings. That accessibility makes studying geology even more rewarding, allowing me to easily observe what I learn in the classroom to the world around me. Pursuing a Ph.D. will enable me to continue doing research on natural hazards while expanding my experience in fieldwork and data analysis. More than anything, I want to be a geologist because I truly cannot imagine having the same curiosity and passion for anything other than this field.

While growing in my knowledge of Geology, I have discovered that Geology is so much bigger than just pretty rocks, unlike what most people see this career as. Geology can be used as a tool to help people in many ways. For example, Geologists can help in natural disaster situations by making individuals aware of the foundation their houses and businesses are built upon, and what can be done to ensure the stability of the house or business to be able to secure the safety of the public. Geologists also study hazards such as volcanoes, and if activity starts to ensue within the volcano, they can help the community near the eruption site know when to evacuate and provide knowledge on the danger of the location. Being apart of something bigger than myself and helping people is a daily goal, and this career allows me to not only pursue what I love but also

Anna Heikes, SA-12114
Trinity University
Texas Section



I grew up in the Texas Hill Country in a small town called Spicewood. One of my favorite memories is Bee Creek, a spring-fed creek tucked away off a country road. My friends and I would frolic and play in the clear, cold water. We'd use water plants to become "mermaids" and dive below the

surface. Locals who lived along the river would tell me stories about bathing in the creek before plumbing. Bee Creek was known by my community as a source of recreation hidden from the rest of the world. Those beautiful clear pools and limestone topography linger in my memory to this day. But only in my memory.

The population in Spicewood exploded as I was growing up. The Texas hillsides became speckled, then filled with homes. The creek I loved so much started to dry up. The deep pools I could jump in only came up to my waist. Then they dried up entirely. I remember being so excited the creek was full after a large rainstorm that I played in the runoff. After that, my parents didn't let me go to Bee Creek anymore. Today, the large pools have been replaced by small puddles and a trickle of water from a combination of the increased water demand and dry conditions.

The loss of the creek I grew up in is just one of many. As Texas continues to grow, one of its most pressing challenges is water security. With more people relocating to our state and our groundwater resources diminishing, the situation is becoming increasingly dire. The Edwards Aquifer, which supplies nearly all my home's water, has been under restrictions for years due to persistent droughts.

I couldn't sit idly by and wait until after graduation to begin working towards protecting my home. This summer, I started working at the United States Geological Survey (USGS) as a hydrologic technician student trainee. When I'm not in classes or labs, I aid in making measurements of streams, rivers, and groundwater, and publishing that data for the public. I also assist in water quality measurements and lab work. As I like to joke, I get paid to play in water. But my job is so important: the data I collect is used by water regulation agencies to determine water availability and enforce restrictions.

Many of my coworkers come from different backgrounds–biology, fisheries, and oil field construction. I am one of the few technicians that has a geology background. I understand how faults influence fluid flow and how porosity changes between stratigraphic layers. With my geology background, I know what the data will be used for, and how I can provide a steady and strong source of data.

I want to be a geologist to ensure a future where little children can, like me, play in streams and rivers across our state. I want my work, both in the present and future, to safeguard the natural beauty and resources we have for the joy and appreciation of future generations.



Avery Laws, SA-12650
Palomar Community College
California Section

"Rocks are the records geologists read to inform us of the long, dynamic history of the Earth. Complex and seemingly incomprehensible, the 1.8-billion-year geology in Joshua Tree National Park is capsulized along this round-trip, 18-mile tour road. With the Geology Tour Road Guide brochure as your primer, travel the road to better understand the foundational materials and shaping forces of this desert landscape".

As I sat in the back of the family pickup truck year after year, cruising down the dirt path of Geology Tour Road in Joshua Tree National Park, miles of rock piles blurred past. This stark, otherworldly landscape looked unlike anything I had ever seen, sparking a flood of questions: Why does Joshua Tree look so different from Yosemite or the Grand Canyon? Why are there no "real" mountains in the Plains? How were the Great Lakes formed? In school, it had been ingrained in me that biology studied plants and animals, chemistry, the elements, and math, numbers, but I never encountered a subject that explained the 'whys' and 'hows' of landscapes like those that I loved in the National Parks. I didn't know what discipline held the answers to my questions—I only knew I wanted to find them.

What I didn't realize at twelve was that the sign at the start of that road in Joshua Tree and the sights beyond it were quietly planting the seed of my love for National Parks—and for geology. The sign and rock piles became more than landmarks; they marked the beginning of my journey to understanding the physical world around me.

For years, I carried my curiosity about landscapes without knowing where to find the answers. In my second year of community college, I ended up dropping a class and needed to quickly find a replacement. A friend suggested an introductory geology course, mentioning that the professor was highly entertaining, and the class was surprisingly interesting. I was hesitant at first—geology, from what little I knew, seemed like a subject for people obsessed with rocks, and that simply wasn't me. But with few options left, I decided to give it a try. Little did I know that one decision would answer my childhood questions, introduce me to the fascinating world of our Earth, and transform my old perception of rocks into to an appreciation for their intricate past and immense impact in shaping the landscapes I have always admired.



Caryse Oliver, SA-12423
Syracuse University
Northeast Section

I am in mineralogy lab and my TA is holding a chunk of blue calcite, which, just like the one in my room, always brings to mind a memory. We were in the garage, where everything was laid out on folding tables. I was trying to convince River to pick out some things, but he is too young to understand the gravity of what was happening. Maybe some blue calcite from Upstate New York or rutilated quartz from Vermont, as much as our little hands can carry. Of course, I did not know the names of the minerals back then—I just knew they would soon be gone. As the youngest ones, we were the last line of defense before the estate sale.

It's funny; before that day, I had never noticed the living room was more decorated than the gemstone gift shop in the Smithsonian. The priceless minerals didn't faze me until my great-grandparents' life's work was reduced to price tags of 50 cents apiece. Looking back now, it haunts me. I can only dream of such a collection—of days when you could walk out of the Herkimer diamond mines with a quartz the size of your fist. Or perhaps my great-grandfather just had an eye for it.

More than a decade later, I find myself sitting in Mineralogy, wondering whether my great-grandparents ever understood the intricacies of their collection. Did they know the difference between trigonal and hexagonal crystal systems? Did they ever look at a thin section, or read up on twinning? I am resigned to the fact that I will never know, but this is a feeling that I hate: not knowing. I think

it is what originally attracted me to geology– reclaiming my great-grandparents, and trying to understand them. However, something that started as a way to connect with them just ended in more questions. Fundamentally, that is what I love about geology– that the more you understand, the more questions you have. And although my passion may have started as a way to understand them– it has become wholly mine. Today, geology is not just a bridge to my roots; it defines how I see the world and how I envision my future.

Not only is geology fascinating in its endless questions, it is critical for our future. The climate crisis demands bold solutions, many of which lie within the realm of geology. From understanding Earth's natural systems to discovering and ethically sourcing critical minerals needed to electrify society, geology provides the answers to confront the environmental challenges we face today. Like many others my age, I feel an acute responsibility to help combat the climate crisis in some capacity. However, my interest is beyond obligation – I consider myself lucky that I found a subject where my interests perfectly align with a problem that I am passionate about solving. It feels almost serendipitous.

For me, geology is not just about the academic pursuit of knowledge; it is about creating a career that reflects my values. My long-term goal is to contribute to the electrification of society and help address the climate crisis through the lens of geochemistry and mineralogy. I see myself researching new ways to extract and process critical minerals sustainably, minimizing waste and environmental degradation. Whether it involves designing innovative techniques to recover rare earth elements or studying the geochemical processes that make mineral deposits viable, I want my work to leave a positive mark on the world all while doing what I love.

In a sort of poetic sense, I feel as if my trajectory in becoming a geologist is similar to that of geology itself. Just as the origins of geology began with people trying to understand Earth's history, I began trying to understand my history– through my great-grandparents. And I found that it was the answer to my future – just as geology will be the answer to our collective future via the climate crisis.

Grace Sandidge, SA-12114
Middle Tennessee State University
Tennessee Section



Growing up as a first-generation Asian American, I can recall my parents working tirelessly to provide my brother and me with opportunities they never had. Part of their vision for both of us involved higher education, and from as far back as I can remember, college was always part of the plan. In 2006, I packed my bags and headed off to pursue a degree in psychiatric medicine. My curiosity about processes and fascination with patterns drew me into behavioral science. But I underestimated how challenging life as an adult can be, and my first semester as a traditional student was also my last. My first attempt at higher education was an experience I never quite expected. For the first time in my life, I experienced academic failure and I decided to leave school behind and work on a career in retail management. Fast forward to 2020, my life has changed quite a bit since I left my higher education pursuit in 2006. I felt like I was hitting all the major milestones from growing my family, purchasing a house, and building up my career, and then in 2020, the pandemic happened, and the world stopped for a brief period including my world.

Although there was a lot of uncertainty during this time, I felt compelled to reconsider my career and decided to pursue a bachelor's degree with the support of my family. But I had a limited frame of knowledge concerning what I really wanted to do. I figured college is the place to help me figure this out and in 2021, I put my application in as an undecided, nontraditional student at Volunteer State Community College (VolState). I considered several options here such as math teacher, accountant, and vet technician. But none of these career paths seemed right and after three semesters plus one summer session, I realized in my last semester my passion for geology when I tried an online introduction to Geology course. It was like a secret revealed itself to me for the first time and I could not get enough. The patterns of change and processes that shape the topography around us captivated me. It was hard to imagine mountains being eroded down to peneplain and built again over geologic time. Each lesson kept me on the edge of my seat. It was with this introductory class that I found my calling in life and my path towards becoming a geologist began.

In 2021, I received my associate's degree in science and continued my education at Middle Tennessee State University (MTSU) to complete my bachelor's degree in geosciences with a concentration in geology. My love for Geology has only grown stronger with each semester from the classes to the adventures I never dreamed I would be a part of. For the first time, I experienced exploring a cave, camping outside, traveling overseas, and investigating faults, folds, and sinkholes up close. I can recall the first fossil I found in the field and felt an immense appreciation of how old this Ordovician shell fragment is and what it would need to have withstood for me to be holding it in my hand that day. My desire to become a geologist only grew stronger with curiosity driving my interests to understanding this dynamic planet. Every geology course that I have taken brings on a new level of interest that I didn't realize I had. Each night at dinner, I found myself regurgitating what I learned in class that day, discussing with my kids about how some metamorphic rocks formed or what the world must have been like during the last ice age. I started to fill every space around my house with new rocks I had picked up. Each day I work on getting my geology degree, I become more excited at the possibilities to help investigate the physical world around me. A desire to understand Geologic processes continue to inspire and amaze me as my curiosity of these changes that may have occurred motivates me to pursue and seek answers. Once I become a geologist, I am excited to see where this field will take me and my family.

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Esther Oyedele, SA-11008
Virginia Tech
Ohio Section

It was a scorching summer afternoon in 2023 when I first stood at the edge of Horseshoe Bend in Arizona, gazing down at the emerald-green waters of the Colorado River winding through the sandstone cliffs. The sheer scale of the landscape was breathtaking, yet what struck me most was the realization that this magnificent scene was deeply connected to a crisis unfolding just upstream at Lake Powell. As a geoscientist studying groundwater resources, I knew that what I was witnessing was not just a picturesque view, it was a glimpse into the pressing water challenges of the American Southwest. In the next quarter century, geology will play a pivotal role in ensuring the sustainability of our planet's resources, with geologists at the forefront of addressing climate-driven challenges.

Water scarcity, critical mineral demand, and climate resilience will define the next era of geoscience. Among these, water resources will be one of the most pressing issues. Across the world, aquifers are depleting faster than they can recharge and changing precipitation patterns threaten both agriculture and urban water supplies. Through satellite remote sensing and advanced hydrological modeling, geologists are developing new methods to track groundwater depletion in near real-time, providing essential data for policymakers. But technological competence alone is not enough, we must also navigate these challenges with ethics and integrity.

Consider the case of groundwater over-extraction. In some regions, unregulated pumping has led to land subsidence, permanently reducing aquifer storage capacity. Without ethical oversight and transparent communication between scientists, governments, and communities, the short-term exploitation of groundwater could lead to irreversible damage. Geologists have a responsibility to ensure that science informs sustainable management, advocating for policies that balance immediate water needs with long-term conservation.

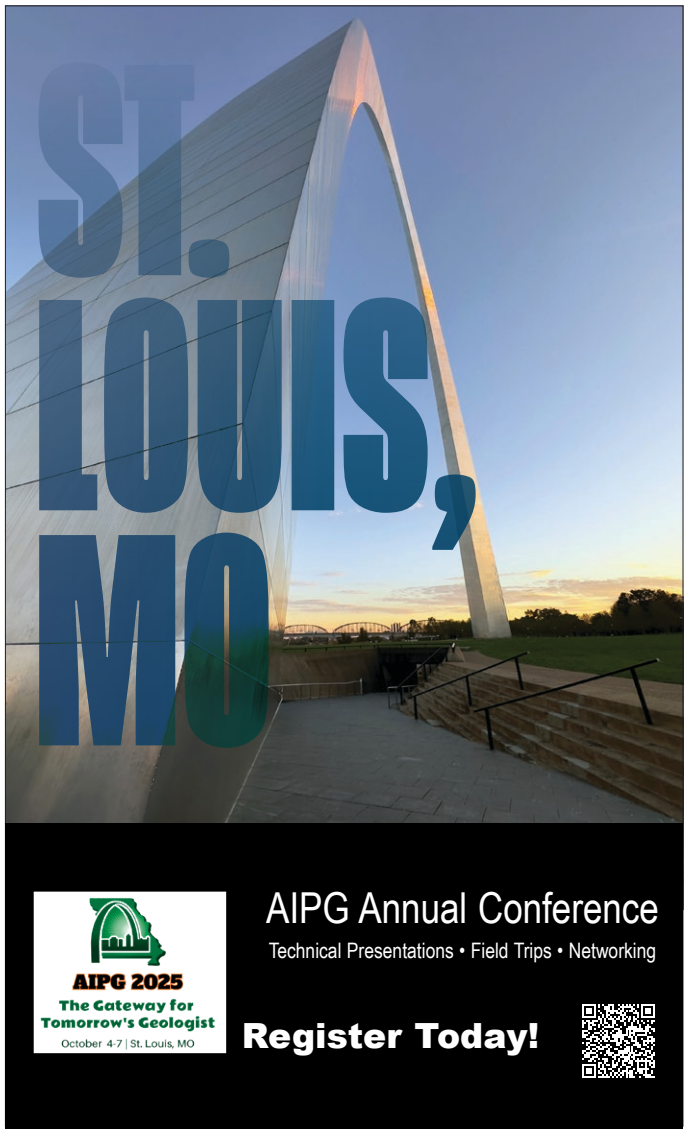
Beyond water, the demand for critical minerals required for renewable energy infrastructure - lithium, cobalt, and rare earth elements - is surging. Geologists play a crucial role in locating these resources through geological exploration, identifying potential deposits that mining engineers then extract. However, mining comes with environmental and social costs. The next generation of geologists must champion ethical sourcing, ensuring that communities affected by mining projects are not exploited and that ecosystems are not irreparably damaged. Transparency, environmental stewardship, and adherence to rigorous ethical standards will be essential as we navigate the complex intersection of resource extraction and sustainability.

Geology's role in climate resilience will also be transformative. As rising sea levels and increasing natural disasters threaten communities, geologists contribute to hazard assessments and risk mitigation. They study seismic activity, flood patterns, and coastal erosion to provide critical insights for designing resilient infrastructure. While engineers take the lead in infrastructure design, geologists provide the foundational data necessary for informed decision-making. Competence in geoscience means not only understanding these hazards but also effectively communicating risks to the public. In this, integrity is key - communities must trust that geologists are providing unbiased, fact-based assessments.

Reflecting on my own journey, I have seen firsthand how competence, ethics, and integrity define the impact of geologists. As an American Geophysical Union Local Science Partner, I have just begun engaging with policymakers, learning that effective science communication is just as crucial as the science itself. Data alone does not drive change - trust does. Whether advocating for water conservation policies or responsible resource management, geologists must be reliable voices in public discourse, building trust through transparency and ethical engagement.

The next twenty-five years will test our ability to balance human progress with planetary health. The contributions of geology will extend far beyond academic research; they will shape how societies adapt to environmental challenges. By prioritizing competence in scientific methods, upholding ethical standards in resource management, and maintaining integrity in public communication, geologists will not only protect the Earth's resources but also ensure a more sustainable future for generations to come.

As I stepped away from the edge of Horseshoe Bend that day, I carried with me a deeper appreciation for the work ahead. The choices we make now as geologists - how we study, communicate, and act - will determine the legacy we leave behind. And in that legacy, I hope the world will see not just scientific discoveries, but a commitment to doing what is right.



MICHIGAN



Sydney Davis, SA-11839
Eastern Michigan University
Michigan Section

I want to become a geologist because of the diverse opportunities in the field and the services we can provide to society. Pursuing this career has provided me with opportunities and experiences I would not have had otherwise. For the majority of my life, I believed I was going to enter the field of veterinary medicine. During high school, I was accepted into a dual-enrollment program where I had the option to take up to sixty free credits worth of college courses. This allowed me to complete my general education credits and entry-level courses to the major I desired which at that point was veterinary science. It was during an entry-level veterinary course in which a professor spoke about the effects of climate change that made me transition from wanting to pursue veterinary medicine to environmental science.

Eastern Michigan University's (EMU) environmental science program provides a variety of different concentrations. Right off the bat, my top two choices for a concentration were the concentration previously known as environmental hydrology and environmental geosciences. Both the hydrology and geoscience concentrations required me to take a few geology courses. At first, I was not that interested in geology. Due to the pandemic, the first couple of introductory geology courses I took were online. The classes being online and living through a pandemic hindered my ability to enjoy the courses to their intended capacity. It was not until I took my first in-person course titled The Earth System Through Time that my seeds for the love of geology were planted. In this course, I learned about the Earth's history from its formation to the present, including the geological events and processes that shaped our world today. Learning this material changed my perspective on how I view the world and made me think and ask questions I never cared to answer before. I also believe that I large component of why I appreciated this course so much was due to the professor who taught it, Dr. Steve Loduca. You can tell as he lectures he is passionate about what he does and as a student, you can not help but start to feel the passion as well. After this course, I decided I wanted to be a geology major and become a geologist.

Since that decision, an overwhelming amount of doors and opportunities opened for me. I met my mentor and advisor Dr. Christopher Gellasch and became an undergraduate researcher under him. For my research, I have had the privilege of traveling to the 2023 and 2024 Geological Society of America Connets conferences to present poster presentations. I have also presented my reach at the university's Undergraduate Symposium. In 2023 I joined EMU's AIPG student chapter, GeoClub at EMU and was elected chapter president for the 2024-2025 school year. Before college, I never thought I would choose geology as my major or career path. I barely even knew it existed as a career. The more immersed I became in my geology courses, I realized that being a geologist is a fulfilling career that encourages continuous learning and offers opportunities to travel the country or even the world. Through EMU's program, I was able to visit and observe the geology of six states that I had never been to before.

The general public often associates geology with the oil and gas industry or a bunch of people who like to look at rocks. These assumptions are not entirely false, but they overlook reality; the field is vast, including various niches and innovations that serve as the foundation for the future. As we observe the effects of climate change through the rise of more extreme weather, geologists are needed more than ever to understand and predict the behavior of the physical Earth under changes in environmental conditions. As a future geologist, I want to use my knowledge and expertise to be a problem solver and preventer. My particular area of interest is in hydrogeology. I want to use that to find solutions for places that have water insecurity or contamination. Later in my career, I want to be able to travel globally to tackle similar situations as well. I also want to become a geologist because I aspire to be a role model for underrepresented communities. It is hard to strive to be something you do not know exists. Thousands of children have no idea that geology is a possible career path. I want the children of these communities to be exposed to geology and geoscience so they can find out how important it is long before they reach college age. I am currently using our AIPG Student Chapter as an agent to fulfill that desire by hosting and attending community outreach events. As a future geologist, my goal is to transform our challenges into opportunities and inspire more geologists for the next generation.

OHIO



Victoria Lambert, SA-12709
Wright State University
Ohio Section

I want to become a geologist because I have always been fascinated with rocks and minerals. Ever since I can remember, I have had a growing collection of rocks, crystals, and fossils from each state or country that I have visited as a keepsake. I started this collection as an alternative to touristy knickknacks where I would try and find rocks that were specific to certain locations and take them home if it was permitted as I am respectful of the local environment.

My interest in geology actually began when I moved to Honolulu, Hawaii, because my dad was in the United States Air Force. We lived on the island of Oahu for three years and our family visited Maui and The Big Island. While on the Big Island, we stayed in a cabin on the grounds of Volcanoes National Park that overlooks the active volcano Kilauea, and played on Punalu'u Beach which is know for its unique black sand. I became fascinated with the many interesting ecosystems I learned about in our travels on the Hawaiian islands. At the Haleakala National on Maui, I began collecting Junior Ranger badges.

I next moved to Kaysville, Utah, where we lived for four years. I hiked parts of the Rocky Mountains and compared the ecological differences caused there to where we had lived in Hawaii. The nearby Farmington Canyon Complex has the oldest rock in Utah, dating to the Precambrian Era. I went camping on Antelope Island, which includes all three types of rocks: igneous, sedimentary, and metamorphic. It is an island located in the Great Salt Lake with so many unique flora and fauna and smelly brine shrimp, the only creature that can survive in that high salt concentration environment. I visited Yellowstone National Park and Grand Teton National

Park, where I learned about the geysers and hydrothermal vents. I was fascinated by the clockwork eruption of the Old Faithful geyser and the different colors of the Morning Glory pool. I viewed the glaciers in the Great Tetons, sculpted U-shaped canyon, and lakes next to the magnificent mountains.



Claire Loeffler, SA-12598
The Ohio State University
Ohio Section

I am what they would've called a wild child. A child who caused my parents to change the lock on the door as a four-year-old because she had a tendency to escape into the woods behind the house. A child fascinated by the way creeks carved into the soil, how tree roots broke through layers of rock, and how the ground beneath seemed to hold stories she couldn't yet interpret. The natural world has always captivated me and as I explored beyond my backyard into the wonders the rest of the world held, I was greeted by landscapes full of untold stories waiting to be discovered.

But it wasn't until high school that I realized these stories could be more than just a personal passion, they could be a career. My first exposure came from an introductory class on geology as a junior. I remember sitting in awe as we delved into the interconnected systems of the Earth, my teacher describing how mountains rose, glaciers shape valleys, and rocks hold clues to Earth's distant past. For the first time, I could connect the natural wonders I'd explored as a child to scientific processes that had shaped them over millions of years. That class was my introduction to geology as a discipline and a possible career, and it sparked a curiosity that has only grown deeper as I gained further understanding.

When I arrived at Ohio State, I knew I wanted to continue studying geology, but I had no idea just how many opportunities I would find. I quickly became involved in laboratory research, where I was introduced to geochemical analysis techniques such as ICP-MS and ICP-OES. Learning how to analyze trace elements in rocks, water, and sediments gave me a new perspective on the field. Through my work I've learned how geology isn't just about understanding the past—it's about applying that knowledge to address challenges like water scarcity, climate change, and environmental sustainability.

One of the most rewarding aspects of my studies has been applying what I've learned to real-world challenges. Beyond the lab, I have been given the opportunity to design my own research to explore the crucial role geochemical processes play in addressing environmental issues like water scarcity and climate change. By studying how glaciers store and release water and analyzing contamination in runoff, I can connect the lithology to the retreat of glaciers to show there are real, tangible impacts on people's health. That's what excites me most about this field—it's not just about understanding the past, but about using that knowledge to solve problems in the present and future. Procuring new data for potential innovation sparks a curiosity in me that drives me to go into the field, ask questions, and discover

Geology allows me to connect the wonder I've always felt for the natural world with a sense of purpose. This field intertwines science, discovery, and problem-solving, and I can't imagine a better way to spend my life than understanding and protecting the planet that lets me be a wild child, fascinated by every new adventure.



Morgan Lesson, SA-12597
The Ohio State University
Ohio Section

Ever since I was a child, I have been fascinated with the outdoors and science. I loved fossils and spent many of my days at the Cleveland Museum of Natural History, knowing that one day, I wanted to become a paleontologist. Naturally, my favorite place inside of the museum was the dinosaur hall. I was obsessed with the PBS Kids show, Dinosaur Train and was thrilled when I had the chance to meet Dr. Scott D. Sampson, the paleontologist featured on the show. Even at such a young age, I was inspired by his work and wanted to be a part of uncovering Earth's prehistoric past.

I have been fortunate enough to visit many national parks with my family. Many years ago, we took a cross-country road trip along Route 66 in our camper. The locations that stood out to me the most were the parks that had unique geological features: my favorite being the Grand Canyon with its vast landscape and colorful layers of strata. This trip with my family was very influential on my life and allowed me to understand my place on Earth. From early on, I have always been very curious about the world around me and continue to ask questions. I know that these focal values of my life will be utilized and are a perfect match for a career in geology.

As I grew older, I continued to stay connected to the Earth sciences and was involved in environmental, climate advocacy and sustainability work through clubs at school. I am an Eagle Scout, and during my time in the BSA (now Scouting America) program, I was able to directly impact my community by engaging in conservation related service with both my troop and my Eagle Scout Service Project. This hands-on work allowed me to realize that a career in the Earth sciences was meant for me. When I applied to college, I felt that my goal was to study the Earth and find a way to connect my passion for conservation with my future career.

Currently, I am working towards a bachelor's degree in Earth Science with a focus in the geological sciences. I am also on track to earn the Certificate in Natural History Museum Curation. After I graduate, I plan to attend graduate school to earn a doctoral degree. I hope to research areas related to vertebrate paleontology, invertebrate paleontology, paleobotany, paleoecology, and conservation paleobiology. My long-term goal is to work at a natural history museum and be able to balance field work with museum responsibilities, such as curation and collections management. I aspire to contribute to academic research and public education to further the field of geology. I understand that my career path may change, however, since geology is so broad, there are plenty of other branches that I could feel fulfilled in if I decide to take another route. Geology is full of opportunities to advance, gain knowledge about the world, and truly make a difference.

I understand how important research is to the progress of science and society as a whole. Paleontology utilizes the history of the Earth to make predictions and learn more about our future which, in this day and age, is incredibly important. For example, the changes occurring in our climate as well as the mass extinction events that are occurring due to these changes are very relevant today. Geology in its entirety works to connect the beginning of the Earth, its processes and products with the current state of its existence and is integral to our survival and progress. By studying Earth's history and changes, I hope to offer solutions that will benefit both our planet and future generations.



Geo-Influencers

Hannah Weaver, ECP-1014

The term “influencer” has gained popularity amongst younger generations and those tuned in to the various social media outlets. It commonly refers to an individual, with a large social media following, who can influence the opinions or actions of others. While most influencers focus on promoting products or services, I’ve found several that promote the subject we all love, the reason we subscribe to The Professional Geologist: geology. Thus, I call them, “geo-influencers.”

I know, historically, social media is not thought of as the best way to get scientific information, but it turns out there is a plethora of genuine sources for geoscience education on various digital and social media platforms; and I think other AIPG members may be interested in following them along with me. Therefore, I’ve rounded up some of the most popular profiles that provide legitimate, entertaining, geoscience-focused videos, posts, and other resources for audiences ranging from the non-technical to PhD-level. Please understand, this is not an all-inclusive list. I encourage you all to explore more “geo-influencers” and send me your favorites!

Shawn Willsey
Shawn Willsey: Geology Explained
https://www.youtube.com/@shawnwillsey

Variety of engaging videos featuring geology from a variety of locations throughout the western US and beyond. Includes field-based and lecture style videos as well as short lessons on rocks and other topics. Viewers are treated as fellow learners exploring Earth's wonders together as part of a collective "team."

Alexis Dahl
Alexis Dahl: Science, Stories and Wonder from Michigan
https://www.youtube.com/@AlexisDahl

This channel follows Dahl’s adventures trying to better understand and connect with their home state of Michigan. Featuring enthusiastic videos on various topics spanning geologic and human history, infrastructure, and interesting natural and man-made features throughout Michigan.



Phillip Prince
The Geo Models
https://www.youtube.com/@thegeomodels

This channel follows Dahl’s adventures trying to better understand and connect with their home state of Michigan. Featuring enthusiastic videos on various topics spanning geologic and human history, infrastructure, and interesting natural and man-made features throughout Michigan.

PlanetGeo: The Geology Podcast
https://planetgeocast.com/

Hosted by Penn State geoscience professor, Dr. Jesse Reimick, and the high school geology teacher that inspired Reimick’s geoscience career, Chris Bolhuis,The PlanetGeo podcast combines deep dives on geology-adjacent topics and interviews with top scientists, writers, and leaders in our field.



Eyes on Earth Podcast
https://www.usgs.gov/centers/eros/eyes-earth

Eyes on Earth is a podcast on remote sensing, Earth observation, land change and science, presented by the USGS Earth Resources Observation and Science (EROS) Center.

Seismic Soundoff Podcast
https://seg.org/resources/podcast/

Seismic soundoff showcases conversations addressing the challenges of energy, water, and climate. Produced by the Society of Exploration Geophysicists (SEG), the episodes feature in-depth discussions in applied geophysics.



Geo Rutherford
@Geo Rutherford
www.georutherford.com

Features entertaining videos on limnology and geography education. Hosts "spooky lake month" every October, presenting daily videos on mysterious limnology phenomena.



Codi Lazar
@tectonic_city
www.youtube.com/@tectonic_city

California geology professor; posts humorous geoscience graphics and memes about teaching geology, geoscience-related news, and geology puns.



Cate Larson
@groovygeologist
www.groovygeologist.com

Gen-Z geology communicator; casual, entertaining geoscience-education posts and videos. Features field work, humor, and geoscience-modified pop culture memes.

Special thanks to 2025 AIPG President Sara Pearson for sharing some of her favorite "geo-influencers" with me to add to this list!







On the Shoulders of Giants:
How Ancient Thinkers Shaped Modern Geology

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

The record of geological thought begins with observations made by early Greek philosophers. Writers such as Xenophanes, Aristotle, and Eratosthenes made many of the first recorded geological observations and conducted the first scientific calculations to describe Earth. As early as the 6th century B.C., Greek philosophers such as Pythagoras began to suggest that Earth was a sphere. A century later, Xenophanes, was the first to document the presence of marine fossils near the tops of mountains and, a century after Xenophanes, Aristotle documented that Earths surficial processes resulted in very slow changes. Aristotle's successor, Theophrastus, was the first to attempt a classification of rocks, minerals, and sediments. Eratosthenes, who was both a mathematician and a geographer, made the first attempt to classify minerals by their physical properties and described minerals, ores, and building stones in his book, *On Stones*. Perhaps the greatest leap forward by the Greek philosophers was Eratosthenes astonishing calculation of the circumference of the Earth to be 252,000 Stadia (a distance between 24,200 and 25,050 miles, because the exact length of a stadia is unknown but estimated to be between 509 and 525 feet). This calculation is within 1% of the known circumference of the Earth, a remarkable achievement for a man using only a stadia rod and geometry.

Roman scientists and philosophers continued to move forward with the study of Earth. Chief among these early scientists was Pliny the Elder, who compiled the *Naturalis Historia* (Natural History) which became the model upon which the concept of the Encyclopedia was based. Among Pliny's contributions was an expansion of the mineralogical work started by Theophrastus. Pliny also delved into crystallography, describing the octahedral shape of diamonds, and was the first to describe using one mineral to scratch another as part of fraud detection, predating the Moh's Hardness Scale by roughly 1,700 years.

However, not all contributions to geological thought were recognized in the west. Approximately 1000 AD, Ibn Sina, a Persian polymath who extensively read Aristotle, began to formulate his ideas on the processes that shape Earth's surface. Ibn Sina wrote a treatise on the geology of the Amu Darya River in Uzbekistan, along the border of modern Turkmenistan and Afghanistan. He commented that rocks could be formed "from water and mud" or "from fire", presaging two of the three primary types of rocks. Ibn Sina also described the basics of stratigraphy when he wrote:

> *"It is also possible that the sea may have happened to flow little by little over the land consisting of both plain and mountain and then have ebbed away from it. It is possible that each time the land was exposed by the ebbing of the sea a layer was left, since we see that some mountains appear to have been piled up layer by layer, and it is therefore likely that the clay from which they were formed was itself at one time arranged in layers."*

This statement is among the earliest examples of the Principle of Original Horizontality. Sina went on to state that *"One layer was formed first, then at a different period, a further layer was formed and piled, upon the first, and so on"* a statement of the Principle of Superposition some 700 years prior to the statement by Nicholas Steno.

By 1500 AD, the study of Earth had progressed to the point that the first scientific texts that provided a systematic, observational description of Earth materials and processes were produced. Among the most important of these were two authored by Georgius Agricola, a German scholar from a small town in Saxony. The first, *De Natura Fossilium*, was the first comprehensive attempt to classify rocks, minerals, and sediments using a strictly observational method. The second, *De Re Metallica*, was the first attempt to describe the formation of ores, as well as detailed descriptions of methods of mining and smelting ores. For nearly a century, *De Re Metallica* was **THE** source of information on mining.

> ***Lyell's work ushered in the modern study of geology and provided scientific evidence that Earth had existed for millennia, an observation upon which Charles Darwin would rely as he outlined his thoughts on evolution and natural selection.***

The 18th century saw one of the defining arguments in geology as the Neptunists argued that all rocks, even igneous rocks such as basalt and granite, were formed by deposition from a universal ocean. The Plutonists argued that some rocks were formed from molten material and were later weathered upon exposure at Earth's surface. In his 1788 work, *Theory of the Earth*, James Hutton laid out many of the basic principles of geology. Among them was a discussion of plutonism, as well as a statement of the Principle of Uniformitarianism. By 1795, Hutton had published a three-volume work titled *An Investigation of the Principles of Knowledge and of the Progress of Reason, from Sense to Science and Philosophy*, which clocked in at more than 2,000 pages. This great length, combined

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Code Red for Geoscience:

A Unified Call to Defend Credibility and Act for Our Future

Sara Pearson, CPG-10650
sara.pearson@wmich.edu

Geoscientists are, and have always been, indispensable contributors to the fabric of society, providing the foundational knowledge for finding clay for pots and flint for arrowheads and tools, prudent resource management, ensuring secure and efficient access to critical minerals essential for modern technology and national security, supporting sustainable agriculture and the protections and management of vital water resources, guiding infrastructure development, and helping communities prepare for and mitigate natural hazards. Our expertise underpins national priorities, from economic vitality to environmental stewardship, and it was with a profound understanding of this vital role, coupled with a recognition of the need for public trust, that the American Institute of Professional Geologists (AIPG) was established in 1963. Our founding fathers perceived a dual necessity: to actively promote the geosciences as a respected and essential profession, and critically, to protect the public from unscrupulous individuals who might falsely claim expertise they did not possess. They astutely identified rigorous certification of individuals—based on verifiable education, extensive experience, and a solemn pledge to a stringent code of ethics—as the most effective means to visibly distinguish qualified professionals committed to integrity, thereby establishing a trusted standard of excellence and fostering professional credibility.

> **"We are no longer merely witnessing an "erosion" of public confidence; we are enduring a daily barrage where established scientific consensus is casually rejected in favor of unfounded, often deliberately misleading, and long-debunked information."**

The professional credibility painstakingly established by our field and the very operational capacity of our profession are now confronting an existential crisis, an alarming escalation from previous concerns into a full-blown systemic threat. We are no longer merely witnessing an "erosion" of public confidence; we are enduring a daily barrage where established scientific consensus is casually rejected in favor of unfounded, often deliberately misleading, and long-debunked information. A painful and dangerous paradox has emerged: while national rhetoric increasingly acknowledges the critical importance of geoscientific contributions to energy reliance, strategic mapping, critical mineral supply chains, and workforce development for national security, the tangible commitment in the form of federal funding for the research, for the public scientific resources that underpin this work, and for the educational institutions that train our successors, is being drastically scaled back. This abandonment at the national level thrusts an untenable burden onto often ill-equipped state agencies and the fluctuating priorities of private industry.

This fiscal retreat is dangerously synchronized with the active dismantling of our academic pipeline. Even as AGI data from 2023 shows the U.S. had 643 four-year degree-granting geoscience programs and 385 Masters-granting programs (part of 1,907 such programs identified worldwide), we see these vital nurseries of future expertise being shuttered or diluted—consider the legislative threat in Indiana, where arbitrary enrollment thresholds could extinguish all but one program, or the University of Toledo's decision to eliminate its dedicated geology degree for a broader, less geologically rigorous environmental course of study. This occurs even as AGI projects a 5.6% increase in geoscience-related jobs by 2033. However, this future projection starkly contrasts with the alarming reality of the present: according to AGI, between February 2025 and March 2025 alone, geoscience employment plummeted by 13%, a staggering loss of nearly 39,916 jobs. How can we possibly bridge the gap to meet future demands when the present is characterized by such severe contractions and the educational pathways are visibly narrowing? Will the needed professionals emerge from the dizzying array of courses on platforms like Udemy, where what "appears" to be an individual such as "Geo Pro" who offer purportedly comprehensive training, including practice tests for the rigorous ASBOG licensure exam, for less than $50? I reached out to ASBOG's Executive Director Deana Sneyd to ask her whether she knew anything about the course. She said that it is an AI generated course that should not be used as a study tool. While there may be some such offerings that might have merit, the overarching system lacks transparent vetting or adherence to established educational standards. How can we, or the public, verify if a certificate from such a course signifies genuine understanding of complex geological processes, or if it's merely a digital token purchased at a steep discount? The stark reality of this devaluation of expertise is further embodied by "accredited" "certification courses" advertised on social media, like the one **Peter Dohms,** CPG-7141 sent to **David Abbott, Jr.**, CPG-4570, and I have seen myself in my social media feed highlighting an

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Answers on Page 39



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

1. These sequences are found on land at the core of mountain chains. They consist of cherts that overlie basalt, overlying gabbro, overlying ultramafic igneous rocks. They are equivalent to present-day siliceous ooze, overlying oceanic crust that rests upon mantle rock. These lithologies form part of the process of mountain building that involves tectonic plate collisions.

a) Molasse sequences.
b) Ophiolite sequences.
c) Coolkulite sequences.
d) Quartz arenite sequences.
e) Flysch sequences.

2. The Cayman Trench or Cayman Trough is a complex transform-fault, pull-apart basin that has a small spreading ridge (Cayman Rise). The Cayman Trough marks the boundary between the North American and Caribbean tectonic plates. It marks the deepest part of the Caribbean Sea (>25,000 feet deep). It lies between or separates the following islands:

a) Martinique from St. Lucia and St. Vincent.
b) Cuba from Hispaniola and Puerto Rico.
c) Seychelles from Aruba and Bonaire.
d) Haiti from the Dominican Republic.
e) Caimans are mean, dude! I was playing golf at this resort and a hungry caiman came out of a pond and ate my golf ball, my putter, my cap, my bag of Cheetos….



3. "Creep" is best defined as:

a) Ductile flow resulting from high strain rates.
b) A slow-moving intermediate or felsic lava flow of high viscosity travelling over a considerable horizontal distace from the erupting vent.
c) The churning and stirring of sediment by slow-burrowing organisms.
d) Slow deformation under small constant stresses acting over long periods of time.
e) A weird dude who is definitely not "cool."

4. This famous geoscientist is known for contributions regarding radioactive dating and mantle convection as a mechanism of motion in continental drift:

a) Arthur Holmes.
b) Inge Lehmann.
c) Karl von Terzaghi.
d) Edward Bullard.
e) Albert William Kaline.

5. During times of polarity reversals of the Earth's magnetic poles:



a) The magnetic field weakens, but it doesn't completely disappear. The magnetosphere, together with Earth's atmosphere would continue to provide some protection.
b) The planet would be more vulnerable to the detrimental action of cosmic rays and charged solar particles.
c) Disruptions of flow in the Earth's molten core (changes in convection patterns) may trigger the event.
d) There is not a clear, direct correlation between major mass extinction and magnetic pole reversal.
e) Come on, dude, everyone knows the answer to this one. When magnetic poles flip-flop penguins migrate north, and polar bears move south!

President's Message, Continued from p. 33

accredited certification program for "Geobiology," which shockingly features the pseudoscience of dowsing to find water and a learning objective of how geobiology is different from Feng Shui. The Alma Oasis website even states, " Becoming a geobiologist requires a solid grounding in geology, physics, dowsing, and energy work. Our training program is designed to provide you with all the knowledge and tools you need to serve your clients effectively."[1] This isn't just a dilution; it's a dangerous pollution of the public understanding of our field and a potential subversion of the very certification and licensing standards we strive to uphold.

How can the public clearly distinguish between a geobiology program that is merely touted as 'accredited' and a legitimate scientific degree in geobiology from renowned institutions like the University of Michigan, Stanford, Harvard, Penn State, Indiana University Bloomington, and others? For more about the pseudoscience geobiology program, I encourage you to read David Abbott's *Professional Ethics and Practices* column 195 in the next edition of *TPG*.

Given this escalating crisis that threatens the very foundations of our profession and its ability to serve society, the time for cautious observation or polite calls for change is definitively over; an immediate, unified, and forceful response is imperative. We, as geoscientists, individually and collectively, must rise to meet this challenge with unprecedented resolve, making the rigorously gathered, ethically interpreted, and clearly communicated scientific truth an undeniable and louder force than the pervasive noise of misinformation and neglect. Therefore, the original mission and mechanisms of AIPG, particularly its commitment to individual certification (CPG), are not merely still relevant; they have become more critically important now than at any point since our inception. This certification is our most potent shield against charlatanism, our clearest beacon for the public and policymakers seeking genuine, trustworthy expertise. We must aggressively champion the CPG as the unambiguous gold standard. We must actively and vocally fight for the restoration of funding for geoscientific research and education, advocate fiercely against the closure of vital university programs, and relentlessly challenge the spread of misinformation at every turn—in public forums, in policy discussions, and across the digital landscape where these falsehoods proliferate. This requires us to step up our game, to embrace modern communication channels as our founding fathers embraced the tools of their time, to educate, to inspire, and to shore up our professional credibility and build deeper public trust not just through our credentials but through consistent, transparent, and respectful engagement. The stakes are incredibly high—the continued relevance and integrity of our profession, the safety and prosperity of our communities, and the very capacity of our nation to make informed decisions about its future. Let us ensure that our collective voice, fortified by expertise and anchored by ethical commitment, is the one that resonates with clarity and authority, guiding us through this crisis and fortifying our professional credibility while earning a new era of trusted geoscientific leadership.

A Call for Unified Action: A New Collaborative - Geo-ACTS

To translate this urgency into focused action and to effectively marshal our collective strength, I am formally proposing the initiation of a new AIPG collaborative effort. The Geoscience Advocacy, Credibility, Training, and Standards or Geo-ACTS collaborative will be dedicated to developing and implementing strategies to combat misinformation, advocate for robust funding and educational programs, champion professional certification, and ultimately, unite our members in a concerted effort to safeguard and elevate the geoscientific profession. By calling it a collaborative, I invite the participation of our sister organizations to join. I call upon each of you to consider how you can contribute to this vital initiative as we stand together for the future of geoscience.

To translate this urgency into focused action and to effectively marshal our collective strength, I am formally proposing the initiation of a new AIPG collaborative effort because this challenge is not unique to AIPG, but we as the advocates of the profession are in a unique place to take the lead. This collaborative will be dedicated to developing and implementing strategies to combat misinformation, advocate for robust funding and educational programs, champion professional certification, and ultimately, unite our members in a concerted effort to safeguard and elevate the geoscientific profession.

"We, as geoscientists, individually and collectively, must rise to meet this challenge with unprecedented resolve, making the rigorously gathered, ethically interpreted, and clearly communicated scientific truth an undeniable and louder force than the pervasive noise of misinformation and neglect."

For those ready to take an active role and lend their expertise to this new group, please express your interest by contacting me directly at sara.pearson@wmich.edu. We are eager to assemble a dedicated team and will be providing further details regarding the collaborative's structure and first meeting in the near future. Your commitment is crucial as we embark on this important endeavor.

I call upon each of you to consider how you can contribute to this vital initiative as we stand together for the future of geoscience. In conclusion, our role in this digital age is clear. We must become active stewards of truth, educators who simplify complex concepts without diluting their essence, and passionate professionals who set the highest standards of competency and ethics. Together, we can reshape the narrative around science and reaffirm the indispensable value of geoscience in society.

1. https://almaoasis.com/product/geobiology-certification-course/



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

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

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

DEI in AIPG

Thomas Rankin, CPG-09404, wrote, "You may not think so, but your article regarding DEI in 'The Professional Geologist' [column 192, Jan '21] is political in tone and content and I was not very comfortable reading it. Most adults have very strong political opinions that are 180 degrees out of phase of one another and as such, trying to explain your opinion regarding DEI and have the polar opposite finish your article and say, "ya know, Dave is right", is zero.

"I love and treat everyone with respect no matter who you are or what you do, as long as you are not hurting anyone, obey existing laws, and treat me with the same respect.

"I don't need the government to tell me how I should behave to be quite honest.

"But Thank You just the same."

Tom, thank you for your note. Since I wrote column 192, many organizations have announced they are abandoning their DEI efforts. In a few cases, the DEI concept has been abused by specifying that X number of some group of employees must be members of specified minorities. Such programs are clearly wrong. AIPG has never had such an approach. Just as clearly, the non-white percentage of AIPG's membership is too low. AIPG's DEI Committee has also identified practices that have inhibited the participation in field trips and other activities by those having various disabilities. We should be working to encourage more non-whites to become geoscientists in the same way that women have been encouraged to become geoscientists over the past 50 years. We should also be encouraging members of the general public to learn more about geoscience and how it affects their daily lives. This was the main point of column 192; if that is viewed as political, so be it. I appreciate receiving an alternative viewpoint. Alternative views on any of my columns are welcomed. I also note that the Executive Committee and others are considering abandoning the DEI name because of its adverse political connotations to a name that better describes the committee's purposes.

Geoethics, sustainability, and the unsustainability of resource extraction

Geoethics was among the topics discussed during the March 20th AIPG Ethics Webinar along with the International Association for the Promotion of Geoethics (IAPG). The IAPG was initially supported by over 20 associated geoscience organizations, including AEG, AGI, AGU, EFG, GSA, and GSL. Conspicuously absent from this list are those geoscience organizations focusing on the extraction of natural resources: AAPG, AusIMM, CIM, IMM, SEG, SME, and SAIMM. This reflects the original 9th fundamental value of the IAPG, "Ensuring sustainability of economic and social activities in order to assure future generations' supply of energy and other natural resources." As I pointed out in *Natural resources and sustainability: geoethics fundamentals and reality* (2020, *TPG*, Oct/Nov/Dec) and in Column 178 (July 2021), this statement is oxymoronic, the extraction of natural resources is by definition **unsustainable**. Yet human civilization depends on supplies of natural resources.

Unfortunately, this 9th fundamental value of the IAPG fails to transparently and forthrightly acknowledge the depletability of natural resource deposits thus inhibiting a fully integral and transparent discussion of this geoethics value statement's goal of providing a sustainable supply of natural resources. The depletability of natural resource deposits is a fact of nature. Deposits are size-limited. This same failure to forthrightly acknowledge and address the depletability of natural resource deposits is a major failure of the International Association for the Promotion of Geoethics' (IAPG's) *White Paper on Responsible Mining* (Arvanitidis, et al., 2017).

I recently checked the IAGP's website and little has fundamentally changed. Natural resources-focused professional societies are still not members or affiliates. Sustainability is still a primary goal along with the failure to forthrightly and honestly acknowledge that natural resource deposits are depletable and thus unsustainable even though civilization depends on their supply. **When is the IAGP going to become honest?**

Recycling small batteries

In chapter 9 of *Pitfall: the Race to Mine the World's Most Vulnerable Places* Christopher Pollon discusses recycling as one means of reducing the need to find new deposits and open new mines. One of the things that has always bothered me about government-sponsored recycling programs is their fear that some perceived major polluter will dump his polluting products into the program. For example, a city-wide program for recycling unused paint is not started because painting contractors may take advantage of the program. Isn't recycling more important? Consider, for example, common small batteries, the D, C, AA, AAA, etc. batteries that we all use. Everyone agrees that they shouldn't be thrown out in the trash, but no one is willing to put bins for their recycling into grocery



or convenience stores. What about paying a few cents for each battery recycled, the way we used to pay for recycling pop bottles before pop was put into aluminum cans and plastic bottles? The bins could be collected by those collecting all the bins around town and sending them to the recycling plant. This is how lead-acid car batteries and car catalytic converters are recycled. Stillwater Mining buys recycled catalytic converters to increase the quantities of PGMs in its processing plant and that increases the percentage of palladium and platinum that can be recovered from the primary ore.

other. Rule 4.2.1 of the AIPG Code of Ethics states, "A Member shall not issue (a) false statement(s), (a) misleading statement(s), or (a) sensational, exaggerated, defamatory, and or unwarranted statement(s) regarding a professional colleague. Differences of opinion occur and statements regarding opinions should be restricted to and based on logical and scientific principles and should be made in a respectful and professional manner."

In the second case, I asked "Should a 'reasonableness' standard be added to the prospect's evaluation as soon the materiality of the particular factor to the prospect becomes apparent.

The proposed general Reasonableness standard would be: "The author(s) of geoscience reports or presentations must ensure the Reasonableness of all contained conclusions and recommendations. 'Reasonableness' means that other qualified and experienced geoscientists with access to the same information would consider the author(s)' interpretations and conclusions to be with a reasonable range

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The use of professional judgment

The use of standard practices and the need to use professional judgment when deciding how to proceed with a particular practice were among the topics briefly discussed during the March 20th AIPG Ethics webinar. This discussion brought to mind a couple of topics in previous columns. In column 152 (Oct/Nov/Dec '14), I used the dispute between two well-respected consulting firms about whether the available data allowed for the estimation of gold mineralization at the Brucejack gold deposit in British Columbia. One consulting firm concluded that the results of a bulk-sampling program could not be used for a reliable gold resource estimate, while another consulting firm concluded that a reliable gold resource estimate could be made and did so. The company's release of this estimate was accompanied by the detailed drilling results from 16 of 17 drill fans from the bulk sample area, including 3½ pages of detailed assay results, and also posted a series of maps and cross sections from this drilling on its website. The disclosure of the differing professional opinions had a significant negative impact on the company's stock price. Both consulting firms based their differing professional opinions on their interpretations of the data available at the time. Their statements about the dispute were respectful of each

AIPG Code of Ethics?" (column 182, Jul/Aug/Sep '22). Mineral exploration provides an example of the use of reasonableness. Lots of prospects are examined and selecting the most promising while rejecting the less promising. sampling. Most prospects don't pan out. The potential quantity of mineralization is too small, or the grade is too low. But there are other reasons for rejection, such as the inability to obtain needed mineral rights. Exploration financing fluctuates and when funding is reduced, less promising or less advanced projects are dropped. One or more deleterious elements, such as a radioactive element being present in one or more minerals in the deposit, or the presence of asbestiform minerals are examples. The increasingly important ESG (environmental, social, governmental) issues often arise early in a project's life. The exploration geologist with the first boots on the ground is often the first to learn about such issues, which may or may not be significant. There may be problems with too much water, or too little. All of these other reasons are varieties of modifying factors used in the major mineral resource and mineral reserve classification systems. But the reasonable prospects for economic extraction phrase in the definition of "mineral resources" in the JORC Code (2012), SME Guide (2017), SEC, CRIRSCO (2019), and similar classification systems clearly indicates that the application of a modifying factor such as those listed above are and should be applied to a

of variation. Any standards used, assumptions applied, and any method relied upon should be reasonable within the context of the purpose of the report or presentation. Any method applied in the subject report or presentation should be within the expected capability and consideration of an assumed likely reader of the report or presentation." The purpose of a Reasonableness standard is to ensure that any geoscience reports or presentations reflect a realistic assessment of the purposes of the report or presentation, particularly from the perspective of the assumed reader of the report or presentation. Identification of any unreasonable factors in the report would be legitimate grounds for rejection of the proposed project. No action was taken on this recommendation; should there be? Let me and the Executive Committee know.

Acknowledging uncertainties and limits of current understanding inherent in studies of natural systems

Geoscientists study an area and produce reports expressing their opinions on the likelihood or probability that an ore deposit exists, or that landslides will or will not occur, or that a plume of pollutant will move in a particular direction at a particular rate. In *Degrees of Belief–Subjective Probability*

and Engineering Judgment, 2002, American Society of Civil Engineers, ASCE Press, Steven G. Vick addresses how these probabilities are expressed. Mathematically, probability calculation requires large numbers of statistically valid samples, something we seldom have. People are always seeking certainty, or, if certainty is not achievable, the probability of certainty. As Vick points out, the word *probability* itself is a major part of the problem because there is the well-developed mathematics of frequency probability derived from the analysis of a very large population of statistically homogeneous samples that is very different from the judgmental and subjectively derived degree-of-belief probability related to a single mineral or petroleum deposit or dam or building site. Vick notes that geotechnical and other forms of geologic studies depend on the "drill-test-analyze" paradigm. We collect and analyze samples to determine frequency distributions and related statistics. But underlying sample collection is the professional judgment used to determine what types of samples to collect, what types of tests and analysis to perform on those samples, and the thinking underlying the interpretations we make of the results.

Vick reviews the development of theories of both degree-of-belief and frequency probability. He also presents numerous geotechnical case histories demonstrating the use of both inductive reasoning and judgment and deductive analysis, and the strengths and weaknesses of these approaches. He then delves into the details of subjective or degree-of-belief probabilities, pointing out common pitfalls in their application and how, by understanding the pitfalls, their influence can be reduced, and experts may develop their expertise. Vick concludes with a chapter on "Judgment, Probability, and Thinking" and how they come together. He notes that subjective knowledge and experience lead to judgment, "the ability to distinguish what is important and to interpret meaning and context." This leads to expressions of degree-of-belief probability, a quantified expression of judgment relating to uncertainty. "But thinking is the mortar that cements all this together. Thinking is the most highly personal of all human activities, engaged in by people—not algorithms or machines (at least as far as we know)." Thus, thinking is inherently subjective.

I recognize the importance of professional judgment and believe all geologists should read and re-read Vick's book when analyzing and interpreting the data we collect. Vick has not provided a cookbook, but he has provided a fundamental discussion of the use and misuse of both inductive and deductive reasoning and its quantification we all should know and use in our professional work.[1]

The ethical use of AI in professional work

During the March 20th Ethics Webinar questions and some discussion concerned the use of AI programs in professional work. Some employers prohibit their employees from using AI because of uncertainties about where the data underlying an AI response came from. This is a legitimate concern and is a reason for not using AI. On the other hand, using AI to enhance a graphic presentation of your data or using a program like Grammarly to improve your writing is not a problem. AI programs are still in their infancy, and questions about their use continue to arise. For example, is the use of AI to enhance a photograph ethical or not? At a minimum, you should report the use of AI in any document containing an AI-enhanced photograph. Please contribute your questions, examples, and other comments to this column, as Letters to the *TPG* Editor, or as independent articles to the *TPG.*

1. See review of *Degrees of Belief in The Professional Geologist,* November 2005, p. 14-15.

Former AGI Executive Director Charles Groat Passes Away

The American Geosciences Institute (AGI) is saddened to share the news that colleague and friend Dr. Charles (Chip) Groat passed away on March 14, 2025. A former AGI Executive Director (1990-1992), Dr. Groat received the AGI Medal in Memory of Ian Campbell for Superlative Service to the Geosciences (1998) for his outstanding performance in and contribution to the geoscience profession. Dr. Groat provided leadership to the profession in many roles throughout his career, including as an active member of these AGI Member Societies: the American Association of Petroleum Geologists, the American Geophysical Union, the Association of American State Geologists (AASG), and the Geological Society of America.

Dr. Groat served as associate and acting director of the Bureau of Economic Geology at the University of Texas at Austin (1968-1976) and associate professor in the Department of Geological Sciences (1974-1976). He also was associate professor and chairman of the Department of Geological Sciences at the University of Texas at El Paso (1976-1978). From 1978 to 1990, he was a professor at Louisiana State University's Department of Geology and Geophysics. In government roles, Dr. Groat served as Assistant to the Secretary at the Louisiana Department of Natural Resources (1983-1988) and as Director and State Geologist for the Louisiana Geological Survey (1978-1990). He also served as President of AASG from 1987 to 1988.

After leading AGI in the early 1990s, he became Executive Director of the Center for Coastal, Energy, and Environmental Resources at Louisiana State University (1992-1995). He later joined the University of Texas at El Paso, where he was the Director of the Center for Environmental Resource Management and Director of the Environmental Science and Engineering Ph.D. Program, Professor of Geological Sciences, and Associate Vice President for Research and Sponsored Projects (1995-1998).

Dr. Groat was appointed Director of the U.S. Geological Survey by President Bill Clinton in 1998 and was retained by President George W. Bush. He led the agency until 2005, when he returned to the University of Texas at Austin to direct the Energy and Earth Resources Graduate Program and the Center for International Energy and Environmental Policy. In 2008, he was named interim dean of the Jackson School of Geosciences. Dr. Groat became the founding President and CEO of the Water Institute of the Gulf in 2011. From 2019 to his retirement in 2021, he served again as acting director of the Louisiana Geological Survey.

"Through his tireless work in academia, government, and the nonprofit sector, Chip Groat provided exemplary leadership to the geoscience community over the course of his career," said AGI Executive Director Dr. Jonathan Arthur. "His generous service to the AGI federation and the wider geoscience community has been a priceless benefit to the enterprise."

Answers:

1. The answer is choice "b" or "ophiolite sequences."

Molasse sequences refer to clastic strata such as sandstone, shales, and conglomerates that form as terrestrial or shallow marine deposits along the front of rising mountain chains. These clastic sediments are post-collision orogenic deposits.

Flysch sequences describe sedimentary strata that progress from deep-marine deposits and turbidites to shallow-water sandstones and shales. Flysch sediments are deposited in the foreland basin of a developing orogen. These clastic sediments are pre-collision to syn-collision orogenic deposits.

Quartz arenites have 90% or greater quartz content. These mature sand deposits are generally associated with high-energy environments and long distance of transport from the original source.

If you ever find a coolkulite sequence, be sure to let me know what it is.

2. The answer is choice "b" or "Cuba from Hispaniola and Puerto Rico.

The islands of Martinique, St. Lucia and St. Vincent are part of the "Lesser Antilles"; a volcanic island arc associated with the eastern boundary of the Caribbean tectonic plate (subduction zone). Seventeen active volcanoes are part of the island arc including Soufrière Hills on Montserrat, Mount Pelée on Martinique, La Grande Soufrière on Guadeloupe, Soufrière Saint Vincent on Saint Vincent, and the submarine volcano Kick 'em Jenny which lies about 10 kilometers north of Grenada.

The Seychelles are not in the Caribbean area, but are found in the Indian Ocean, east of Africa and northeast of Madagascar.

Aruba, Curaçao and Bonaire are volcanic islands associated with the geologically complex southern Caribbean plate tectonic boundary. In this area, the Caribbean Plate interacts with the South American Plate forming Barbados, Trinidad and Tobago and islands off the coast of Venezuela and Colombia. This boundary is a combination of transform faulting along with thrust faulting and some subduction.

Haiti and the Dominican Republic form the island of Hispaniola with Haiti on the west and the Dominican Republic on the east.



Location of the Cayman trough (trench).

3. The answer is choice "d" or "Slow deformation under small constant stresses acting over long periods of time."

In rock deformation, high strain rates are often related to brittle failure. Ductility refers to total percent deformation before rupture. Ductile flow is the opposite of brittle behavior. Ductile flow is influenced by the environmental conditions and the earth materials involved. For example, high temperatures promote ductile flow. Given the same set of environmental conditions, dolomite is more brittle than limestone. Under certain circumstances some earth materials may be prone to strain hardening where, beyond the yield point, stress rises with increasing strain. Strain hardening reduces ductility which increases the chances of brittle rupture.


Soil creep and landsliding over the Austin Chalk in the Bosque Escarpment area at Waco, Texas.

Intermediate and felsic lava flow of high viscosity do not travel very far from the source of the eruption. Slow-moving, viscous andesite flows rarely extend more than a few kilometers from their vents. Rhyolite and dacite lava flows of even greater viscosity may form steep-sided lava domes over the erupting vents.

The churning and stirring of sediments by burrowing organisms describes "bioturbation."

4. The answer is choice "a" or "Arthur Holmes", an English geoscientist (1890 – 1965).

Inge Lehmann (1888 – 1993) was a Danish seismologist accredited with the discovery of the Earth's solid inner core and molten outer core based on data from seismic waves.

Karl von Terzaghi (1883 – 1963) was an engineer known as the father of soil mechanics and geotechnical engineering. He was born in Prague (Austria-Hungary; now in the Czech Republic).

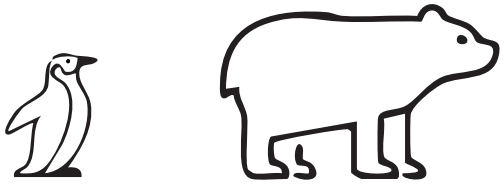
Edward Bullard (1907 – 1980) was an English geophysicist best known for the geodynamo theory that explains the Earth's magnetic field. Bullard and the American geophysicist and oceanographer Maurice Ewing are credited as the founders of the discipline of marine geophysics.

Al Kaline (1934 – 2020) was not a geoscientist, but a famous professional baseball player. Known as "Mr. Tiger", he was the right

fielder and later first baseman and DH for the Detroit Tigers ball club for 22 seasons. He retired with 3,007 hits and 399 home runs.

5. The answer is choice "a" or "20 feet; the structure is synclinal."

Now, about penguins and polar bears…



Executive Director's Message, continued from p. 32

with Hutton's ponderous and generally unreadable style, rendered the information useless to all but the most dedicated readers.

It was not until Charles Lyell authored *Principles of Geology*, a three-volume work that was published between 1830 and 1833, that modern geological thought was presented in a way that could be readily digested by a literate, but non-specialist audience. Lyell's work ushered in the modern study of geology and provided scientific evidence that Earth had existed for millennia, an observation upon which Charles Darwin would rely as he outlined his thoughts on evolution and natural selection.

> ***Just as Eratosthenes, Pliny, Ibn Sina, and Lyell adhered to the strictest academic standards, you adhere to the highest professional standards.***

Each of these early scientists was driven by a thirst for knowledge and guided by the observations and data collected, regardless of where those data led. Each published their work, welcoming debate and criticism of that work, to sharpen their focus and derive the most plausible explanation based on the evidence at hand.

In the nearly 200 years since Lyell published his work, the science of geology has expanded to touch every aspect of modern society. Geologists have made remarkable strides and developed new techniques to better understand Earth and to locate and extract the materials that are critical for the development of the modern world. In many cases the immediate application of a new discovery was not readily apparent, and it was only after another geologist (or engineer) recognized the application that the true value of a specific advancement could be realized. Thus, the value of stable isotope mass spectrometry was unrecognized until it could be applied to mineral exploration or used to reconstruct past depositional environments, guiding petroleum exploration, or providing insight into the geological history of specific locations.

Today's geologists stand on the shoulders of these geological giants. We use our combined knowledge to protect the public, to provide the resources required for society, and to solve problems when they arise. Your membership in and, for many of you, certification by AIPG, demonstrates your commitment to the highest professional and ethical standards. Just as Eratosthenes, Pliny, Ibn Sina, and Lyell adhered to the strictest academic standards, you adhere to the highest professional standards. Your choice to be bound by our code of ethics illustrates your commitment to geological excellence.

At AIPG, we will continue to support our members and to advocate for our profession at all levels. Your support makes that advocacy possible. As the global competition for resources increases, it will become even more important that AIPG and our members take a leading role in the ethical, professional practice of geology.

With best regards,

Aaron W. Johnson, CPG-12229

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A Geologic Enigma Illustrating the Method of Multiple Working Hypotheses

William J. Elliott, CPG-04194

Mono Lake basin is located in east-central California, at the north-south-trending boundary between the Basin and Range Province (to the east) and the Sierra Nevada Mountains (to the west). At the western edge of Mono Lake, a steep granitic/metamorphic slope rises at a 32° angle, westward and away from Mono Lake (Figure 1). This boundary is the locus of the buried Lee Vining, down-to-the basin (east) fault (Bailey, 1989).

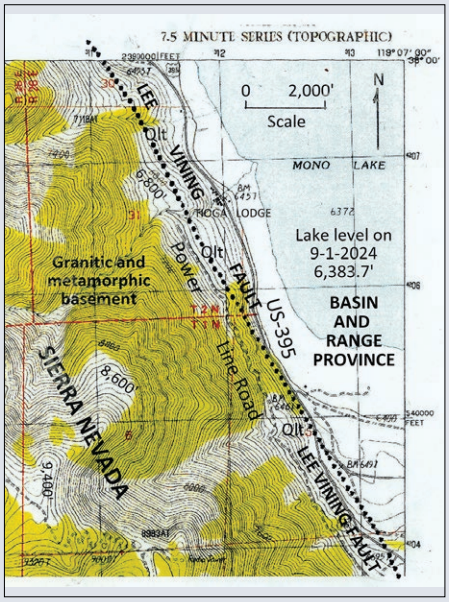


Figure 1. Mount Dana 7½' Quadrangle, CA
Qlt = Pluvial Lake Russell Terrace Deposits butting up against Sierra basement rock. Power line road is the approximate contact.

US-395 parallels this boundary along the west side of the lake.

While I have been driving this short stretch of highway between Lee Vining and Conway Summit over the years, several questions regarding the nature of the geology along it have occurred to me.

For instance, road cuts on the west side of US-395 look for all the world like a jumbled mass of rock that one would expect to see at the toe of a major landslide (Figure 2). Before the April 2016, Marina Fire, this hillside was completely covered and obscured by trees and underbrush – making a reasonable geologic assessment from the highway a "best guess", at best.



Figure 2. Jumbled possible slide debris in road cut on west side of US-395.

Following the Marina Fire, the slope was denuded and laid bare, opening the landscape to interpretation.

Thus, ancient shorelines created during former high stands of pluvial Lake Russell are now easily observed on the hillside along the west side of the Mono Basin (Figure 3). The associated lake terrace deposits left over from these high stands also stand out prominently on the barren slope above US-395 (Bailey, 1989; Figure 4).

What was originally thought to be, perhaps "the toe of a major landslide" related to the steep hillside on the west, now appears to be no more than debris that has sloughed off the lake-side edges of these old lake terrace deposits.

With that in mind, one is again reminded of the importance of utilizing The Method of Multiple Working Hypotheses (Chamberlain,



Figure 3. View to the west of three pluvial Lake Russell high-stand shorelines. Marina Fire, April 2016, denuded this hillside.

Continued on p. 47

Can you help me find my lot?

Peter Dohms, CPG-07141

It was 1975 and our exploration office had made what we thought was a discovery in far SW Arizona, a unique deposit type that none of us had ever worked with before. Vuggy veins comprised of quartz, calcite, fluorite, barite, iron oxides, lead minerals, zinc minerals, and abundant silver. Thicknesses sometimes greater than 100 feet. I had been dispatched to search the surrounding areas for similar occurrences and, on this day, I was traversing the west side of the Colorado River between Yuma, Arizona and Blythe, California. It was afternoon; earlier in the day I had looked at the old Paymaster Mine and had also found a prospect near the River that had some similarities to what we were finding on the Arizona side.

When you drive about 45 on a washboard road, the vehicle moves much more smoothly than when you are traveling at a more reasonable rate of speed. It was getting towards "beer-thirty" and Blythe was still 20 miles away. I saw some high-tension power lines approaching, with a small, informal campground beneath. There were a number of men standing around and they waved me down. It developed that one of them was looking for "his land," and could I help? So, I dropped the tailgate and spread out maps of the area.

It turned out that the man looking for his property had purchased it sight unseen in reply to a newspaper ad in Los Angeles ("Buy five acres in the Desert and move out of the smog;" you get the picture). Internally, I rolled my eyes. I asked to see the paperwork and was shown a "deed." The lot was described using the section subdivisions of the Cadastral Survey, something like "The South Half of the Southwest Quarter of the Southeast Quarter of the Northeast Quarter of Section xx, Township 10 South, Range 20 East, San Bernardino Baseline and Meridian." Oh boy! A five-acre, unsurveyed lot in the desert.

Well, my maps covered that part of the referenced township, so I started to work my way down to the five acres in question. I saw that the section was just a short distance south of the powerlines we were underneath, and that a small road dropped south from the powerline trail a bit west of the section, and that there was another road (or jeep track, or mule track) shown on the map at about what appeared to be the north boundary of the section should be. So, I jotted down a few notes and addressed the group. "OK, this is about how you get there. Drive along this powerline road for about 8.4 miles and you will see a road to your left going south. Turn onto that road and drive about 0.6 miles and you will see a jeep trail (or mule trail) on your left going east. Take that trail for about 1.25 miles, stop, get out, walk about 2,310 feet due south, and you will arrive at the northwest corner of your lot; be advised, the lot is NOT surveyed so there will be no markers on the ground;" hoping all the while that these directions and cautions would be enough to cool the interest of the owner. Nope; he wanted to find his lot and he told me he was ready to set up housekeeping before sundown.

I looked at his rig. A sedan pulling a small, broken-down trailer. I continued; "OK, my best advice is to drive back to Blythe and see if you can rent a jeep. My second-best advice, if you're determined, is unhook the trailer and leave it right here with these good people. Then scout your route, and don't try to cross any soft sand or sharp gullies. The desert is unforgiving." He seemed to think my "second-best" advice was the way to go. So I asked, "How about water?" He replied that he would get a friend to help dig a well. I played my final card; "What about power?" He waved his hand at the 350,000 volt overhead lines and expressed the opinion that he would get with the power company to drop a connection. At that point I was defeated; I said, "I have to be on my way; best of luck to you." There is no way of knowing if he ever got to his "lot."



STEAK SAUCE

Peter Dohms, CPG-07141

Field work sometimes comes with unexpected adventures in dining. Now, if you're doing a prolonged project from a camp, you get to know what to expect. But if you're doing a project involving brief initial reconnaissance in a large area, with moves from town to town, sometimes you can encounter a surprise.

During the early 1970s I was based in Tucson, Arizona. When the summer months came, my boss would have the two of us travel north for extended reconnaissance. At the time, our preferred target was "bulk tonnage, low grade silver deposits," with selections to visit based on a previous literature search (our office was blessed with a fine reference library). In the course of our travels, we wound up in a small town in far eastern Nevada; a good distance north of Las Vegas. Our area of interest centered on some jasperoid occurrences I had picked out during the literature search.

When we checked into the small motel we asked the proprietor about restaurants; there were two in town. One in the historic "downtown" of the old mining camp, the other out by the highway "bypass." We were planning to stay two or three nights, so we decided to go downtown first. Looking at the menu, my boss John decided he would order a steak. The waitress asked if he wanted any "steak sauce or A-1." He replied, "Only if it's a lousy steak," his usual answer. Typically everyone would laugh, and no steak sauce would ever appear. This time, however, the waitress didn't laugh; she turned away and returned with steak sauce.

I looked at John, and John looked at me. One of us said, "This isn't a good sign." That, unfortunately, turned out to be correct. The next night we ate at the other restaurant.



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Maps, Apps, & Databases:

Free Online Toolkits for Geologists

Rasoul Sorkhabi, Ph.D., CPG-11981

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

Several geological map portals, apps, and databases are available online for free use by geologists – researchers, students, and teachers. In this article, I introduce and briefly describe some of them.

Geoscientist toolkit: Maps

Nowadays one can access geological maps of various countries and states through their geological surveys. But there are several international initiatives that offer digital dynamic geological maps with global to continental coverage. The following are some of these major online platforms.

1. OneGeology

OneGeology[1] is an international collaborative geology project supported by 118 countries through the leadership of UNESCO. This project was initiated as part of the 2008 International Year of Planet Earth. OneGeology portal was launched in 2008 at the 33rd International Geological Congress in Oslo, Norway.

2. Macrostrat

Macrostrat[2] is "a platform for geological data exploration, integration, and analysis." An article by Peters et al (2018)[3] describes this platform.

Macrostrat includes 2,540,323 geologic map polygons, 51,212 stratigraphic names, 35,481 rock units, and 1,534 regional rock columns.

Macrostrat contains multidisciplinary data helpful for petrologists, stratigraphers, paleontologists, and geochronologists, among others. With data from both outcrops and subsurface formations, petroleum geologists working in North and South America will find Macrostrat especially useful.

The project was funded by the US National Science Foundation (NSF) with support from the University of Wisconsin-Madison.

3. European Geological Data Infrastructure (EGDI)

EGDI platform is a collaborative project on geological information across Europe. It was launched in 2016 and has expanded since then. It is supported by 48 partners.

The portal includes Map Viewer[4] and Data Search[5]. The Map Viewer has options to download GSI files, so you can include them in your data and presentations. More than 800 map layers are available. The subsurface data available is from thousands of experts in 37 national and regional geological surveys across Europe. A YouTube clip[6] from Geological Service for Europe provides more information about EGDI.

The various geologic data are harmonized for all of Europe, so projects examining the continent as a whole or trying to draw conclusions at the regional level may find it most helpful. The database also contains environmental topics such as groundwater and soil, which are of help to researchers who need analytical data for environmental assessment projects.

4. US Geological Survey Maps

USGS platforms offer "The National Geologic Map Database" (NGMDB) and "World Geologic Maps".

1. https://onegeology.org/
2. https://macrostrat.org/
3. Peters, S. E., Husson, J. M., & Czaplewski, J. (2018). Macrostrat: a platform for geological data integration and deep-time earth crust research. Geochemistry, Geophysics, Geosystems, 19(4), 1393-1409.
4. https://www.europe-geology.eu/data-tools/map-viewer/
5. https://www.europe-geology.eu/data-tools/data-search/
6. https://www.youtube.com/watch?v=yL6WBvOjzf4&t=5s
7. https://ngmdb.usgs.gov/

NGMDB[7] contains MapCatalog (products from over 600 publishers), MapView (interactive geologic map), TopoView (topographic maps), Stratigraphy (stratigraphic charts and formation names), Standards & Guides (for creating geologic maps and reports), and Geologic Map Schema (for creating digital geologic maps).

USGS World Geologic Maps[8] were produced as part of the 2000 World Petroleum Assessment described in USGS Digital Data Series 60[9]. The portal includes geologic maps of Africa, Arabian Peninsula, Arctic, Asia Pacific, Bangladesh, Caribbean, Europe, Former Soviet Union, Gulf of Mexico, Iran, North America, South America, South Asia, and Afghanistan.

Geoscientist toolkit: Apps

There are several open-source apps that help geology students, teachers, and researchers with field work and research. The following are some of these free apps introduced here as information (I have not used all of them).

1. ROCKD

Rockd[10] is a mobile application that provides access to geological data for field work and research by geologists and soil scientists. Rockd is a "one-stop shop" for geologists looking to integrate various kinds of geological information, from outcrop and paleofacies maps to structural measurements.

Rockd has various modules including: (1) summary geologic and geographic information about your location of interest; (2) a camera scanner tool to identify rock types; (3) access 140 interactive geological maps to learn about the geology of your location; (4) paleogeographic maps; (5) GoDeepDive (published literature); (6) an app to measure and record geologic data such as strike and dip; (7) capability to record and log your observations.

Rockd was funded by NSF and is maintained by the University of Wisconsin Macrostrat Lab. Rockd is available on Apple Store and Google Play.

2. Mancos

Mancos[11] is a geologically focused app for Apple users, including the Apple Watch. Created by Hunt Mountain Software, Mancos utilizes GPS and internet connectivity to display a map and identify rock type, stratigraphic age, and fossil assemblage (where available). The app also includes features like a fossil database, road trip tracking with geological updates, and the ability to have the app speak the geology as you travel. Its geological maps and stratigraphic information come from the Macrostrat platform, and the fossil information comes from the Paleobiology Database. It can be downloaded from Apple Store and Google Play.

3. Rock Identifier

Rock Identifier[12] is an app that helps the identification of rock based on image analysis. "Simply take or upload a photo of any rock and get accurate ID results withing seconds." This is a great tool for amateur geologists and students making their first attempts at rock identification (and perhaps also discussing and testing the results).

4. Stereonet Mobile

Stereonet Mobile[13] helps you collect, visualize, and analyze geological orientation data on the go. Created by structural geologists Rick Allmendinger, Stereonet Mobile is a companion to Allmendinger's Stereonet 11 Program[14] for desktop computers. You can download it via the App Store.

5. Geologic Compass Apps

Lambert[15] is a geological compass that measures strike (orientation) and dip direction and angle of geological features and has real-time stereographic projection for visualization. Available on Apple Store.

Rocklogger[16] is another geological compass app. The measurements can be exported to spreadsheets. Available on Apple Store and Google Play.

FieldMove Clino[17] was developed by Petex company. Downloadable from Apple Store and Google Play. You can also store georeferenced digital photographs and text notes.

6. Geology Toolkit Lite

"Geology Toolkit[18] is a thoroughly practical, lively and comprehensive application that allows geologists and hobbyists or even kids to examine and explore minerals and rocks fea-

8. https://certmapper.cr.usgs.gov/data/apps/world-maps/
9. https://pubs.usgs.gov/dds/dds-060/
10. https://rockd.org/
11. http://www.huntmountainsoftware.com/html/mancos.html
12. https://rockidentifier.com/
13. https://www.rickallmendinger.net/stereonet-mobile
14. https://www.rickallmendinger.net/stereonet
15. https://lambert-ios.soft112.com/
16. https://rocklogger.en.softonic.com/android
17. https://www.petex.com/pe-geology/move-suite/digital-field-mapping/
18. https://play.google.com/store/apps/details?id=mvpm.minerals.and.rocks.geology.toolkit.premium

tures under the petrographic microscope or as hand-specimen." Downloadable from Google Play.

7. Virtual Microscope – Minerals

"The Virtual Microscope - Minerals[19] is a professional and interactive virtual petrographic microscope that allows geologists to examine and explore minerals and their microscopic features. This app contains only minerals in thin sections using transmitted light - non-opaque minerals."

Geoscientist toolkit: Databases

Let's look at some online databases on minerals, geochemistry, and fossils.

1. Mindat

Mindat.org[20] is an online database about minerals around the world. It was originally created by Jolyon Ralph in 1993 and is now operated by the Hudson Institute of Minerals. The platform includes data on mineral species (6,117), rocks (3,174), localities (410,555), occurrences (1,603,801), photos (1,417,705), articles (2,898), and glossary terms (26,066). Geologists interested in chemical composition, physical properties, host rocks, and/or mineral mines will find this large database on mineralogy helpful. Mineral data are enhanced by images and published literature.

2. GEOROC

The Geochemistry of Rocks of the Oceans and Continents (GEOROC)[21] is a database drawn from published analyses of rocks, including major- and trace-element concentrations and isotope ratios. GEOROC was initially constructed in 1998 at the Max Planck Institute for Chemistry. In 2021, the database was transferred to the Georg-August-Universitaet Goettingen.

Currently, GEOROC contains 22,750 papers, 685,660 samples, 2,680,100 analyses, and 39,334,100 single data values. Researchers in geochemistry and critical minerals will find GEOROC useful as a global database on elemental concentrations in various rock types with references included.

3. EarthChem

EarthChem[22] is a free and open data repository of geochemical data worldwide geochemical, mineralogical and petrological database.

The project is funded by the NSF and maintained by the Lamont-Doherty Earth Observatory at Columbia University.

EarthChem encompasses four individual portals: (1) PetDB (data from peer-reviewed literature); (2) EarthChem (multiple data sources), and (3) Library of Experimental Phase Petrology. Data can be retrieved through Search options.

4. USGS National Geochemical Database

This database[23] includes geospatial data on geochemistry of hard rocks, sediments, soils, and elemental concentrations from the continental USA and Alaska drawn mainly from USGS or other Federal agencies work. Geologists and environmental scientists working on projects related to the United States will find this geochemical database critical for their research. The data locations are georeferenced for easy use and visualization.

5. Paleobiology Database

The Paleobiology Database[24], "revealing the history of life," originated in 1998 at the University of California- Santa Barbara' National Center for Ecological Analysis and Synthesis under the title "Phanerozoic Marine Paleofaunal Database." It was funded by the NSF. The Paleobiology Database is currently housed at the University of Wisconsin-Madison and is supervised by an international group of paleontologists.

6. Neotoma Paleoecology Database (Neotoma)

Neotoma[25] stores data on fossils and paleoecology from tens of thousands of sites globally related to the Pliocene-Quaternary period. The data comes from thousands of publications and is updated regularly. The initiative was funded by the NSF and is supervised by an international group of scientists.

Note to the readers:

If you are aware of any open-source databases, apps, and global maps, please inform the author by email (rsorkhabi@egi.utah.edu).

19. https://play.google.com/store/apps/details?id=com.geology.virtual.microscope.minerals.thin.sections.pro
20. https://www.mindat.org/
21. https://georoc.eu/georoc/new-start.asp
22. https://www.earthchem.org/
23. https://www.usgs.gov/centers/gggsc/science/national-geochemical-database#overview
24. https://paleobiodb.org/#/
25. https://www.neotomadb.org/



Geologic Enigma, continued from p. 41



Figure 4. View to the north of Pleistocene Lake Terrace Deposits (Qlt) masquerading as the toe areas of landslides lobes. Surficial sloughing and sliding along the eastern edges of these terrace deposits has caused havoc for the westbound lanes of US-395 (See Figure 2).

1890). It is always a good idea to also keep in mind the six dimensions of geologic thinking when sorting out seemingly enigmatic geologic puzzles. These are:

1. X
2. Y
3. Z
4. Time
5. Geologic Processes
6. Interaction of Geologic Processes

Think of this as a three-dimensional box moving through time with geologic processes taking place inside and interacting with each other.

Before jumping to conclusions, stand back from the outcrop or the geologic problem, write down all possible solutions (pencil and paper), even if you know some cannot be correct, stand back and look at your list and ask yourself, which one or ones make the most sense. Then start looking for evidence to back up your thesis. Be willing to change your mind more than once during this process of elimination. Overconfidence can be a silent killer.

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United States Geological Survey, 1988, Mount Dana CA, topographic map, scale 1"=2000', contour interval 40'.

United States Geological Survey, 1988, Lundy CA, topographic map, scale 1"=2,000', contour interval 40'.



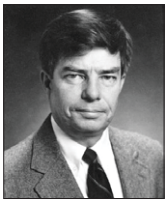
In Memoriam

Robert R. Jordan, CPG-01262

Yorklyn, Delaware

March 1, 2025

Member Since 1966



Obituary and photograph provided by Ernest A. Mancini, Professor Emeritus, Department of Geological Sciences, University of Alabama, Tuscaloosa, Alabama and William L. Fisher, Professor Emeritus, Jackson School of Geosciences, at the University of Texas, Austin, Texas.

Robert R. Jordan, Ph.D., passed away on March 1, 2025. Dr. Jordan served as state geologist and director of the Delaware Geological Survey (DGS) for 34 years. The work of the DGS during his tenure has contributed significantly to the understanding of the geology, hydrology, mineral resources, and geologic hazards of Delaware. Under his distinguished leadership, the DGS established a reputation for providing objective scientific information, advice, and service to the citizens of Delaware, its businesses, and governmental agencies. He was involved in the development of state legislation and regulations related to water resources, oil and gas development, mineral extraction, subaqueous lands, solid waste disposal, beach preservation, state boundaries, and the professional licensing of geologists. The work of the DGS has continued to help ensure a sound scientific basis for economic development, management of water resources, land use decisions, and environmental protection.

Dr. Jordan received an AB degree from Hunter College and MA and PhD degrees in geology from Bryn Mawr College and is an Emeritus Professor in the Department of Earth Sciences at the University of Delaware. He taught a variety of undergraduate and graduate courses in geology and mentored graduate students in the Department of Earth Sciences during his tenure as state geologist. He authored or coauthored some 125 publications primarily on stratigraphy, sedimentary petrology, the Atlantic Coastal Plain, applied geology, and geology in public policy. He made numerous technical presentations at local, regional, national meetings and conferences.

Bob was active in leadership in numerous scientific and professional organizations and held elected and appointed offices in many of these. Dr. Jordan served as President of the Association of American State Geologists (AASG), Editor for the American Institute of Professional Geologists (AIPG), and Treasurer for the American Geosciences Institute (AGI). He was a Certified Professional Geologist of the AIPG (CPG 1262) and was licensed as a Professional Geologist in Delaware, North Carolina, and Texas. He was awarded Honorary Membership of the AASG, Honorary Membership of AIPG, and Honorary Membership of the American Association of Petroleum Geologists (AAPG) for his significant contributions to these organizations. He is a Fellow of the Geological Society of America for his teaching and scientific contributions. He received the Galey Public Service Award from AIPG and the Distinguished Service Award from AAPG. In 1996, Dr. Jordan received the AGI medal in memory of Ian Campbell for superlative service to the geosciences, and in 2006 he was awarded the prestigious AIPG Ben Parker Memorial Award.

Bob Jordan was a valued friend and colleague, a person given to order and civility in conversation, conduct and activity. He will be missed by the many who had the privilege to know him.

Eugene J. Blazenko, CPG-02236

Urbandale, Iowa

January 18, 2025

Member Since 1971



Obituary and photograph excerpted from the Des Moines Register website.

Eugene J. (Gene) Blazenko, formerly of West Des Moines, IA, went to be with the Lord at the age of 86. Gene was born on June 21st, 1938, in Calgary, Canada where he and his sisters were raised by their mother, Annie Blazenko after the death of their father Steve Blazenko in 1948. He excelled in football and hockey until moving to Norman, OK to attend the University of Oklahoma where he earned BS and MS degrees in geology and played on a semi-professional hockey team. He grew and remained very close with his step-father, Dan Iwasyszyn until his death in 1999.

After graduation, he began a wildcat oil career that led him to Evansville, IN. There he met and married the love of his life and wife of 57 years, Susan (Grasty) Blazenko on June 2nd, 1967. They lived in Evansville before moving to Oklahoma City OK where their son Stephen was born, and then Calgary, Canada for nine years before settling in West Des Moines in 1980. In 1988 he founded GSS in Des Moines, which continues to be a successful enterprise today with employees across the USA. Recently, Gene and Susan moved back to Oklahoma, settling in Tulsa to be closer to family, his beloved Sooners and to escape Iowa winters.

Besides traveling and being with friends and family, Gene and Susan were long-time members of Des Moines Golf and Country Club where they enjoyed much time socializing and playing golf.

In later years, Gene loved snow-birding in La Quinta, CA where his favorite activities were spending time with friends and family, volunteering through church teaching young children to read, golfing, watching the BNP Paribas tennis tournament, making his wife laugh uncontrollably and cheering on the Sooners in any sport. He was an avid reader and never stopped learning. He could often be found with a cup of coffee in his hand and a question on his mind. He loved getting to know people and learning how they interpreted the world. His devotion to his wife and family was evident in that he never missed an opportunity to go on summertime adventures with his grandchildren, support, encourage and mentor them in all that they did, just as he had done for Stephen.

His was a life well-lived with no regrets.

Helen V. Hickman, CPG-07535

Lake Clarke Shores, Florida

February, 2025

Member Since 1988



Helen Hickman received a Joint Bachelor of Science degree from Aberystwyth University in Wales in 1978. She was a Senior Hydrogeologist with Geraghty and Miller, Inc., then worked as a Principal Hydrogeologist with Montgomery Watson. She worked as a SE Regional Groundwater Practice Leader with Brown and Caldwell, and a groundwater resources leader with Rare Earth Sciences (dba HAS). Most recently, Helen was a Principal Hydrogeologist of Aquatech GeoSciences, Inc. in Florida.

Helen was active in the Florida Association of Professional Geologists, in addition to her many activities in AIPG. Helen was active at both the Section and National levels. She served as Florida Section President for multiple terms, was a National Advisory Board member, and was National President in 2016. Helen received the AIPG Presidential Certificate of Merit in 2015, 2018, and 2020.

Helen and her husband Jerry had recently bought a farm in Tennessee and were planning to retire there.

The following information was provided by several individuals in tribute to her memory…

Helen Hickman, PG, CPG was a kind and dear person and cared deeply for the role of the professional geologist. I miss her. I knew her on a professional level and interacted on matters in the Florida PG world. Her British accent was always pleasuring to hear and her counsel bridged decades of experience in water resource issues. I received the Galey Award in 2018, and she was part of the group that put forward my name. I was humbled and grateful to her and others for that honor. In the past few years, she was a consultant contributor to several of our client's deep well water projects lending her decades of professional expertise to the problem solving. The last time we talked was when she was mostly retired and, in the mountains, working on remodeling her cabin.

Thomas A Herbert, PhD, PG, CPG

My relationship with Helen began back in the ’90s, when she was one of my supervisors. Over the years, that professional connection evolved into something much deeper—she became my mentor, my friend, and, at times, even a mother figure. After our time together at Montgomery Watson Harza, I had the privilege of watching Helen show the world what I had always known about her: she was a consummate professional, a dynamic leader, and a powerful communicator. Her wisdom, warmth, and unwavering integrity left a lasting impact on me and everyone lucky enough to know her.

Susan Bodmann, PG, PMP

Helen was a wonderful person and will be missed. It is still a shock to learn that she died. She was a very competent geologist and very willing to offer her management and organizational skills to AIPG. She and I spoke frequently, particularly during the years we served on the AIPG executive board and the years we each served as AIPG's national president. She helped me in 2011-2012 to complete the MOU between AIPG and Geological Society of London. She prepared the assessment of comparing requirements for the professional geologist designation at each professional organization. I enjoyed working with her on other AIPG projects as well. Helen joined the Foundation of the AIPG as a Trustee initially and then became secretary. She was an active trustee and helped with planning fundraiser events for AIPG annual meetings and assisted with the silent auction which was held for donations to the Foundation.

Barbara H. Murphy, CPG, 2012 AIPG President, Past Foundation Chair and Trustee

I met Helen in 1988. She was, and remained, headstrong, feisty, funny, and passionate throughout our friendship and her career. She dedicated hundreds of hours to volunteering with AIPG and FAPG, as well as engaging in local and regional public education for students. Helen met with countless legislators to educate them on the importance of geologist licensure and the vital role geologists play in Florida. She had a talent for weaving tales, and there was always a playful spark in her eye, hinting at the mischief beneath the surface. Though short in stature, she was big in personality and believed in getting things done, and she accomplished much personally and professionally. She was also a loyal friend to both people and her beloved animals. Her affection for her big Dobermans was pure joy, whether training them up or fending them off. It was not uncommon for Sophie, one of her favorites, to interrupt a call, as she playfully rolled Helen around in her desk chair while seeking attention. Helen was easy prey since her feet barely touched the ground.

I will miss her.

Anne Murray, CPG

I was surprised and saddened by Helen’s passing. When I hired her at Geraghty & Miller, she had only recently been married, and her accent and expressions had not been Americanized. That led to a lot of coffee break entertainment with questions like “what did she say?” Her early assignments were as a field geologist on water wells and injection wells and I’m sure there were some conversations with the drillers that ended the same way.

Helen was very passionate about her life, her career and her friends.

Thomas L. Tessier, CPG, PG-FL

Helen and I worked together as members of AIPG’s Executive Committee for a number of years. As with any large organization there are always challenges of one sort or another to tackle. I found myself more and more reliant on the wise counsel of Helen for the particularly difficult problems we encountered together. I would often call her asking for her advice or help and she would respond with not only wisdom but also with humor and encouragement. Her laugh was infectious. It was a delight working with her and she was a highlight of my time on the Executive Committee. I will miss her deeply.

R. Douglas Bartlett, CPG, 2018 AIPG President

I met Helen through the FAPG many years ago and had many great discussions on protecting our licenses and getting young graduates to get their PG licenses. I later got to work with her on a couple of business development projects and strategizing on how to win… and that’s when I got to see more of Helan’s humor and wit come out! We had some good conversations and laughs and I’m sure a beer was in there, too…after work, of course!

I was reading a fiction set in the UK and it had a lot of colloquial terms in it, and I asked her about it…She went to the University of Wales, she had a great time explaining the language and even said a few sentences in Celtic which I had no chance of understanding.

I also got her valuable opinion on running for AIPG office and she gave me a lot of good advice and was so kind-hearted to give me words of encouragement.

We are fortunate to have had her as a colleague and friend.

Charles W. Drake, CPG

I worked with Helen for several years on the Foundation of the AIPG first when she served as a Trustee and later as Secretary. She had a great work ethic, creative ideas, and a sense of humor that made the work easier to complete. She was generous with her time and knowledge. She often assisted with setting up and running the silent auctions at the annual meetings. This was a huge help due to the frantic pace and logistical challenges. I consider myself very fortunate for having known and served with her.

Michael D. Lawless, CPG, 2010 AIPG President, Foundation Chairman

I first met and started working for Helen in 1997 at Montgomery Watson as the junior member of the Water Resource Technology Center team. I only got to work with her for a little over three years, but during that brief period, I learned so much. Helen was a great teacher and mentor, not only on technical matters, but also on how to collaborate with others in a business setting and building and maintaining a team. She embodied the "firm but fair" practice in her interactions with contractors and colleagues that I strive to emulate. I loved hearing Helen's stories about breaking into the industry. I remember her telling me the story about buying her four-wheel drive Bronco because she never wanted to have to rely on anybody to get her around a jobsite. Helen could always come up with a cheeky British idiom to address or de-escalate every challenge we came across. Helen and I stayed in contact after she left Montgomery, and I will cherish those conversations and memories.

Neil Johnson, PG

Bill W. Whaley, CPG-09664

Albuquerque, New Mexico

October 19, 2024

Member Since 1995



Obituary and photograph obtained from the Albuquerque Journal website.

William "Bill" Wayne Whaley, 66, passed away on October 19, 2024, in a watercraft accident in Pensacola, Florida.

Bill is survived by his beloved triplets: Alexa Whaley, Christa Whaley Armstrong, and Trey Whaley. He also leaves behind his cherished mother, Dorothy Whaley, and his grandson, Conrad Armstrong. He was preceded in death by his father, William Wayne Whaley Sr., and his sister, Jamy Peevy.

Raised in New Mexico, Bill graduated from Eldorado High School and earned a bachelor's degree in Geology from the University of New Mexico. He turned his passion into a career, founding Hydro Geologics Services (HGS), where he spent 25 years drilling water wells across New Mexico. Known for his generosity, Bill often provided his services at reduced rates and never hesitated to help those in need. His kindness extended to everyday life—whether over-tipping at local restaurants or being the first to show up when a friend or family member called.

Bill was a member of Calvary Church and, for the last four years, split his time between Albuquerque, New Mexico and Pensacola, Florida. In Pensacola, he lived life to the fullest, spending his days on the water and enjoying the company of his partner, Christina Gallegos, and her family.

Adventure was always calling Bill, and he eagerly shared that spirit with his children. Whether boating, skiing, surfing, or dirt biking — he was never too old for an activity and every gathering felt like a celebration.

He had a gift for making everyone feel welcome, earning him friendships that spanned generations. His children's friends lovingly called him "Papa Whaley," and he made them feel just as much a part of the family—bringing them along for lake trips, ski weekends, and endless fun on the water.

Bill had a rare ability to find joy in every moment and person he encountered. His presence will be deeply missed by everyone who had the privilege of knowing him. To his family, he is a legend.





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. This year 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 with the award increased to $5,000. 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 AIPG to provide prize money for the student poster session at the National Conference in St. Louis. These grants are only possible through your generous donations. Every donation helps the Foundation to contribute toward building the future of geology. The National Conference in St. Louis will include a silent auction and a fundraising field trip to some outstanding karst features in Missouri to raise money for the Foundation. If you have any questions or comments about the Foundation, please contact me or any of the other Trustees for additional details and check the AIPG web site for more information about the Foundation. Your continued support is greatly appreciated. Thank you.

Mike Lawless

Michael D. Lawless, CPG, PG
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Comments on proposed rule: Modernization of Property Disclosures for Mining Registrants

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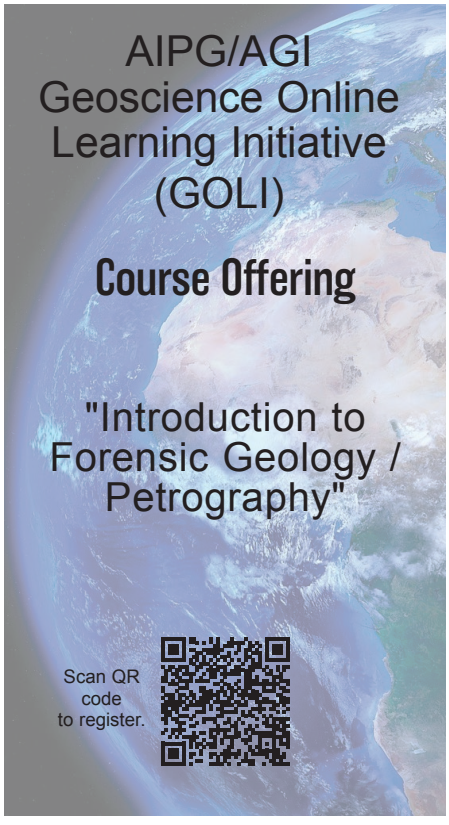
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