Student Edition!

Classroom Earth

Peer Reviewed Articles:
Geoscience Modeling
Doppler Radar Estimates of Precipitation
Enrollments in U.S. geoscience programs remained relatively steady during the 2016-2017 academic year. Undergraduate enrollments have not substantially changed since 2012. However, a growing percentage of those undergraduate enrollments are in online degree programs, which have been offsetting enrollment declines particularly seen in private 4-year colleges and regional state universities. Following national trends observed across STEM fields in the past couple of years, geoscience graduate enrollment levels have declined 8%.

- Christopher Keane
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On the Cover: Shirley Tsootsoo Mensah, SA-7566, from Eastern Illinois University at Yellowstone National Park’s Upper Yellowstone Falls during summer field camp. Read about Shirley’s experience at field camp on page 19 of this issue.
The mission of the American Institute of Professional Geologists (AIPG) is to be an effective advocate for the profession of geology and to serve its members through activities and programs that support continuing professional development and promote high standards of ethical conduct.

AIPG Publication Policy, October 4, 2019. AIPG encourages submission of articles and editorials for publication in TPG on topics related to the science and profession of geology. Submitters shall be of interest to the members of AIPG, other professional geologists, and others interested in the earth sciences. Articles and editorials may be noted as follows at the discretion of the Editor: “The opinions, positions and conclusions presented herein are those of the author and do not necessarily reflect the opinions, positions or conclusions of the American Institute of Professional Geologists.” All materials submitted for publication, including author opinions contained therein, shall include accurate and appropriate references. The Editor has the authority to solicit, edit, accept, or reject articles and editorials and other written material for publication. The Executive Committee has the authority to act on any particular case to support or overrule actions of the Editor regarding the solicitation, editing, accepting, or rejecting of any particular article, editorial, or other written material for publication.
Texas Sunset Commission
Prolongs Life of Texas Board of Professional Geoscientists

John Berry, Texas PG-2709, CPG-4032, Editor, TPG, and Councilor-at-Large, AIPG Texas Section
(http://aipg-tx.org/officers-biographies/#Berry)

At its meeting on November 14th, the Sunset Commission of the Texas Legislature recommended continuing the Texas Board of Professional Geoscientists for another six years. This result was achieved by the dedication and perseverance of many AIPG Members and Texas PGs. The effort was coordinated through the Texas Geoscience Council (https://www.txgeoscience.org/) and the Texas Lobby Group, which was hired by the Council for this purpose. Both the national AIPG (http://aipg.org/) and AIPG Texas Section (http://aipg-tx.org/) made considerable financial contributions to this effort, as did many other organizations, particularly the Association of Engineering Geologists and individual licensees (www.aegweb.org/group/TX).

Texas Lobby Group said that it required an intense effort on their part, as the Sunset Commission’s staff had made an unequivocal recommendation to abolish the Board, and the general political environment is heavily against the existence of all occupational licensing by the state government: powerful and well-funded national organizations such as the American Legislative Exchange Council (ALEC, see https://www.alec.org/ and click on “About”) and the Institute for Justice (see https://www.facebook.com/instituteforjustice/ and click on “About”) promote model laws against it, and geological licensing in particular has already been threatened in several states.

The phrase “avoiding a North Carolina situation” came up repeatedly in the Commission’s discussion: a recent US Supreme Court decision (North Carolina State Board of Dental Examiners v. Federal Trade Commission (2015)) in a case against the NC Board of Dental Examiners over tooth whitening by unlicensed practitioners decided against the Board, stressing that “The need for antitrust law (is) particularly great “in light of the risks licensing boards dominated by market participants (i.e. in this case, the board had a majority of dentists) may pose to the free market.” The Court declined to exactly fix a line for what constitutes excessive control of a licensing board, saying only that the determination is context-dependent. The Court also agreed with the FTC’s position regarding the lack of state oversight of the Board, reaffirming the requirements of active state supervision: (1) supervision is substantive, not merely procedural; (2) the supervisor may veto or modify decisions of the Board; (3) the mere potential for review is not a substitute for actual supervision; and (4) the supervisor may not itself be a market participant. Since the Board of Dental Examiners was not subject to any state oversight at all and was largely dominated by market participants, it clearly did not meet these requirements.”

This decision is thus a threat to all occupational licensing boards in the country as generally presently constituted. In particular, it will require that the TBPG be dominated by non-geologists, and will be directly supervised by another agency. The Sunset Commission, however, has only begun to consider the implications of the decision and is not yet ready to implement any changes in the TBPG (or any other board).

Even the Economist, an international, generally liberal publication, recommended against professional licensing in its November 17th-23rd, 2018, issue (p.5):

“...governments should tear down barriers to entry such as non-compete clauses, occupational licensing requirements, and complex regulations written by industry lobbyists. More than 20% of American workers must hold licenses in order to do their jobs, up from just 5% in 1950.”

We are thus placed in bad company: in the same issue the Economist actually promotes a resurgence of trade unionism!

This is not the end of the fight to save TBPG. A bill to implement the Sunset Commission’s decision must be written, passed by the legislature, and signed by the Governor, who is known to be against regulation of any kind. Therefore, starting immediately, all geologists in the State of Texas need to contact their local Senators and Representatives, and even their Federal Legislators (apparently, letters from their federal colleagues greatly influence state legislators). Fund-raising for the Texas Geoscience Council is also a priority because this effort will require additional lobbying efforts.

The six-year extension was expressly chosen so that the TBPG will come up for review again in the same session as does the Texas Board of Professional Engineers. The intent is to examine the two Boards in parallel, with a view to assessing the advantages of combining them (perhaps with the Board of Land Surveyors as well).

Continued on p. 45
We have received a gratifying flood of well-written submissions for this Student Issue: two papers coauthored by students for peer review, and three other technical papers by students, three student essays, six reports by students on their field course experiences, and twelve articles by CPGs wishing to pass on their experience and advice to students and young professionals. One of these (Mathews) is a very instructive short story about how a little corruption leads into a vortex of more and more corruption, ending up with career and personal destruction. There is an enormous fund of information about the value of keeping an open mind to all experience, technical and interpersonal (Herbert, Elliott), the importance of networking (Dail, Burton), of thinking “outside the box”(Elliott), and of developing an interesting resume and a winning interviewing style (May and Brackman, Adler) contained in these articles. Two of them (Ridgely and Stinson, both based on personal experiences in the field, deal with the importance of professional behavior in the face of the unprofessional, even exploitative, behavior of others: Stinson, in particular, deals with issues of diversity.

It is eight years since The Professional Geologist has printed any articles discussing climate change: the emotions provoked at the time were very divisive. However, in this issue I have decided to gently reopen the topic, partly as a consequence of receiving a Letter to the Editor (Diefendorf) pointing out that, if we appear to have a closed mind on the subject, we will potentially turn away many of the younger generation who could otherwise benefit immensely from our focus on ethical and professional behavior and from the national and international acceptance of CPG status as a guarantee of competence. As threats to State Licensure mount in intensity, the CPG is likely to become more important, not less so, and the benefits of membership in AIPG more apparent. A report on the fate of licensure in Texas, and the role of AIPG in successfully defending it, appears in this issue.

We all have our views on the subject of climate change, but I hope that we can discuss it without becoming carried away by personal rancor. My own view is colored by having grown up on the outwash plain of the Weichselian (Wisconsin) maximum advance, and my earliest hunting expeditions for left-handed gastropods in the gravels of a Plio-Pleistocene course of the Thames laid down under tropical conditions and now 100 feet above sea-level. I spent an early holiday cruising on the Norfolk Broads, which are lakes that were originally medieval (12th to 14th centuries) peat diggings supplying fuel to Norwich and Great Yarmouth – Norwich Cathedral took 320,000 tons of peat per year! A rise in sea level during the fourteenth and fifteenth centuries then flooded the Broads to a depth of up to 13 feet. Amusingly, when I wrote a term paper in college on the history of the Broads, using as one source a book called “The Making of the Broads”, I had trouble taking the book out of the library as it was shelved under Pornography! I spent the summer of 1963 working for the US Navy on a tabular iceberg drifting 300 miles from the North Pole, followed by a career in the oil industry. We should all realize that our views on this topic are colored, if not determined, by our social environment, our personal experiences and, in particular, by the ways in which we make our living: we should therefore respect the personal experiences and views of those with whom we disagree.

Accordingly, in this issue we have a review (Greenslade) of a book on climate change that has been reviled on the internet, as being biased one way or the other, by people on both sides of the debate, and the subject is also discussed in David Abbott’s column. David includes a discussion by Past-Young Professional member of the Executive Committee, Brandy Barnes, on how to deal with the differing views of Members and colleagues on climate change. She emphasizes that AIPG as an organization does not support any particular view. She stresses the art of listening respectfully and understanding where the other person is coming from, and sums up these skills as a prime example of Professional behavior. So many other articles in this issue, such as those by Stinson, Mathews, Ridgely, Elliott and Owens, discuss different aspects of professional behavior that one could say that an underlying theme of the whole Student Issue is the development of professionalism in all aspects of one’s life and career.

The Past and Future of AIPG

The side-by-side articles in the Fall 2018 TPG by Aaron Johnson and Douglas Bartlett were highly insightful, especially in regard to AIPG’s relationship to the public. As this topic reflects on our ability to grow and survive as a professional society, we need to address what maintained our early growth and what we need to do to reclaim that growth.

AIPG was founded in 1963 and by 1965 had 850 CPG members. By 1972, that number had grown to over 2,200 active members, the vast majority of whom were employed in the energy and minerals sector, and AIPG focused on that sector. However, in 1972, the newly formed EPA put forward the Clean Water Act, and geoscientists began to find themselves involved more and more with public environmental issues. Also, increases in AIPG membership had begun to slow and, in 1976, President John Haun lamented “We cannot, in good conscience claim to speak for the entire profession with such a small membership.”

AIPG then opted to change its image by renaming the society the Association of Professional Geological Scientists. At the same time it adopted a grace period of reciprocity between some states that registered geologists. These dramatic actions resulted in a 50% increase in membership in about one year. Of course the name was changed back to AIPG after a couple of years for reasons that may reflect ongoing conflicts within the profession.

By 1984, AIPG membership had sustained a modest growth to over 4,700 active members, and a higher percentage of them were now involved in the environmental sector. Note that only about 170 of these CPGs currently remain as active members. of this number,. By this time the USEPA had put forward the CERCLA Act (Superfund), which provided many more opportunities for earth scientist employment. Many states now saw the need to regulate the qualifications of those doing the work and passed legislation requiring registration of Professional Geologists, thus fulfilling a primary goal of AIPG.

As these registration bills came into force, many newly registered PGs saw little justification to join AIPG; some joined competing certifying organizations, and active membership began a slow decline. In response, by the mid 1990s AIPG began adding new classifications of membership to increase its numbers. These memberships did not require certification, and one of them focused on establishing student sections at Universities. This latter effort has proven admirably successful, although it is not clear how many of these members will ultimately stay with AIPG.

By 2000, numbers of active CPGs had declined to about 4,000 and have steadily dropped to 2,769 at present with total non-student membership being less than the number of CPGs 35 years ago. In contrast student membership has grown and in 2016 students outnumbered CPGs! However, it is unclear how AIPG can maintain its goals, growth and position in the earth sciences, no less be comparable to other professional societies such as NSPE or AIA without a major change in direction.

In 2008, Past-President Dan St. Germain bravely appointed an Ad Hoc Committee on Climate Change to arrive at a position statement for AIPG. The Committee’s statement was a compromise between political versus scientific debate and, therefore, had little meat. It was even more ambiguously revised by the Executive Committee. In 2010, the AIPG Executive Director ceased the publishing of articles and opinion pieces on climate change in the TPG, and no applicable articles or letters have appeared since. AIPG and AAPG remain as the only major international science societies that are non-committal on global warming or climate change. In 2010, AAPG abolished its Global Climate Change Committee because their President determined that “Climate change is peripheral to our science and ….. AAPG does not have credibility in that field.”

The makeup of AIPG is not the same as AAPG. In fact, based on AIPGs own surveys, the majority of members are not employed in the petroleum or energy sector. Will AIPG continue to ignore the fact that a good number of its members practice in environmental and engineering fields that are directly involved in mitigating the impacts of global climate change and, that regardless of cause, these impacts provide major employment opportunities for our members? Even after ten years of silence, it is probably impossible to find agreement on what position AIPG should take on this matter, although more members especially from the Gulf Coast Region may now recognize the merits of addressing these issues. For the time being, can we put differences aside and at least focus on the fact that climate extremes are growing and the role that geoscientists can and should play in preparing for those extremes?

In the TPG’s President’s Message (Fall 2018) regarding communicating science, Douglas Bartlett references the science historian Naomi Oreskes. Perhaps it is ironic to note that Ms. Oreskes is an outspoken supporter of the current scientific consensus on global climate science and that our current statements on energy related issues still show a bias toward denialism.

As a society that has a goal of communicating with the public, how will history treat AIPG if we don’t accept the projected impacts from global warming, and provide credible professional input into such related matters as coastal, flood zone, infrastructure protection, as well as water supply and drought planning? How can we expect to retain students as future members, if we don’t participate in what many, including the banking, insurance and military sectors, consider the greatest environmental crisis of the century? Can AIPG maintain professional membership or even survive as an organization if it does not address these issues? Will AIPG have a future? Perhaps we should canvass our Student Members on these issues, as they appear to be our future.

Drew Diefendorf, CPG-3598

Drew Diefendorf is a 42-year member of AIPG including seven sections, two of which he served as Section President. He was also a member of the 2008 Ad Hoc Committee on Climate Change.
Optimization Algorithm for Locating Computational Nodal Points in the Method of Fundamental Solutions to Improve Computational Accuracy in Geosciences Modeling

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AS-0020

Abstract
Using the Complex Variable Boundary Element Method (“CVBEM”) to model ideal fluid flow, a new algorithm is applied to an approximation method that reduces computational requirements while increasing matrix solution demands. Ideal fluid flow is examined by use of the algorithm with the CVBEM as a case study. Traditionally, the modeling nodes are placed on or close to the problem geometry boundary in a somewhat regular pattern. In the current paper, an algorithm is developed and demonstrated that optimizes node locations by examining the possible locations for nodes exterior of the problem domain and then measuring the computational accuracy of the corresponding approximation function with respect to the problem boundary conditions continuously specified on the problem geometry boundary surface. Application of the analysis approach to other similar problems in Geosciences is straightforward. A three-dimensional application towards modeling groundwater flow about a building foundation is examined as a case study. The methodology is gaining value within the Geosciences toolbox as experience with complex computational techniques continues to advance. The computational Method of Fundamental Solutions is also investigated with similar success.

Introduction
In this paper, the well-known three-dimensional source function is used as the basis function family from which specific basis functions are selected for an approximation function. The three-dimensional potential function approximation (real variable) examined is

\[ \hat{u}(x,y,z) = \sum_{j=1}^{n} c_j \frac{1}{R_j} \]

where the \( c_j \)'s are constant real-valued coefficients determined by collocation of the approximation to candidate collocation points defined on the problem boundary; and the \( R_j \)'s are the usual non-zero radial distance measures between the nodal point locations \( P_j \)'s and arbitrary point \( P(x,y,z) \). Other fundamental basis functions may be used that satisfy the governing partial differential equation (PDE) which in the current case, is the elliptic Laplace equation. Although variations on the PDE and additional sophistication may be readily included in the approximation, we only carry forward the basic formulation of the above equation. The focus of this paper is the description of the proposed nodal position optimization algorithm. As a case study, a three-dimensional brick-geometry problem domain is examined, representative of a high-rise building foundation element that is located in the midst of a highly urbanized area such as Los Angeles, California. The relevant soils are expansive clays and soil-water is abundant. At issue are the solid-water pressures for purposes of designing dewatering system elements and protection against soil-water leakage in subterranean structures such as parking garages. In the problem, this geometry is positioned in the first octant of the usual three-dimensional coordinate system. The three dimensions are specified to be of different value. Figure 1 displays the problem setting.

The 3D geometry under detailed analysis has dimensions \((x, y, z) = (8, 4, 2)\). Several such elements are deployed in the building foundation, but only one such element is examined in this paper. For demonstration purposes, two three-dimensional (3D) potential functions are examined as case situations. These two 3D functions are defined by,

\[ u_1(x,y,z) = \frac{1}{R}, R \neq 0 \text{ and } u_2(x,y,z) = x^2 + y^2 - 2z^2. \]

Both of the above potential functions are entire functions defined throughout 3D space, and with values known continuously on the test problem boundary.

Literature Review of MFS and BEM Nodal Point Positioning Techniques
The paper by C. S. Chen (2016) discusses a brief history of the Method of Fundamental Solutions (MFS) and the simplicity associated with this method that makes the method appealing [1]. In [1], Chen attempts to find the optimal node locations...
The effectiveness of a particular and collocation location as variables as well as node and collocation point pairs are determined and optimized. In that paper, the computational approach is identical between schemes except that the basis function family is different. Yet, all these methods have the same underpinnings rooted in the generalized Fourier series approach to solving Partial Differential Equations (PDE). Additionally, the placement of both modeling node and collocation point positions were predetermined to be uniformly distributed without attempt to optimize the node and collocation point locations. In [1] and [6], among other papers [7–10], attention is paid to examining how to select locations for positioning computational nodes, among other issues, with no clear conclusion as to the best method for selecting computation node locations. For example, in [9] Carlos Alves uniformly distributes collocation points on the problem boundary and sources outside the boundary without determining which locations are best with use of the MFS. In 2015, Chen attempted to create an algorithm to find source locations that were “satisfactory” without proving the source locations to be the global maximum [10]. These papers indicate that there is significant variation in computational results depending on two key topics. The first is the choice of nodal locations. The second is the choice of collocation point locations. In the current paper, the focus is toward presenting a computational algorithm that addresses the computational node positioning problem by saturating a surrounding space of the problem domain with candidate node locations to be subsequently assessed in multiple node models based on the MFS, using the standard source function to generate basis functions. Of course, other PDE formulations and the choice of basis functions can be examined accordingly as long as they satisfy the Laplace equation and are analytic. Because collocation point locations are also subject to end-user preferences, the presented positioning algorithm used for selecting node locations is also applied to selecting collocation point locations on the problem boundary. Consequently, a set of ordered pairs of combinations of candidate locations of (node, collocation point) are developed and then examined as to computational model performance.

Thus, the approximation function includes node location and collocation location as variables as well as node and collocation point ordered pairs. The effectiveness of a particular model is measured, in this paper, by consideration of the usual RMS error (or $E_2$ error) in matching problem boundary conditions and also examination of the maximum absolute value (or $E_\infty$ error) in fitting to the problem boundary conditions. Obviously, other error norms can be examined. In the current paper, the effectiveness of the model is described by the dual measures of ($E_2, E_\infty$).

The algorithm examined in this paper initiates by assessing the effectiveness of using a single node MFS model. This is the N=1 situation of the algorithm. All candidate node locations are examined, in turn, in developing the respective single node MFS model. Furthermore, the node positioning is cascaded with all candidate collocation point positions, producing a set of single node MFS models, each with a different node and collocation point combination. Once the entire space of said combinations are examined, the algorithm chooses the positioning ordered pair that has the minimum error measure outcome. This positioning order pair is then considered optimized and held fixed for further use in the evolving algorithm. The algorithm then continues to the N=2 situation by developing all possible two-node and two-collocation point combinations. As with the N=1 situation described above, all possible MFS models are developed and the corresponding error measures evaluated. However, in this situation the first node and the first collocation point optimized locations from the N=1 situation described above are retained. As before, the algorithm chooses the second node and the second collocation point locations that minimize either of the error measures defined above. This completes the N=2 situation. The algorithm continues to the N=3 situation, and hence to larger N value situations, following the procedures described above. As the N value of the situation increases, the approximation computational error measure is reduced.

However, the use of the computational MFS involves issues such as the stability and accuracy of the underlying matrix solver. In our work, the matrix solver is a barrier that was not further examined. But because the algorithm results in a reduced error measure as N increases, the computational experiments indicate that fewer nodes and fewer collocation points can be used yet produce computational error measures that are as low as when using much larger but uniformly distributed node and collocation points. This means that with fewer nodes and collocation points involved in the MFS model, the matrix solver issue is generally more successful in producing a stable outcome.

**Optimization Algorithm Description**

There are three types of modeling points that are used to determine the approximation function and its accuracy. The three types of points are candidate nodal points, candidate collocation points, and evaluation points. The candidate nodal points are points positioned exterior of the problem boundary that ultimately are the location of the basis function nodes used in the approximation function. The collocation points are points located on the problem domain that have known potential values and are used as the boundary conditions when determining the coefficients for each basis function in the approximation function. Lastly, the evaluation points are points on the problem boundary at different locations than the collocation points that enable the determination of error in the approximation function. Unlike the collocation and nodal points, evaluation points act independently of the other two model points. Nodal points and collocation points are related in that the pairing between one nodal point and one collocation point determines the coefficient of the basis function at that specific nodal point. Evaluation points exist solely to determine the error associated with the approximation function. Root means squared (RMS) error is used as the evaluation criteria for optimum node location, and also maximum absolute error (Max error).

To determine the optimum pairing between a specific node and a specific collocation point each node must be tested with each collocation point and the RMS error and Max error associated with that approximation function must be recorded. The following algorithm outlines the process by which nodal point and collocation point pairs are determined and optimized.
OPTIMIZATION ALGORITHM

1. Create a pool of node points located exterior of the problem domain. This set should be in no particular pattern. Randomness in coordinates is beneficial.
2. Create a pool of collocation points located on the problem boundary. These are locations where the potential is known.
3. Create a one node approximation function for each combination of node and collocation point. Record the error for each.
4. Select the node and collocation pair that produced the least error.
5. Create a two node model, utilizing the selected pair from step 4 as one of the node pairs.
6. Test all two node approximations for error. The approximation function that results in the least error becomes the best two node model.
7. Repeat steps 4-6 until the number of nodes desired in the model is reached.

The following test problems are examined to demonstrate the validity of the algorithm.

Example Problem: Pressure Source

To demonstrate the algorithm, a concerning soil-water pressure source, such as a longitudinal crack along the surface of a high pressure water pipeline, leads to detailed analysis, including forensic as well as remediation examination, involving complex computational modeling methods. The pipeline exerts pressure uniformly and can be modeled by the equation,

\[ u_i(x,y,z) = \frac{h}{\sqrt{(x-x_j)^2 + (y-y_j)^2 + (z-z_j)^2}} \]

where \( h \) = the constant pressure source strength defined at source location \((x_j,y_j,z_j)\). The approximation function is defined by

\[ \tilde{u}_i(x,y,z) = \sum_{k=1}^{n} \alpha_k \frac{1}{R_k} \]

where \( \alpha_k \) is a real-valued coefficient, and

\[ R_k = \sqrt{(x-x_k)^2 + (y-y_k)^2 + (z-z_k)^2} \]

where \((x_k,y_k,z_k)\) is the kth node. To solve for the \( \alpha_k \)'s, pressures must be defined on the boundary. These locations \( P_l = (x_{l_j},y_{l_j},z_{l_j}) \), points on the boundary become the collocation points where the pressure is known, by measuring the pressure at location \( P_l \). Set \( k = l \) so there are an equal number of nodes and collocation points. The resulting collocation matrix equation results in the coefficients corresponding to each node, and produces an approximation function to approximate pressure on and within the problem domain.

The problem domain is located in the first octant. It is positioned so that the origin or bottom right corner is located at (1,1,1), and has length = 8, depth = 2, and height = 4. The test problem is another source function with source point located at the origin (0,0,0) where \( h = 1 \). Figure 1 depicts the problem domain and the location of the test pressure source as a star at (0,0,0).

The solution to this boundary value problem is,

\[ u(x,y,z) = \frac{1}{\sqrt{x^2 + y^2 + z^2}}, x,y,z \geq 0. \]

To create the space of candidate node locations for use in the basis function definition, an adequate amount of nodes must be assessed. To minimize the algorithm’s run time, the number of node locations examined is limited to 512. Figure 2 depicts the location of each of the candidate nodes.

Figure 1 - Problem Domain

Similar to the creation of the nodes, candidate collocation point locations must be positioned on the problem boundary. The number of collocation points need not be the same as the number of candidate node locations. For this example, there will be 1000 candidate collocation points. Figure 3 depicts the distribution of candidate collocation point locations.

Figure 2 - Candidate node locations assessed.

Figure 3 - Candidate collocation points in the problem domain.

The accuracy of each one node approximation function must be evaluated and compared. Let \( n \) = the number of candidate nodes and \( m \) = the number of candidate collocation points. To test accuracy, every combination of candidate nodes and candidate collocation points will be paired and used to create an approximation function. Thus, there will be \( n \times m \) approximation functions to be compared for computational error. The ordered pair with the least error is deemed the optimized node and collocation point location and combination for use in a one node model. Table 1 demonstrates the comparison of errors that occurs automatically within the algorithm for the one test node model and 5 test collocation locations.

Because the number of possible combinations of nodes and collocation points for the sample size that is used is large the first five error assessments are presented to give insight into the process that is occurring. Table 1 lists the possible ordered pairs for a one node model with five choices for col-
location point locations. If the ordered pairs listed in Table 1 were the only possible combinations that could be used for the approximation, then the algorithm would choose ordered pair 3 because it has the least error.

Utilizing a test pool of 1000 nodes and 729 collocation points, the best node to collocation point pair to approximate this pressure source is node (.01,.01,.01) and collocation point (3.18,5,1.36). The RMS error associated with this pair is .000164 and the max error was 0.00116. This result is expected because the approximation function picks the node that is closest to where the actual source function is located. Essentially, when using a one node model to model a single source the approximation function will simply attempt to "copy" the source.

Following the algorithm, the one node ordered pair is now held as the first node selected in the next two node model and also is removed from the candidate ordered pairs for future selections. The algorithm now tests for the best two node solution keeping the optimum node and collocation pair from the one node model as one of the two nodes. This process is then repeated for each additional node until there are n basis functions in the approximation function.

Figures 4 - 9 are visualizations of the Approximate Solution using the Complex Variable Boundary Element Method optimization algorithm developed in this paper (left hand graphs), the analytical solution (center graphs) and the difference between them (right hand graphs) for representative orthogonal planar sections through the problem domain shown in Fig.1., using 10 nodes. The contours are unitless and display the

| Table 1 - Record of Computational Error for the Single Node Models |
|----------------|----------------|----------------|
| Ordered Pair | Node           | Collocation Point | RMS Error |
| 1             | (11, 7, 5)     | (5, 5, 2)         | 0.1085    |
| 2             | (11, 7, 5)     | (5, 1, 2)         | 0.2059    |
| 3             | (11, 7, 5)     | (6, 3, 2)         | 0.0896    |
| 4             | (11, 7, 5)     | (1, 3, 2)         | 0.4281    |
| 5             | (11, 7, 5)     | (5, 3, 3)         | 0.1317    |

Figure 4: Computational results on the x-z plane where y=5.

Figure 5: Computational results on the x-z plane where y=1.

Figure 6: Computational results on the x-y plane where z=3.

Two New Student Chapters Join AIPG!

Welcome, University of Minnesota - Twin Cities and University of Alabama!

University of Alabama Student Chapter Group Photo: Marcella McIntyre-Redden, Geological Survey of Alabama and Alabama Geological Society; Richard Katz, Retired Mining Engineer/Geologist (Speakers on Left); Dr. Andrus, University of Alabama Dept Chair, Geological Sciences; Student Officers, Caryl Orr AIPG Member Sponsor
The courses that may or may not be offered at your institution of higher learning are: conflict resolution and speech. Both are generally not within the earth sciences departments, but both are invaluable in your career. Regardless of the discipline you eventually specialize in - oil and gas, mineral exploration, hydrogeology, or environmental geology - all will require the knowledge and skills imparted by these two fields of study. Whether you are dealing with local, state, or federal agencies, conflicts are inevitable. Conflict within the workplace can also be unavoidable, add to that the almost inevitable dealings with the NIMBY members of the public, as well as with other anti-mineral or anti-fossil-energy organizations, and it is certain that you will be dealing with conflict. It is not practical to pursue the many facets of conflict resolution, but it is critical to know some of the basics that will make your job easier.

As regards a speech course, if you hope to advance in your profession, you will often be required to give presentations on the work you have done. This may be a presentation to upper management, a client, or at a professional meeting. Being able to present your work in a clear and timely speech will do wonders for career advancement.

The good news is that you may be able to obtain this knowledge after graduating. It is a bit more challenging and will require discipline and perseverance, but it is doable. Depending upon where you end up working, you may find adult education courses offered at a community college or a university college. Public speaking can be learned and practiced through a local chapter of Toastmasters. Toastmasters clubs are prevalent in many locations and can often even be found in small rural towns. With today’s access to the internet, I suspect you may find numerous resources available to get proficient in both of these disciplines.

Give it a go, you will be glad you did!
The same collocation and node candidate locations and problem domain as used in Problem 1 will be used to approximate the solution for this new test case.

Figs. 10 through 15 are visualizations of the solutions to Test Problem 2 constructed in the same way as were Figs. 4 through 9, for the case of 20 approximation functions.

Students!
Could you use $1,000-$3,000 to help pay for your education?

AIPG offers National Undergraduate Scholarships and the William J. Siok Graduate Scholarship annually. Up to ten undergraduate scholarship are awarded to declared undergraduate geological sciences majors who are at least sophomores. Scholarship awards in the amount of $1,000.00 - $3,000 each will be made to eligible students attending a college or university in the U.S. Scholarships are intended to be used to support tuition and/or room and board. The graduate scholarship offered is $1,000.

Scholarship application deadline is February 1, 2019.

Go to www.aipg.org/undergraduates or www.aipg.org/graduates for application instructions.
Discussion of Computational Results

For Example 1, computational error decreases as the number of nodes used to approximate the exact solution increases. Remember that the analytic solution to this boundary value problem is

\[ u(x,y,z) = \frac{1}{\sqrt{x^2 + y^2 + z^2}}, \quad x, y, z \geq 0. \]

The basis functions used in the approximation are of the form

\[ \sqrt{(x-x_j)^2 + (y-y_j)^2 + (z-z_j)^2}. \]

Thus, the one node approximation selects the node closest to the origin of the source function it attempts to model. When additional nodes are added in an attempt to better the approximation, error decreases, but the change in error between each additional error decreases. Figure 16 depicts the reduction in error that occurs when a higher n approximation function is used to approximate pressure.

Example problem 2 had similar error reduction patterns when more basis functions were introduced in the approximation function. Figure 17 depicts the RMS error for twenty approximation basis functions. The figure shows the error decreases, but takes longer than the first test problem and has more error than the first test problem. Because of the computational difficulty of this problem more nodes are necessary to gain a better approximation.

Conclusions

Although there are some observations stated in the literature as to computational accuracy improvement by use of different nodal point location strategies, there is not a formalized procedure for identifying the optimum location of modeling nodes that minimize computational error goals. Such a formal procedure is presented in this paper in the form a new algorithm that enables such optimum node locations to be identified. The locations of modeling nodes are treated as additional degrees of freedom in the computational modeling effort to reduce computational error in achieving problem boundary conditions. As expected, the use of the presented algorithm improved computational modeling accuracy. The over-arching conclusion can be made that the associated increase in available degrees of freedom provides significant additional opportunities in reducing computational error. Additionally, the ability to optimize node locations enables the reduction in the number of basis functions required to create an approximation function with the same amount of computational error as previous approxima-

Recommendations for Future Research

The algorithm explores a set of possible node locations, collocation point locations, and node, collocation order pairs. Because the algorithm is greedy the time to run the algorithm is expensive resulting in a restriction to the number of nodes and collocation points in the set of possible locations. Different problems will inherently result in different node locations. Future research into an algorithm that can reduce the set to only the most probable locations to offer the best approximation. This type of algorithm would use the gradient as criteria for deciding where to place more or less nodes.

Acknowledgements

The authors would like to thank the faculty of the United States Military Academy for the invaluable feedback they provided in the development of this paper, as well as their continued dedication to our academic careers after our graduation.

References

After returning home after my first experience as a new, professional geoscientist I wrote this short essay for all my Millennial peers who are working diligently to improve our science. This essay is also dedicated to other generations, particularly Baby Boomers, who have been educating and mentoring us through these early stages of our student and professional careers.

When does the transition into becoming a professional begin? When you address your colleagues with respect or treat every technician as you would like to be treated? Perhaps when you are conducting fieldwork safely and respecting the boundaries of others? Or how about addressing Indigenous rights in the bayous of Louisiana or the fens of Minnesota? When do we complete the metamorphosis into a professional?

Today! Every day you conduct scientific studies in a lab or compute data or complete your geophysics assignment you are a professional geoscientist and must act like one. If you are using inclusive language in your student chapter meetings and educating young scientists about paleontology you are improving the geoscience community and are already acting as a professional.

Today marks the end of my first project as a consulting geoscientist - not a student geoscientist but a full geoscientist. During this project I was asked to assist in tasks I have previously conducted as a student geologist including sample collecting, core logging, and identifying minerals for a project to evaluate lithium occurring in spodumene-bearing pegmatites. I became very confident during graduate school at providing structural analyses of the high-grade ore zones and the barren waste rock to identify the structural control of the ore. A task that was new to me was working with a fellow new geoscientist who was not sufficiently professional. Their unprofessionalism included raising their voice at other geoscientists when they didn’t feel like they were getting their way, drinking alcohol and smoking marijuana in the core shack while working, and arriving to work late every day. Their excellent geoscience work did not erase how they acted, nor does it position new, young geoscientists in a positive light.

As new geoscientists, particularly Millennials, we will be scrutinized more than other workers and we need to prove our value to ourselves, the companies we represent, and our scientific community. Our generation is already thought by today’s media to be lacking in work ethic and drive and we need to show that we are willing to put in the work necessary for success. If we are to be trusted in the future to issue water quality policies or develop warning systems for natural disasters, we need to concentrate on becoming professionals as early in our careers as possible.

The metamorphosis to professional might not be easy but we can help ourselves, mentor our colleagues, and support those who may need it. As we join the ranks of professional geoscientists, alongside the likes of Zelma Maine Jackson, Harrison Schmitt, and Kathryn D. Sullivan, we will change our professional environment for the better in our evolving field through contributions like #MeTooMining (Grant and Calleja, 2018), education, improving public policies, and collaborating with computer science to improve geosciences: but all of that will only be useful if we also act as professionals.

Acknowledgements
Thank you to all the helpful mentors in the geosciences for their patience and willingness to help our new generation, especially when it’s difficult.

References:
Unforgettable Applied Volcanology in Italy

Dani McDowell, SA-8828, Senior in Applied Geology, Metropolitan State University

Edited by: Dr. Uwe Kackstaetter PhD, MEM-2437
Professor of Applied Geology, Metropolitan State University

This summer, the Department of Earth and Atmospheric Sciences at Metropolitan State University of Denver, through their Applied Geology program offered a two-week international field course in Applied Volcanology in Southern Italy. Incidentally, Italy contains the only active volcanoes in mainland Europe and some of the most active volcanoes in the world. Italian volcanism is the result of plate convergence between the oceanic components of two tectonic plates, Eurasia and Africa. Subduction of oceanic crust remnants caused magma upwelling and has created an “island arc” system comprised of these very active volcanoes. The trip was led by Dr. Uwe Kackstaetter and was designed to explore and research these volcanoes. Each student who attended was also expected to research and write an expert paper on a particular location of their choosing. They say the best geologists have seen the most rocks... but what about eruptions?

The MSU Denver students at a vineyard on the slopes of Mt. Vesuvius. (From left to right: Kaite Burger, Dani McDowell, Jared Current, Laura Kackstaetter, Lindsay Mota, Uwe Kackstaetter, Gianna Antunovich, Celine Gill, Adlin Botkin)

The trip began in the heart of Rome, where we indulged in authentic Italian food, tourism, and of course, lectures. The first several days were heavily focused on the historical significance of Rome and the impressive hydrogeology under the ancient city. Rome has an entire aqueduct system in the subsurface and continuously cycles fresh water throughout its pipes and fountains. This system was set in place when Romans first built the city, and we all drank out of the same fountains that they did.

After our time in Rome, we packed our bags once again and headed south to the city of Pozzuoli—home to The Phlegraean Fields, otherwise known as Campi Flegrei. This is a large active volcanic area situated to the west of Naples, Italy, near the Gulf of Naples. The 13km wide nested caldera encompasses 24 craters and volcanic edifices within this supervolcano system. This area also shows major evidence of bradyseism, a phenomena directly related to the filling and emptying of the magma chamber that causes major fluctuations in land elevations. To fully experience this anomaly, we put on wet suits, hopped on a boat, and dove into the supervolcano’s main caldera to see the sunken parts of the Roman city of Baiae. Around the 4th century the lower part of the city dropped about 50ft beneath the sea due to the last negative bradyseism event as the magma chamber deflated.

Over the next three days the class focused on the stratovolcano Mt. Vesuvius, and the ancient Roman cities destroyed in the notorious 79 C.E. eruption. We were absolutely humbled to be able to walk the ruins of Herculaneum and Pompeii, the two Roman cities demolished by pyroclastic flows. While we all enjoyed the archaeological significances, we were all also anticipating climbing to the crater of our first volcanic mountain. We set off to Mt. Vesuvius National Park and climbed the long, winding road as far as we could get before we hiked the rest. As we reached the top, our jaws dropped at the first sight of the immense crater. After a brief lecture, every student could be seen sitting on the ash covered ground, hounding for small (1 to 10 mm), perfectly euhedral monoclinic pyroxene crystals found literally everywhere along the tourist foot path and within the loose ash. Needless to say, when we retreated back to the
Having spent much time at the sleeping giant, Mt. Vesuvius, we were excited to venture to a more active volcano. So, what better place than Mt. Etna, the largest and most active volcano in Europe? In fact, Mt. Etna or “Mongibello” is considered to be the second most active volcano on earth, as far as lava productivity is concerned. Located on the East coast of Sicily and visible for tens of miles, the 10,991ft mountain originated as a shield volcano but contains countless flank eruptive features which contribute to its constant activity and massive size. The journey up the volcano seemed to take forever, but we were elated to see the dozens of craters and lava tubes on the ascent. Unfortunately, we didn’t have the time to hike to the main summit crater, but we did get to take a tour through several of the flank eruptive cinder cones. Naturally, we collected copious amounts of volcanic samples. Thanks to Dr. Kackstaetter, we were also able to take readings of the temperatures a few inches below the surface at various locations on one of the most recent cinder cones.

Though we had already been on volcanoes, and experienced steam vents and other active volcanic features we started to wonder if we would ever see an actual eruption. Luckily, our next objective was to study Strombolian eruptions, so we embarked on a ferry to Stromboli Island, an isolated stratovolcano in the Aeolian Sea, North of Sicily. Strombolian eruptions are a beautiful display of nearly constant lava fireworks, and all of us were eager to see it. We only had to climb 924m at sunset, no big deal right? It was either climb the volcano or sit in a boat and watch from below, so characteristically we climbed the volcano. As we gained elevation and got closer to the summit, our adrenaline climbed as well. Within just a minute or two of sitting on the edge of the crater, the volcano roared, and we saw our first eruption, spewing molten rock fragments 50 feet into the air not 400 feet from where we were standing. Although the eruption was loud, you could hear crickets amongst the students. Two of the four craters erupted every 5-10 minutes and we stayed for as long as our guide would allow us. Again and again Stromboli would roar to life with each eruption more spectacular than the previous. The concept of lava bombs, ejecta, tephra and ash suddenly became real as each formed literally before our eyes, no longer obscure or theoretical as in a classroom setting. Needless to say, this experience left me flooded with admiration for geology and was one which I will always remember.

When I followed my passion for geology, I would have never imagined it would take me across the world to so many incredible places. The MSU Denver Applied Geology program absolutely exceeded my expectations in this field course. The knowledge acquired from Dr. Uwe Kackstaetter and fellow students made this a once in a lifetime experience. While the Applied Geology program at MSU Denver may be new, the quality of education and the diligence to get students out of the classroom is phenomenal. The best geologists have seen the most rocks and, in our case, “eruptions.” We are, indeed, better geologists for all the rocks and eruptions we were fortunate to see in Italy.

Iceland’s Volcanic Landscape, Glaciers, and Jökulhlaups: A Sensory Overload

Steven M. Battaglia - freelance researcher, student, and previous author for TPG with educational roots at the University of Illinois and Northern Illinois University.
I had the opportunity to take a trip to Iceland this past summer. I landed at Keflavík International Airport, the airport just outside the country’s capital, Reykjavík, that serves the entire island. The weather when I arrived was partly cloudy to cloudy with temperatures in the low to mid-50s. The wind was blowing greater than 20-25 mph, and never slowed throughout the trip.

Iceland is the land of fire and ice. The volcanism that makes up the majority of the island occurs both because of (1) its position over an active oceanic hot spot and (2) its location on the mid-Atlantic ridge system where the North American and Eurasian Plates are spreading apart. Iceland’s geographical location lies in the North Atlantic just outside the Arctic Circle, which ensures a moderate- to polar-like climate for the small European nation. The landscape is a unique combination of young volcanic rocks, tundra and glaciers that create a stunning picture of Earth’s dynamic elements.

From the airport, I drove three hours to the southern coastal town of Vík. The eastward drive was filled with views of the vast countryside; eroding mountainsides and waterfalls, moss-covered basaltic rock and shrubbery, livestock and gorgeous horses, likely bred since the time of the Vikings hundreds of years ago, roaming the open plains. And, with the active volcanism (as well as the geothermal energy being utilized on the island), hints of sulfur within the air filled my nostrils throughout the journey.

When I arrived in Vik, I quickly made my way to the starting location of a scheduled 3-hour Ice Cave Tour. The tour guide drove our group onto the glacier Mýrdalsjökull, near the volcano Katla, where we hiked on top of young volcanic rocks and explored two melting glacial caves in the rainy and windy conditions. Katla’s volcanic eruptions have occurred very recently in geologic time, since 930 AD, and about twenty eruptions have been documented. The young volcanic bombs that are scattered over the ground throughout the country are a reminder of the ongoing volcanic activity. Additionally, the eruptions that occur are explosive because of the ice cap covering the active volcano Katla.

Once all of us on the tour were dry and warm in the vehicle (and away from the blowing cold rain), we drove back to the starting point in Vik. Finishing the tour, our guide noted that, because of the rain and melting glaciers during this part of the year (mid-summertime), the area was under a watch for a jökulhlaup (pronounced yo-cool-lop), he then gave us warm goodbyes without providing any more detailed descriptions of what this potential local event is or how it could effect us!

The Icelandic term jökulhlaup, which translates directly as “glacier run,” describes events in which large amounts of water from one of its glaciers burst outward towards the ocean — in English, a subglacial outburst flood. The outbursts occur when geothermal heating from below the glacier causes meltwater to accumulate under pressure in subglacial basins until it violently bursts forth through the ice cover. Meltwater from cracks at the top of the glacier can also add more water into the subglacial basins thus increasing the pressure. When there is a significant amount of water, a tunnel valley opens in the ice blockage and can discharge the excess meltwater as a turbulent flow. This leads to strong erosion of the valley floor and a large flood of water outward towards the ocean. Once excess flow of water has ceased, the tunnel valley closes, and the process can be repeated at a later time in the season or the following year.

Luckily for me, a jökulhlaup did not occur while I was still on the island. However, one did occur only a few days after I departed Iceland. If it had occurred while I was still on the southern coastline, I would not have been able
to make it back to Reykjavik and the airport. The jökulhlaups that occur in the south can reach to a height that is above Ring Road, the one main paved road that circumnavigates the country, and the outburst of water can flood parts of the road for hours to days. Although being stuck, or stranded, on this North Atlantic polar “paradise” for a few extra days does not sound so bad.

Overall, the sensory experiences I gained from Iceland have stayed with me. Iceland’s beauty is appealing enough in itself to interest any traveler or vacationer. Yet, I strongly recommend that those of us who have studied geology, and who therefore could gain a huge appreciation for such a unique landmass, should set out to investigate this lonely island in the North Atlantic. Iceland’s presence and geological history can reveal a great deal of knowledge to better understand and acknowledge the Earth’s processes as a whole as well as our connection with the Earth itself.

To quote Hume once more: “The advantages found in history seem to be of three kinds; as it amuses the fancy, as it improves the understanding, and as it strengthens virtue.” By experiencing firsthand what the Earth itself has to offer to the human senses leads to a spiritual awakening in us that influences the meaningful aspects of our lives.

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(Un)Traditional Field Camp with (Un)Traditional Outcomes

Alexander C. Reimers - B.S. Geology: North Dakota State University ‘18  HFC Family: Western Michigan University ‘18  M.S. Hydrogeology: Clemson University ‘19

The Western Michigan University Hydrogeology Field Course (HFC) based in Kalamazoo Michigan, was nothing short of an adventure. From babysitting a 48 hour aquifer pump test, to analyzing the water quality of beautiful Lake Michigan on a research vessel, I found myself constantly surprised by the broad field experiences and skills developed and taught by enthusiastic faculty from across the United States.

Like all traditional geology field camps, the HFC at WMU is an intensive 6 week program designed to integrate many aspects of geology into an all-encompassing capstone experience. However, the HFC uses state-of-the-art equipment, technology, computer software programs, and field and laboratory techniques illustrated in figures 2-4, that industry professionals seek in entry-level candidates’ skill sets within the environmental sector. The director of the HFC, Thomas Howe, treated everyone like family but also held us to high expectations, which I found extremely conducive to learning.

Overall, my experience during the HFC at WMU was excellent. I am currently in a Master’s program in Hydrogeology at Clemson University and continue to boast about my experiences and learned skills at WMU HFC to my undergraduate professors, graduate professors, fellow geology students, and anyone who is interested in gaining industry wanted skills in environmental geology. Don’t hesitate to reach out to me (alexander.c.reimers@gmail.com) if you would like a more detailed anecdote.

"It is the mark of the instructed mind to rest satisfied with the degree of precision which the subject permits... and not to seek an exactness where only an approximation of the truth is possible." - Aristotle
My experience at the WMU Hydrogeology Field Camp

Ingvild Haneset Nygard

It all began with a Google-search. I wanted to travel and do something relevant for my studies during the summer, so I figured that a field course would be perfect. I would gain a lot of practical experience to put together with my theoretical knowledge about my subject, hydrogeology. A quick search for hydrogeology field camps revealed camps all over the world, so I began to eliminate options to find the perfect camp for me. By the end I was left with the Western Michigan University Hydrogeology Field Camp (WMU HFC) in Kalamazoo, Michigan, as the perfect match.

As I headed over the sea with my new unused steel-toe boots and work gloves in my luggage, I hoped this would be an educational and adventurous summer. Little did I know it would become so much more. The course contained six modules – each one lasts a week and counts as one semester credit hour. The topics included aquifer testing, well drilling installation, surface geophysics, groundwater sampling and monitoring, remediation design and implementation as well as Hazardous Waste Operations and Emergency Response (HAZWOPER) training. The instructors were dedicated, inspiring and gave lectures to support the field exercises. We were taught valuable lessons which we will bring with us into future studies and jobs.

The course was well designed and contained various work methods; individual and group work, written assignments such as papers and reports, oral presentations, preparing fieldwork, performing fieldwork and use of different digital tools to analyze, interpret and present data collected from the field exercises, and final exams. This whole package gave a little taste of how it is like to work with hydrogeology after the studies end, which is a valuable experience to refer to in a future job application. I am sure that I got my current job because of my participation at this hydrogeology field camp.

Besides being the best decision I have made concerning my career so far, I also got a lot of new friends and connections during my stay at the field course. The many hours we spent together in the classroom, in the field and in group works lead to friendships that still last today. I often refer to “when I was at hydrogeology field camp ...” in both job and social settings. The camp director Tom Howe did a huge effort in making my stay a blast. I felt really welcome and fit in with the rest of the participants. I am enormously grateful to have participated at WMU HFC the summer of 2015. And as I headed back home to Norway after that summer, I brought back a lot of good memories, more knowledge, a lot of field experiences, and new friendships along with my muddy steel-toe shoes in my luggage.

WMU Hydrogeology Field Camp

Elijah J. Chandler

My name is Elijah J. Chandler and I studied Geology at Humboldt State University (HSU). Although I enjoyed my professors and classes at HSU, I wanted to expand the breadth of my knowledge so that I could be more versatile in the working world. I realized that hydrogeology was a good fit for me because I wanted to work with rivers, streams, and groundwater flow. That’s when a peer of mine mentioned Western Michigan’s Hydrogeology Field Course. I was immediately interested and after doing some research I knew that’s where I needed to go.

The time spent at Western Michigan was invaluable. We were able to grow in a structured environment that left room for creativity and ingenuity. We spent our time understanding essential background information, which was used daily in practical application at real geological project sites. We built and analyzed water wells, interpreted discharge data, and mapped aquifers using cool technology. Every day was different and every week included new challenges and skills.

Since completing the Hydrogeology Field Course I feel completely prepared and confident in my abilities to be a contributing member in any workforce. Looking at job descriptions online and seeing that the skills they require are all the skills I’ve learned is just reassurance that I made the right choice. I will never forget the relationships I made and the experience I had. I would definitely recommend this program to anyone who is interested.
My Field Camp Experience (as an International Student)

Shirley Tsotsoo Mensah, SA-7566, Eastern Illinois University

My field camp experience was personally an amalgam of bitter-sweet moments; by Day Three of field camp I had emailed my adviser telling her I wanted to return home. Join me in this recap of my journey through field camp as I tell you my experience from a personal perspective as an international student in the USA. I hope you enjoy the ride.

I am Shirley Tsotsoo Mensah, an international student from Ghana pursuing a bachelor’s degree in Geology with a minor in Geographic Information Sciences at Eastern Illinois University. I attended field camp at Western Illinois University from May 20–June 30. Our camp was based in South Dakota, where we spent 5 of the 6 weeks mapping the Black Hills while we stayed in the dorms of the South Dakota School of Mines and Technology. The rest of the time was spent on field trips while camping out in the woods or lodging in hotels (my favorite part).

At the beginning of this journey, I was neutral about field camp. I was not particularly excited about it because all the stories I had heard about field camp were pretty intimidating. We left Illinois on May 20 for South Dakota and that first night with the group was actually my first time ever camping out in the woods. It was a pretty interesting experience, but I think I prefer hotels. I was doing okay at the start of the camp until our group facilitator decided to give us an overview of field work—things we will encounter out in the field every day and how to maneuver our way out there. The thought of the possibility of ticks hiding in my hair, poison ivy causing irritation to my skin, and snakes hiding in the field was not fun news to me. I freaked out (a little too much) to the extent I emailed my adviser at my school, asking to be taken back home. I was quitting and did not care. However, I knew I had to suck it up and face field camp after I had talked to my adviser. I was always on guard every second of my time in the field. DEET spray was my best friend. I would spray it all over me and would literally spray every rock before I sat down on it. My colleagues found that funny every time, but I did not. We had the highest percentage of snakes in the field compared to other field camp groups over the years, according to our facilitator. From the start, it was always one girl who would see the snakes out in the field (Kelli). We decided to call her R-Kelli (Rattlesnake-Kelli). Whenever there was a caution for a sighting of a snake, I would be as far from that area as the east is from the west. I was always in a flight/flight mode—my adrenaline was high, never knowing when the next snake might pop-up or where the next tick might be hiding. I was always ready to jump at the slightest move of what might look like a critter in the field (often happened to just be a falling leaf). Obviously, I really was not used to being in the outdoors. I had to learn for the first time, how to react when there is a bee around me (after I got chased by a bumble bee at Mt. Rushmore, who was after my chips). It was quite embarrassing for help in front of everybody. At this point, my colleagues started wondering why I am from Africa but could not stand the outdoors. They also wondered why I was extremely sensitive to the sun and would easily get headaches after being in the sun for at most 2 hours for someone coming from a continent which is mostly warm. I realized the numerous misconceptions they had about my home and took it upon myself to school them to the best of my knowledge about Ghana and Africa as a whole. I had to tell them, “No, I do not have a pet bear or lion.” I have in fact, never seen an elephant in my entire life, and I am from Africa. Go figure, pretty ironic right? I do not live in trees but lived in a city (with no forests) my whole life. Most of all, it is actually warmer here in the U.S. during the summer than in Ghana because it is more humid here. As such, I cannot stand excessive heat.

I changed the title of the program from “field camp” to “death camp” after my facilitator made us go down an extremely steep slope with schist outcrops, covered with slippery pine needles. A wrong move on that hill would send you tumbling down. We also had to go through a path she calls “tick valley” (yeah, why couldn’t it be “rainbow valley”) where I also got lost. It was a nightmare standing in a field full of ticks and not finding my way out. I almost threw a tantrum in the field that day. Aside from battling critters, I was having some trouble mapping since I had not had much exposure to structural geology out in the field. As mapping continued, however, I started to understand a lot of things out in the field which were previously abstract to me.

On the bright side of things, I enjoyed the one week of field trips where we visited places like Devils Tower, Powder River Basin, Big Horn Basin, Yellowstone National Park, and the Grand Tetons National Park. I got to see a lot of fascinating scenery. Yellowstone was exceptionally beautiful, from the hot springs to the buffalos, grizzly bears, elk, moose, and many other beautiful animals. I enjoyed this week the most because the help we all bond together a little more as a group around the camp fires at the campgrounds. My favorite memory of
us as a group was our decision to wake up at 3am to see the milky way with no light pollution in the sky. It was nothing but beautiful.

We had two more weeks of mapping to do to end field camp after we came back from the Tetons. It was during this time that I had to face my biggest fear. Out in the hills of Bear Butte Mountain in South Dakota, I came face to face with the largest rattlesnake ever seen during our whole field camp. I remembered the universal law of attraction in that moment; I had finally attracted what I feared the most. I started saying my last prayers as I thought of an escape route; moonwalk down the hill or develop wings in a split second and fly off (which was definitely not going to happen). I thought to myself; “if I am to die this way, at least let me die in my home, the real “Wakanda” land. At least they may be able to fix me with their “vibranium” after I got struck by the snake”. Thankfully, I got away safely but that left a scar on me that will probably last a lifetime. I was extremely relieved when we turned in our last map; I could not wait to get back home.

At the end of field camp I realized that even though I hated parts of it, I was happy about the person it had made me into. Being out in the field made me stronger physically, mentally, and academically. I became less fearful of bees and other critters out in the field and also developed a love for hiking and doing more outdoor activities. The moment I was most proud of was navigating and mapping a whole area at the end of field camp and actually fully understanding what I was doing. I scored a B on this map and extremely proud of myself. I was very appreciative of the lifelong friends I had made, the unique experiences I had gotten, and most of all the vast amount of knowledge I had acquired from my field camp professors and colleagues as well. Field camp gave me a deeper understanding of concepts I learned in class as I saw them physically out in the field. It also helped me in deciding which career paths in Geology I would like to pursue as I started to realize my interests, strengths, and weaknesses during the camp. I started to feel more like a Geologist and was ready to start my senior year at EIU with much more enthusiasm because of all the knowledge I had gained at field camp. To future field camp attendees, I would like to encourage you to make the most of your field camp experience. You will make the most beautiful memories during this time. It will, without a doubt, be challenging sometimes but always have in mind that you are going to get through this. There will be days you feel homesick or want to quit but you will always be better off as a person at the end compared to when you started field camp. It is totally okay if you feel incompetent out in the field at the start of camp, do not worry. You will make mistakes but you will learn from them. You definitely cannot expect perfection from geologists in the making; we all have our “faults”. (Did you catch that?). If I, an international student with no outdoor experience survived field camp, then you definitely can!

**Now go rock your world!**

Note: “Our front cover shows Shirley at the Upper Yellowstone Falls”

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Networking: The Key to Survival in a Challenging Employment Market

**Christopher Dail, CPG-10596**

Chris is a thirty-year veteran of the mining industry with exploration experience on several continents seeking a variety of commodity types and currently serves as the Exploration Manager for Midas Gold Corp. in charge of Exploration activities on the Stibnite Gold Project in Central Idaho.

Networking, and not the kind involving electronics, is a key part of being a professional geologist. Without it, when times are tough, you may find yourself a bottom feeder in the employment (or underemployment) opportunity game. So, what does networking mean and entail. Merriam-Webster’s definition (accessed 10/1/2018, https://www.merriam-webster.com/dictionary/networking) is: “…the exchange of information or services among individuals, groups, or institution, specifically: the cultivation of productive relationships for employment or business…”

As a student, one doesn’t have much to show in terms of “experience” for job advertisements. So, networking can be a means to make you stand out on the employment line.

It might mean joining student chapters of professional organizations AND participating in them: putting time, sweat and effort into advancing the goals of your chosen organizations. This could mean anything from serving as a student officer, to fund-raising for scholarships, to organizing and participating in field trips or making contributions to, or editing, the student chapter newsletter. One should also plan on attending professional industry trade organization meetings where folks already in the field...
The University of Tulsa Student Chapter of AIPG (aka Geo Club) celebrated National Fossil Day on October 17. We set up a display with a variety of fossils, including a juvenile mammoth tooth found in the Arkansas River in Oklahoma, in front of our Geoscience Department’s beautiful mineral display. Multiple students volunteered to wear an inflatable T-Rex costume, becoming a living fossil in the display. They really enjoyed dressing up as a living fossil to help bring awareness to National Fossil Day! People seemed to get quite a kick out of waving back to an excited inflatable orange Tyrannosaurus Rex! It was great fun to talk to all the people who stopped by our table, whether they were new to fossils and wanted to know what all the fuss was about or veterans of the department who wanted to see what we had this year for our exhibit. Volunteers enjoyed sharing the fun of bringing fossils back to life with the many curious students who stopped by the department’s excellent display. Many of the students were thrilled that we could touch the actual specimens, something that is almost never allowed in museums or other similar venues. One of our Professor’s engineer friends came to hear about a talk on earthquakes and stopped by our table on his way. He was fascinated by the fossils and reminded of past days when he had found a fossil. Two favorites this year were the fossilized rugose coral and the fossiliferous limestone that contained a remnant of a trilobite and some brachiopods. Students were also amazed with us informing them they could find a variety of marine fossils in Oklahoma due to the ancient ocean that used to cover the State. It was a successful celebration, and a great way to inspire students to explore the environment around them, especially because there are a variety of fossils to find in Oklahoma!

are marketing their services, their projects and/or their people. Often, students are recruited at these industry functions, as there is nothing better than a one-on-one conversation at a trade show booth for both the potential employer and the potential employee to assess each other. This recruiting may not be advertised and is often through word of mouth and simple introductions and “who you know.” An important part of any career in the geosciences is understanding ethical practices and joining AIPG can provide insights into this very important component of being a professional geologist.

Networking can lead to scholarships that greatly enhance a resume, particularly when the scholarship is competitive and is in the field and career path that you plan on entering. For instance, if one is interested in metallic mineral deposits and economic geology, applying for scholarships and joining a student chapter of the Society of Economic Geologists (SEG) and/or the Society for Mineral Exploration (SME), or even better, both, would be an appropriate networking action. Even if one doesn’t win the scholarship, by applying, a group of professionals will see your name and your goals and skills on your application. Consider volunteering to work booths, assist in envelop stuffing, or other preparation efforts for conventions and trade shows in your field(s) of interest, including the AIPG annual meeting.

Don’t hesitate to talk with professors, or alumni, about opportunities. Don’t be afraid to be an intern or do “grunt” work early on to show you are willing to “pay your dues” and to do what it takes to get into the employed world. If you hear of a position but are not qualified or it’s not your cup of tea, don’t hesitate to pass it on to those whom you may know that might be interested. Passing on the opportunity may mean the favor will be returned one day. This is particularly important when there are downturns in the industry, whether it be oil and gas, metallic, industrial or energy minerals, environmental sciences or other geologic fields. Those who know a large number of folks in their respective field have a much better chance of either staying employed or finding new employment quickly if the axe comes their way. I can personally attest from my more than thirty years in the mining industry that ALL of my jobs were the result of networking and word-of-mouth contacts. Through the years I also have passed on countless resumes of students and fellow geologists to prospective employers in my network, even though neither I nor my employer had positions open. Often, this has led to employment for those individuals: conceivably, one of them could one day be MY boss because of this simple gesture. Despite the advancements and benefits of our electronic age - getting out and doing some face-to-face networking will improve your communications skills, get your name out in front, and usually make a you few friends in the process.
Assessment of Uncertainty in Doppler-Radar Estimates of Precipitation for Use in Geoscience Studies

Authors
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Abstract
Doppler radar data forms the underpinnings of various applications in hydrometeorology, engineering, floodplain management, and weather forecasting, (among other uses) necessitating the importance of scrutinizing its accuracy, which depends on the accuracy of measured precipitation estimates obtained from gaged monitoring sites. This article explores the collective use of the WRS-88D Doppler radar system, given its long history, from the assemblage of several thousands of published data pairs of Doppler radar precipitation estimates with actual rain gauge precipitation gauge readings. Detailed statistical analysis of these data pairs shows that the evaluation of the uncertainty in the Doppler radar estimated precipitation can be accomplished using standard techniques, and the display of the computational results can be communicated using scatter plot visualization techniques readily available. The resulting distributions depict the degree of uncertainty associated with Doppler radar estimates of precipitation.

Introduction
Weather radars are playing an important role in predicting precipitation characteristics. The Weather Surveillance Radar (WSR-88D) is a Doppler Radar first introduced in 1988. This is the usual name for the 159 high resolution S-band Doppler weather radars which are part of the NEXRAD (Next Generation Radar) network, and are operated by the National Weather Service. The WSR-88D radar operates by sending and receiving microwave pulses, in the 2-4 GHz range, known as S band. During 1988-2013, many researchers quantified the performance of Doppler Radars by comparing the Doppler radar derived rainfall with the associated relevant gauge observations (considered the “bench mark” data). These comparison studies highlight factors that can affect the reliability of Doppler predictions, including the often used $ZR$ power law relationship, radar miscalibration, signal attenuation and range effect, among others.

Focusing specifically on the data accumulated by the WSR-88D Doppler Radar system, (prior to the completion of the system upgrades to Dual Polarization by 2013), of particular interest is the comparison between the reported precipitation gauge readings and the related Doppler radar estimate of precipitation. In this analysis, published literature in cited references 1-10 contains the data in the form of scatter plots and tables. The data compares the Doppler-radar-derived rainfall estimates with the observed local gauge values, spread across multiple storms and geographical domains with the overwhelming majority categorized via total storm accumulation. We used digitizing software to read the graphs and tabulate the data in each reference for later concatenating.

Method
The raw data file consists of two columns of rainfall data; namely, Doppler Radar Estimated Precipitation (“DREP”) and Gauge Estimated Precipitation (“GEP”). The DREP column includes radar estimated values (in mm) from the Doppler WSR-88D equipment whereas the GEP column includes precipitation values (in mm) as measured by recording precipitation gauges. Combining the two columns creates a set of ordered pairs resulting in 8846 ordered pairs for the subject Doppler data file.

Below, Table 1 summarizes the data characteristics for the Doppler Radar column. Based on the published graphs and/or tables from the cited references, the compiled radar and gauge precipitation values in the current paper specifically focus on total storm accumulation Doppler Radar data for further analysis, as opposed to the other types of radar data available, e.g. Dual-Polarization data.

<p>| Table 1 - Summary of Doppler (WSR-88D) Data Characteristics |
|-----------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Radar Type</th>
<th>Paper ID</th>
<th># of ordered pairs (N)</th>
<th>Radar Data Mean</th>
<th>Radar Data SD</th>
<th>Gauge Data Mean</th>
<th>Gauge Data SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doppler (WSR-88D)</td>
<td>1-10</td>
<td>8846</td>
<td>20.9</td>
<td>22.8</td>
<td>23.8</td>
<td>28.1</td>
</tr>
</tbody>
</table>

Figure 1 depicts the data in Table 1 in its raw form. Using the standard normalization technique to provide scalability, $yi = (xi−\bar{x})/\sigma$, these data are normalized with respect to both the DREP and the GEP variables to produce a set of normalized data pairs. Figures 2 and 3 show the DREP and GEP as con-
DOPPLER-RADAR ESTIMATES OF PRECIPITATION

Continuous variables plotted against one another using RStudio’s “ggplot” (https://www.rstudio.com). Applying a best-fit line to the data in Figure 2 aids in showing nonlinearity of the dataset. Figure 3 displays the normalized DREP and GEP variables, and bins them by the DREP variable into 36 bands of 0.25 standard deviation increments. Figure 3 is instrumental in setting up an algorithm that examines each band utilizing various statistical analysis methods.

The Python “Seaborn” (https://seaborn.pydata.org/) package wrapped around “matplotlib” also performed relevant statistical analysis in this study. The “joint plot” function in Seaborn creates a multi-panel figure that shows both the bivariate (or joint) relationship between the two variables. Figure 4 on page 24 shows the spectrum of the normalized GEP and DREP together with the probability density plot while Figure 5 on page 24 takes a DREP slice, preset to be a 0.25 standard deviation incremental band, and applies a kernel density estimate, meaning a nonparametric or unspecified distributed way to estimate the probability density function of the target random variable. This cross-section of the data with respect to the independent variable (DREP), given in terms of standard deviation units, yields the outcome of a frequency-distribution of dependent variable precipitation to be determined.

The two software programs each provide a high-level of interface for communicating informative statistical graphics. After normalizing the two variables, use of RStudio and Python was central to the analysis of the data. The “joint plot” option in Seaborn aids in analysis and visualization of singular bands of Radar ranges while RStudio’s “ggplot” takes this idea of DREP bands and creates a set of “ridgeline” plots for further analysis and visualization of the entire dataset, consisting of 36 bands of Doppler Radar ranges as seen in Figures 6 and 7 on page 25. In order to accomplish the graphics in these later figures, the first task required is to go back into the original, tabulated data file and conditionally format a new cell that relates to a data pair and creates a responsive bin. The output of this bin categorizes each data point and allows for future plotting ease by preformatting the previously designated 0.25 band increments. In the excel data file: the final “bin” variables follow the labeling system “Doppler Radar ADJ Band” and “Gauge PPT ADJ Band” relating their effective 0.25σ width to the points contained therein. The ggplot function then treats these new “bin” variables as factors and forms the labels for the plotting algorithm to output the useful information as seen previously in the standalone band of Figure 5.

Results

Treating the Doppler Radar Estimated Precipitation (DREP) variable as the input and the Gauge Estimated Precipitation (GEP) variable as the output, the visualizing of these two variables presents an inverse function when arranging DREP on the vertical axis and GEP on the horizontal axis. This allows for the bands of DREP to present relevant statistical information in the form of kernel density estimates,

Figure 1 - Raw Doppler Radar (DREP) and Gauge Precipitation (GEP) values collected, arranged, and documented in Table 1.

Figure 2 - Spectrum of the normalized Doppler Radar and Gauge Precipitation values with a best fit line in red and uncertainty in surrounding dark grey.

Figure 3 - Spectrum of the normalized Doppler Radar and Gauge Precipitation values binned by increments of 0.25.
DOPPLER-RADAR ESTIMATES OF PRECIPITATION

i.e. a probability density, in increments of 0.25 standard deviation units, a specific increment chosen to adequately visually divide the entire dataset evenly for an appropriately focused analysis. Applying this algorithm of normalizing the data, arranging it to present an inverse function, and binning the vertical axis in 0.25 standard deviation unit increments across the entire range of DREP produces the frequency distributions defined by the normalized data analysis conducted for this study.

These results are now suitable to cascade into other computational models such as hydrologic models for floodplain assessment and dam reservoir assessment, among other topics. The results feed into a probabilistic distribution of likely values that cascades into other uses such as estimation of uncertainty in runoff predictions, uncertainty in soil-water contributions related to landslides, uncertainty in estimates of groundwater recharge from precipitation; among several other uses in Geoscience related investigations.

Conclusions

The assessment of uncertainty associated with modern Doppler-Radar measurements of precipitation have several important sources of uncertainty. For example, variable Z-R relationships, radar calibration, clutter, attenuation, and an inaccurate understanding of the physics behind precipitation, along with instrumentation related factors, all contribute to uncertainty. Additionally, uncertainty exists in the operation of the Radar type as well as mathematical prediction applied to the collected data under investigation.

Current research work attempts to display and quantify the uncertainty associated with the published data by use of typically normal statistical distributions fitted to the data pairs of Doppler Radar estimated precipitation (DREP) versus precipitation gauge estimated precipitation (GEP). The analysis shows that the uncertainty in such data is significant, meaning such uncertainty indicates that a point estimate prediction is not appropriate, but this uncertainty can be well visualized using currently available data visualization computational software tools such as Microsoft Excel’s basic scatterplot tool. Further analysis using statistical packages in R Studio or Python accomplish the next task: visualizing standard deviations of differences between the estimated DREP and GEP values.

Figure 4 - Spectrum of the normalized Doppler Radar and Gauge Precipitation values with the probability density plot as it applies to each variable as the independent variable.

Figure 5 - Spectrum of the normalized Doppler Radar and Gauge Precipitation values with a kernel density function applied to one band of DREP (0 to 0.25).
The next step in research will be to better describe such uncertainty trends in order to cascade the resulting distributions into application models such as rainfall-runoff models. Other computational models that incorporate precipitation data that can utilize these results include groundwater, water conservation, environmental, contamination, agricultural, soil-strength analysis (e.g., levees, earthen dams, slope stability, highway embankments, etc.), among other applications. By cascading the input Doppler Radar data into the provided distribution of uncertainty trends developed in the current work, developing a distribution of outcomes for precipitation for subsequent use in other models (e.g. a stochastic “random walk” approach) that operate off the precipitation estimates is possible. Further, it is necessary for the continuing assembly of comparative data in order to provide an exhaustive representation, if possible, of all data comparisons. With such diligence, one can update the uncertainty estimates as data are collected and synthesized to better develop the uncertainty distributions displayed in this work.

References
Slickenside on the Corona Heights Fault

Albert L. Lamarre, CPG-06798

Given that San Francisco is a popular place for travelers, I suspect that over time many geology students pass through this fine city. I suggest that the next time any geology student is here, he or she must take the opportunity and time to see what is perhaps the best example of fault slickenlines anywhere in the world!

Although not one of the famously known faults of the San Francisco Bay Area, the Corona Heights fault has a slickenside that exhibits one of the best exposures of slickenlines you may ever see! The beautifully exposed fault surface is about 70 meters long by 15 meters high, and it forms a cliff face that was once the wall of a quarry. This exposure of world-class slickenlines is developed in Franciscan chert of the Marin Headlands Terrane where the Corona Heights fault, an oblique-dextral fault, cuts through the Castro District south of downtown San Francisco. The fault consists of a thin breccia zone (< 1 meter thick) with an anastomosing network of highly polished grooved slickenlines within the breccia that are profoundly well developed, well exposed, and well preserved. Since the fault cuts radiolarian chert of the Franciscan Complex, the fault surface is all silica, which accounts for the high degree of polishing and mirror-like finish. You can almost see yourself in the reflection.

The fault is at 15th and Beaver streets adjacent to the Peixotto Playground and a nursery school on the west side of the Castro District in southern San Francisco. It’s easy to miss since buildings are so closely packed together there and you probably wouldn’t find it if you did not know it is there.
Give Them an Inch…

Vic Ridgley, CPG-05138

Vic Ridgley, CPG-05138, worked 15 years in hard- and soft-rock uranium exploration, and 34 years in gold, including 20 years at 4 producing Nevada mines. He is now semi-retired and freelances in technical writing and editing.

In 1993, two prominent structural geologists approached AIPG in Nevada about running a 9-day field course through central Nevada to examine some classic basement structural styles relevant to large-scale crustal deformation. The trip was tightly scripted; after completing our travel on Day 1, rounded off with catered dinner, a regional geology lecture and slide show, we mentally prepared for the rigors of the next 8 days. Each day would follow the same rigorous routine:

• Early morning Continental Breakfast
• Morning class (lectures, slides & problem sets), 7:00 to 10:30 AM
• Afternoon field trip with sack lunch
• Evening catered dinner, followed by unsupervised lounge time.

The course content was fascinating. Day by day, we tackled shallow vs. deep crustal folds; rock comminution in proximity to faults; different fold styles; tilting of large crustal blocks; tilting limited to sedimentary cover rocks; metamorphic core complexes; trap-door faults; and an uneroded volcanic vent.

As fascinating as the geology was, the human relations aspect took center stage. I was one of two logistics organizers for the trip. My colleague handled the administrative details, and I took on the daily nuts and bolts of operations. All together, there were two professors, my logistical colleague and I, and 16 paid attendees, including 11 Americans, 3 Australians, 1 Canadian and 1 Irish. So, there were 20 people to look after, and I could easily imagine myself becoming their shepherd, their cruise director and activities coordinator. You see, the two professors were there to teach; the 16 paid attendees were there to learn and my colleague was there to enjoy himself, so that left me responsible for everybody’s welfare and HAPPINESS.

Problems surfaced immediately and centered on the meals. Everybody – I thought – understood that Continental Breakfast is just that: rolls and coffee. The morning of Day 2 I began to hear complaints from the “fruits and nuts” crowd that it was poor “public policy” for our group – known as we are for our robust HEALTHY lifestyles – to be served fatty, cholesterol-rich, non-nourishing foods.

The tour group had a charge account at the local market, and I had been authorized to buy whatever I needed for the day’s supplies, including the picnic lunches. So, during the evening shopping trip on Day 2, I took it upon myself to buy some bananas for the morning of Day 3. They were an instant hit. For one day. On the morning of Day 4 I brought in more bananas. Right away, the “fruits” started in on me: “This is boring; why can’t we have granola?” (This is supposed to be a ringing endorsement of natural food.)

I got somewhat agitated about this, because I felt I was being abused. After all, we had already PAID for the Continental Breakfasts, which were being left UNEATEN in favor of the bananas. So, the next morning I brought in granola bars. This quieted the complaining “fruits” for awhile. But then they started in with: “This is still boring. Can’t you find anything else?” So the next day I brought in a couple of cantaloupes and cut them up right on the serving table.

At this point the banquet manager for the hotel approached me and asked if there was something wrong with his breakfasts. I replied, “Nothing that losing a few of these conference attendees wouldn’t cure!” He said, “Well, if they don’t like the food, I can supply a couple of other things.” So then the two of us got into a US-Soviet style arms race – me outdoing myself each morning with more treasures from the market, he opening the bidding with fruit juices, then fruit cups, then croissants, then scrambled eggs, and finally fried eggs. By the end of the week, we had escalated from 20 rolls (for 20 people) to a full Swedish smorgasbord (at what financial cost I hesitate to guess).

And, at the end of the week, the chief “fruit” was still complaining because I hadn’t been able (not so – I refused!!) to provide loose granola cereal.

That is what went on in the mornings. A similar tale involved lunch.

We had contracted with a local store, “Drew’s VCR and Sandwich Shoppe” (convenient one-stop shopping for movies and lunch!), to supply 8” long sub sandwiches and 1 bag of potato chips for each of 20 participants, for $4 per person per day. Every night, I’d deliver two empty ice chests which he’d fill up with bagged ice in the bottom, and 20 bagged sandwiches on top. After morning class, I’d stop by and pick up the prepared coolers and 20 bags of chips. As well, I had also added miscellaneous items like soft drinks during the previous night’s visit. I stuffed all these items in my long-bed pickup, which was the supply vehicle trailing the main expeditionary force each day.

The first day out (Day 2), there had been really no time to study the menu, or decide on selections intelligently, so I had gambled and taken what Drew (an Indian from India) had suggested the night before – turkey and ham combo with everything on it. The sandwiches were prepared and ready to go on time after class, so I took them. As soon as we got to the field stop and set up for lunch, it started: “What are we having? Why? Isn’t there anything else? All I see is...”

Continued on p. 31
The Characterization and Composition of the Exterior Kasota Limestone with Regards to Weathering of the Cathedral of Saint Columba, Youngstown, OH

Brigitte Petras, SA-8989, Youngstown State University, Department of Geological and Environmental Sciences and Department of Chemistry

Purpose
The composition and characterization of building stones can give insight into the structure of the stone’s cavities, which enable weathering and erosion. Previous studies of the building stone have been conducted by others [Twin City Testing (1918), Bowles (1918), and Sledge et al. (2017)] but this is the first analysis of the structure of the calcic dolomite, known as the Kasota (Mankato) stone, at this location.

Background
The Cathedral of Saint Columba in Youngstown was built in 1958 with Ordovician Kasota (Mankato) stone (see Figure 1) which has been quarried since the 1800s near the towns of Mankato and Kasota in southern Minnesota. Abundant trace fossils represent ancient burrows formed in a shallow-marine and tropical environment.

Materials and Methods
Samples from the building were characterized, using the following techniques, at YSU or Materials Research Laboratory: Scanning Electron Microscopy and Energy Dispersive X-ray Spectroscopy (SEM/EDS), X-ray Florescence (XRF), and X-ray Diffraction (XRD). Adobe Photoshop was used to colorize some of the results. An unpolished thin section was used under polarized light with a Leica Microscope (Figure 2). It was subsequently covered in a thin layer of gold to provide conductivity for the Topcon (ISI) scanning electron microscope of Paramus, NJ, SEM/EDS.

Determination of Structure
Quartz and monocline were detected in both this study (Figure 3) and another study (Charola et al., 2017). Unique to this study, sanidine was detected, while orthoclase, micas, and clays were detected in the former study.

Elements of Kasota Stone
Table 1 on page 29 depicts the XRF data from three different studies. Twin City Testing (TCT) conducted their analysis on the stone quarried from Kasota and Bowles analyzed stones
from Mankato quarries. There is a significant difference in the dolomite content found in this study as compared to the previous studies.

A Closer Examination of Kasota Stone

The nature of the cavities was investigated under the microscope. Colonized and authigenic K-spars are pictured filling in cavities (Figure 6), and Figure 7 on page 30 reveals the nature of cavities, which include detrital and authigenic calcite and K-spar, surrounded by dolomite and calcite. Figures 6 and 7 depict rapid crystal growth with a low Mg/Ca ratio. Figure 8 shows the distribution of certain elements in the stone.

Table 1 - The percent fractions of Kasota stone (TCT) and Mankato stone (Bowles) and how it compares with the analysis at YSU

<table>
<thead>
<tr>
<th>Fractions</th>
<th>Compound</th>
<th>TCT*</th>
<th>Bowles*</th>
<th>YSU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate (%)</td>
<td>CaCO₃</td>
<td>47.4</td>
<td>48.26</td>
<td>59.7</td>
</tr>
<tr>
<td></td>
<td>MgCO₃</td>
<td>36.8</td>
<td>38.67</td>
<td>6.34</td>
</tr>
<tr>
<td>Acid Insoluble (%)</td>
<td>SiO₂</td>
<td>9.7</td>
<td>7.35</td>
<td>24.43</td>
</tr>
<tr>
<td></td>
<td>Al₂O₃</td>
<td>1.45</td>
<td>4.51</td>
<td>3.53</td>
</tr>
<tr>
<td></td>
<td>FeO₃</td>
<td>0.80</td>
<td>0.97</td>
<td>2.08</td>
</tr>
<tr>
<td></td>
<td>MnO₃</td>
<td>0.09</td>
<td>—</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td>TiO₂</td>
<td>0.07</td>
<td>0.08</td>
<td>.36</td>
</tr>
<tr>
<td></td>
<td>P₂O₅</td>
<td>—</td>
<td>0.06</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>K₂O</td>
<td>1.29</td>
<td>—</td>
<td>2.72</td>
</tr>
<tr>
<td></td>
<td>Na₂O</td>
<td>0.08</td>
<td>—</td>
<td>.45</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>97.95</td>
<td>99.90</td>
<td>99.73</td>
</tr>
</tbody>
</table>

Figure 3 - XRD analysis of the Saint Columba building stone.

Figure 4 - Authigenic K-spars (5 µm), formed in the cavities of the underlying authigenic crystal growth of rhombic colonized crystals (dolomite and calcite).

Figure 5 - Calcite is 3 µm and K-spar is 5 µm.

Figure 6 - Cavity with surrounding calcite and dolomite.
Another Material Present

After conducting two spot scans on two elongated materials, the analysis are not precise enough to unambiguously identify the material. The elemental EDS analysis may not be representative of the material because it may be analyzing the materials below it (Figure 10). This material may be illite or an external contaminant such as asbestos.

Current Restoration Efforts

The property director of the cathedral is replacing over twenty slabs, while coating the exterior stone with a water-based water repellent called Natural.
Stone Treatment WB Plus, and replacing the concrete sidewalks with granite.

**Conclusion**

The analysis of the Kasota stone shows elemental ratios and compositions similar to other studies of this stone. Compositions, such as those of clays, micas, and orthoclase, were not detected in this study because very minor amounts of these minerals may have been present in our sample. The elastic heterogeneity of this stone is shown, and the cavities are mostly surrounded by calcite and dolomite. Because acidic water, road salt, and freeze-thaw cycles chemically interact with carbonates, this weathers and erodes the stone at these openings. The water repellent will likely restrict the weathering agents from absorbing into the capillary structures of the stone.

**Future Research Directions**

- Investigate the composition and characteristics of the black crusts on the exterior of the St. Columba Cathedral.
- Explore the effectiveness of the water repellent.
- Further investigate the nature of the fibrous material

**References**


**Acknowledgements**

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**Author’s Bio**

Brigitte Petras grew up in Northeastern Ohio and is in the process of finishing a Bachelor of Science degree at Youngstown State University with a major in geology and minors in chemistry and art history. She would like to continue to learn and apply geochemistry to solving problems in research and industry.
Copper mining along the south shore of Lake Superior began thousands of years ago by prehistoric miners whose identity and origins remain unknown. Rumors of abundant resources of native metallic copper in what is now the western upper peninsula of Michigan were known to European explorers as early as the 17th century. In 1842, the U.S. acquired the mineral rich lands in Keweenaw, Houghton and Ontonagon Counties. Within a short time, prospectors, miners, investors and immigrants began exploring the native copper deposits of the Keweenaw Peninsula. America’s first mining rush was on.

The earliest mines extracted copper from rich fissure deposits. The opening of the Cliff Mine near Eagle River in Keweenaw County in 1845 marked the real beginning of a modern hard rock mining industry in the U.S. Over the next 40 years, the “Cliff Vein” produced over 38 million pounds of refined copper and paid dividends of over $2,500,000 to investors.

Many of the fissure deposits appeared at first to be rich strikes, but in most instances weren’t extensive enough to sustain profitable mining operations. By the 1860s, copper mining in the Keweenaw had spread southward into Houghton County with the discovery of the more extensive and sustainable conglomerate and amygdaloidal deposits. The Quincy Mine in the Houghton/Hancock area and the Calumet and Hecla mine in Red Jacket (now known as Calumet) soon became major producers (see Figure 1). Approximately 5 billion kilograms of copper were produced in the district between 1845 and 1968 (Weege and Pollack, 1971, after Bornhorst, 1992). From the 1850s until about 1890, approximately 90% of the copper needed to supply a growing United States was supplied by the Keweenaw mines.

Michigan Technological University in Houghton, Michigan began as the Michigan Mining School in 1885. Established by the State of Michigan to train mining engineers to operate the local copper mines, the school started with four faculty members and 23 students. The Michigan Mining School, subsequently the Michigan College of Mines, trained nationally and internationally recognized mining engineers. In 1964 the named was changed to Michigan Technological University (MTU). Today, Michigan Tech is one of the leading engineering and science education and research institutions in the country. MTU’s Department of Geological and Mining Engineering and Sciences (GMES) offers degree programs in Geology, Geological Engineering, Mining Engineering and Applied Geophysics.

My time at Michigan Tech (1979-1982) was fruitful from the very beginning of my career. My first job as a professional geologist was with the Colorado Highway Department working on the completion of Interstate 70 through Glenwood Canyon in the 1980s. The project engineer who hired me for a tunnel construction project was a Michigan Tech alumnus. Although I didn’t realize it at the time, I had “taken” what Michigan Tech had to offer. The taking went well beyond getting my B.S. degree in Geology, extending into the geologic setting of the Keweenaw; the rich mining history of the area; its natural scenic splendor; the mentoring I received from professors, grad students, university faculty and staff; as well as many shared experiences and long term and cherished friendships. Since graduating, I’ve made many enduring connections with other MTU alumni. In short, I benefitted far beyond what I had realized at the time.

About three years ago, I became compelled to give back to Michigan Tech in return for all that I had taken. That’s when I began exploring the possibility of establishing an AIPG Student Chapter at MTU. The MTU Geology Club seemed like the logical place to start. Somewhat to my surprise, there was considerable interest among the students and strong support from the GMES Department faculty and staff. As a result, the Michigan Tech Student Chapter was officially chartered by AIPG in October 2017 and is flourishing. The AIPG Michigan Section now has five student chapters.

As sponsor of the MTU Student Chapter, my primary role is to help students with career path related issues. There are other aspects involved, including some most enjoyable field trips. Nonetheless, helping the students chart their career paths and launch their careers is first and foremost.

Here are some things I tell the students:

**Resumes**

Take advantage of the university resume service. They’re very good at setting up and formatting resumes.

Keep your resume to one page, if possible. There are creative ways to format your resume to reduce it to one page while retaining the necessary information.

Emphasize your college experience including: project experience (e.g., senior design projects), internships, co-op positions, work/study programs, research assistantships, field studies (field geol-
ogy, field geophysics, field surveying, etc.) and other relevant coursework. Employers typically aren’t as interested in high school accomplishments, one notable exception being if you were valedictorian of your high school graduating class. That’s worth including on your resume.

For freshman and sophomore students, don’t worry about not having enough college coursework and experience to fill the page. It’s OK to fall back on high school achievements and experience in this case. Chances are that underclass students will be looking for summer internships or research assistantships, which help build your resume. It’s important to realize that you aren’t expected to have a lot of experience for these kinds of positions, so don’t worry about it. Just show your enthusiasm, emphasize your work ethic and communicate your eagerness to participate, learn and contribute.

Tailor your resume to fit different job opportunities. Have more than one version of your resume ready. This is often just a matter of changing the objective statement and possibly rearranging the order of relevant coursework and work experience. For example, you may want to have different versions for seeking positions in: consulting engineering; environmental consulting; mining or oil and gas exploration; mining/oil and gas production; geophysics; academia; government; or for an internship, work study program, co-op position or research assistantship.

Have someone review and proof your resume before you submit it. The peer review process is an integral component of your resume. This is part of the continuous improvement process that you’ll be hearing more about during your professional career.

Interviews and Career Fairs

Interviews can be uncomfortable and difficult, especially at first. As you have more interviews, they become easier and your comfort level and self-confidence increase significantly. Employers look for people who are articulate, self-confident, polished and assertive. Those who have a naturally occurring soft voice should try to project a bit louder when they interact with a prospective employer during an interview or at a career fair.

Prepare for the interview by finding out what the employer does with regard to their business, their corporate culture and community service.

Phone interviews are OK. They’ve become common. A phone interview can lead to an in-person interview or even a job offer. It can also be a dead-end if you don’t make a good first impression.

As hard as it may seem sometimes during interviews, be comfortable, relax and be yourself. Emphasize what you have to offer and how you can contribute to what the employer does.

Attend career fairs. They’re free and offer a broad perspective on which industries and companies are looking for talented and capable young professionals, as well as the kinds of jobs available in the job market. Consider your brief encounter with the recruiters at the career fair to be a mini interview. Making a good first impression is key to getting an interview.

Don’t worry about not having enough experience when interviewing for an entry level professional position. Entry level people aren’t expected to have experience. Although summer internship experience is a plus, it’s most important to convince the prospective employer that you’re the person they’re looking for, the person they should hire and invest in. Emphasize your enthusiasm, work ethic and eagerness to contribute to their success as you learn and grow and develop as a professional.

Employers may request examples of reports you’ve written. Be prepared to provide these as a follow up to an interview. Most employers don’t expect entry level people to have advanced writing skills, so any examples of well written technical reports you can provide are a big plus in leading to a job offer. Good technical writing skills can help set you apart from other applicants.

Believe in yourself. Be self-confident. Don’t be afraid to make mistakes. We all make them. Exercise due care and caution in what you do, but don’t intimidate yourself by fear of making mistakes. I see students, young professionals and even seasoned veteran geologists and engineers who are so apprehensive about making mistakes that they can’t function at an optimum level. We learn from our mistakes and as a result become better at what we do.

Job Sector Preferences

The job market has various sectors. The different sectors have their own particular advantages and disadvantages with regard to location, salaries, stability, sustainability, and lifestyle. What one person perceives as an advantage may be perceived as a disadvantage by others.

Generally speaking, jobs in the consulting engineering, environmental consulting, academic and government sectors tend to be more abundant, have a wider geographic range, are more sustainable and more conducive to a stable lifestyle. These job market sectors tend to be more attractive to those seeking stability and sustainability, including those who wish to settle down and raise a family.

Jobs in the exploration and production sectors (oil, gas, mining) tend to offer more in the way of adventure, excitement and exhilaration. These job market sectors tend to offer more and better opportunities for travel and adventure, as well as higher salaries. They can be very appealing to college graduates who are young, single, and who are comfortable with a more transient lifestyle. These are all things worth considering when charting your career path. Different strokes for different folks.

**Dream Job vs. Starter Job**

Have a vision. Chart your course. Set your sights high. Set your standards high.

Be proud of who you are and where you’ve come from. For Michigan Tech students, know that your university has a strong reputation and holds a prominent place in the engineering and sciences world. Tech grads are well received and sought after by employers.

Your first job may not be your dream job. Chances are it won’t be.

Be patient. Sometimes the right opportunity takes time to develop.

Continued on p. 39
Recently, I was invited to give a colloquium at my alma mater, the University of Missouri. I was flattered and excited that I would be able to help make the University more aware of the ways that AIPG helps to support the profession and students, and to give some insight into the current state of the profession. My talk focused on the job market, and the fact that it’s a good time to be a geologist or to be a student who will earn a degree in geology. The American Geoscience Institute produces a biannual report called The State of the Geoscience Workforce. The next report should be out sometime after the first of the year. I encourage you to find a copy and read through it carefully. I thought I might share some of the same insights here, in The Professional Geologist.

In addition to giving an overview of the job market, I spent a fair amount of time talking about expected skills versus marketable skills. I chose to spend some time addressing that topic, because I review resumes for students who are getting ready to enter the job market, and I see a trend to list skills that, quite frankly, are expected of any student who has earned at least a B.S. in geology. It is quite common to see “field rock and mineral identification” and “taking strike and dip with a Brunton compass” under the skills section of a resume. While these are valuable skills, they do not set the applicant apart from others who have degrees in geology.

Increasingly, I hear from our members, and from others in the field, that students complete their degrees without learning significant skills that will help to set them apart. Most undergraduate and many graduate students in geology have no introduction to geostatistics. Few have completed a technical writing course with a geologic focus. Almost no students have used a theodolite or a total station. Very few have sampled a monitoring well, used field water testing kits, or measured soil moisture. These observations are not meant as a criticism of our colleges and universities. In an era of decreased funding and shifting public priorities our institutions of higher education continue to do an admirable job. Rather, this gap reflects a disconnect between our profession and our institutions of higher education. We must work together to address this ‘skills gap.’

To that end, AIPG has partnered with Northwest Missouri State University to offer the first ever AIPG endorsed Environmental Geology Certificate program. The program is open to all students, regardless of their academic classification (undergraduate, graduate, returning) and enrollment status (full- or part-time). The certificate is designed to equip students with a set of skills that commonly are required by those working in environmental consulting and remediation. Students will be trained in water and soil sampling methods, will learn to use a total station, will learn applied surficial mapping techniques, and will take a capstone course in geological data analysis and report writing. Each student pursuing the certificate will be required to pass a program-based final exam that covers both classroom and field skills. This exam will be administered by the University and observed by one or more members of AIPG. We hope to expand this program to include other colleges and universities across the country.

Our goals in pursuing this program are three-fold. First, by partnering with a University Program, we hope to use our knowledge of the profession and of the job market to provide critical information about desired skills to allow colleges and universities to create curricula that remain abreast of industry needs. Second, we hope to help meet the need for qualified field technicians in the environmental industry. Third, we hope to build a stronger connection between professional geologists and university programs. Our ultimate goal is to provide critical information that will provide a solid basis so that college and university geology curricula continue to provide a mix of intellectual and applied opportunities that make college and university geology degrees inherently valuable.

If you have any comments, questions, or suggestions, or if you are interested in participating in this program as a partner institution or as an AIPG member on our education committee, please feel free to contact me via email, awj@aipg.org.

I hope each of you has a warm, productive winter.

Best Regards,

Aaron
Looking to the Future

Keri A. Nutter, CPG-11579
knutter@dowl.com

I can’t believe that it is already 2019, and we are starting a new year. It seems as if it was just yesterday that I was invited to a meeting at the Anchorage Hilton with the 2013 AIPG Executive Committee as they were scoping out Anchorage for the 2015 annual meeting location. It was at that meeting that I was introduced to AIPG board service and welcomed to the table and into the discussion. Now, 6 years later, I am privileged to be serving as the 2019 AIPG president. All it took was for Ron Wallace, Bill Siok, and Ray Talkington to ask me to sit at the table to share my thoughts about how to appeal to students and young professionals. It was this opportunity that hooked me solidly into an organization that, until that point, I had merely belonged to but had not found the passion to participate in and become engaged with.

I am looking forward to 2019 because the energy is greater than ever in our membership – our young and fresh-minded students and Young Professionals are stepping up to the leadership plate and doing amazing things at the collegiate, section, and even national level. In this Student Issue of the TPG, we have reflections and words of wisdom from our experienced members and many student submittals – more than last year! These student pieces are well-written and showcase the great work and valuable contribution of our students and Young Professionals. This is the shift in energy that will help carry AIPG through some tough times ahead. With licensure under attack in multiple states, the passion of our experienced members is needed to invigorate and encourage all of us to continue working hard for the advocacy and support of geoscientists and the important role of AIPG.

The 2019 Executive Committee is charged and ready to tackle the challenges and tasks necessary to further the growth and reinforce the mission of AIPG – Competency, Integrity, Ethics. I am honored to serve our members and will do so along with a great team of individuals who are a mix of experienced board members and some new faces on the Executive Committee. I am so happy to continue serving with Past-President Doug Bartlett of the Arizona Section; his experience and guidance has been and will continue to be a valuable source of knowledge and encouragement. Todd McFarland of the Tennessee Section is returning to the Executive Committee as President-Elect; Todd and I served together on the board for a couple of years as fellow advisory board representatives, and when Todd was elected 2015 Vice President, and it is exciting to work with him again!

Nancy Wolverson (Nevada), Anne Murray (Florida), and John Berry (Texas) will all maintain seats on the ExCom serving as the 2019 Vice President, Secretary, and Editor, respectively, and I am happy to have the opportunity to keep working with them and learning from their experiences and careers. Matt Rhoades of the Colorado Section will be our trusty Treasurer and Erica Stevenson from Michigan will serve as our Young Professional, receiving the baton from Brandy Barnes of the Carolinas Section who will continue to serve as the Past-Young Professional in 2019. The advisory board, as elected in Colorado Springs in September, will be Steve Baker (California), Colin Flaherty (Ohio), Amy Hoeksema (Michigan), and Shanna Schmitt (Minnesota), who is returning after serving in 2016.

I am also proud to be the fourth female president of AIPG, (following in the footsteps of Susan Landon (1990) and my mentors Barb Murphy (2012) and Helen Hickman (2016), and to be on the first female-dominated board in the history of AIPG. Seven out of eleven of the 2019 Executive Committee members are women, and the average age of the Executive Committee is decreasing – a sign that as the dynamics and demographics of the geosciences evolve, so does AIPG (check out the Geoscience Currents on the American Geoscience Institute’s website). As presented during the 2018 Annual Meeting plenary session, there are more generations than ever in the workforce and as a result, proportionally more different priorities and ways of communicating and relating. But with an organization like AIPG, we can bridge across the demographics and all our differences to remain united, strong, and focused on the future and the importance of the professional geoscientist.

We have a busy year ahead with much support anticipated for states under threats of de-licensure, encouragement for sections that are finding their footing, and continued support for those sections that are consistently leading the charge to educate the public and encourage youth to pursue geoscience careers. AIPG will continue to support student programs and scholarships and to keep the farm system growing to keep the geoscience profession strong!

I want to thank every one of you for your part in keeping this organization the wonderful entity that it is today – from our knowledgeable long-timers, to our brand-new students and young professionals, to the incredible AIPG staff that keep us running so smoothly. You are all what make AIPG great and I thank you from the bottom of my heart!
Construction of a Cold-Seal Pressure Vessel Apparatus

Justin G. Casaus, SA-8013, and Laura E. Waters, PhD

Casaus is a graduating senior currently in the process of submitting applications for graduate school where he plans to apply his work and academic experiences toward the achievement of a PhD in experimental petrology.

As an undergraduate at Sonoma State University, my undergraduate senior thesis research focused on determining the pre-eruptive conditions (i.e., temperature, water content and pressure) of a large (~50 km³) ignimbrite and the associated resurgent lava dome located on the island of Dominica in the Lesser Antilles island arc. My thesis revealed that the magma storage conditions ranged between 769 ±12°C and 794 ± 7°C, and ~8.9 wt.% to 5.5 wt.% H₂O for the ignimbrite. The resurgent lava dome exhibited hotter and drier storage conditions when compared to the ignimbrite, with a range of from 798±40°C to 834 ±15°C, and 8.1 to 4.8 wt.% H₂O. Oxygen fugacities (relative to the ΔNNO buffer) range between ~0 and +1 for both the ignimbrite and dome samples. To test these results, my advisor and I are going to conduct phase equilibrium experiments, and, therefore need to construct a cold seal apparatus capable of reaching the temperatures and pressures of the Dominica samples. I am finding that I can employ all my past experiences and skills obtained as a machinist, auto mechanic, and aircraft mechanic towards the fabrication of key components for the construction of a High P-T cold-seal pressure vessel apparatus.

The apparatus is currently being constructed in a shared space laboratory, where the layout of the lab itself presented obstacles to overcome. The apparatus requires a steady source of water and compressed air. Unfortunately, neither of these were available in close proximity to our designated area which required a certain amount of creativity on the part of my advisor Dr. Laura Waters and myself. We decided that a length of air compressor hose connected to the building-supplied compressed air outlet on the opposite side of the room would be an efficient and practical means of providing our compressed air. Fortunately, a number of capped off water pipes were littered across the wall of the laboratory, but none on our side of the laboratory. Once again, we devised a plan, which consisted of sweating together various lengths of copper pipe and elbows, thus routing the building water to our apparatus.

With our water and air supply problems settled we were able to focus on the construction of a key component to the apparatus, the pressure head coupling. The pressure head coupling joins high pressure tubing to the waspaloy (a nickel-based superalloy) vessel. An over the counter option was not available to us: this required the construction by us of the pressure head coupling. Based on the manufacturing schematics for the pressure vessel we formulated the specifications for our required pressure head coupling. We sourced a length of two-inch wide hexagonal bar made of 310 machinable steel: even though 310 steel may eventually rust, we knew that our lathe and mill could machine it. Using a South Bend 10” lathe, I machined a 3/8” through hole and a 1¾ -12 NPT threaded hole from our raw material. We were very excited when the pressure head seamlessly connected to the vessel with a few frictionless turns.

Currently the apparatus will be used in support of one furnace with the option to add another. Upon completion of the assembly of the apparatus we will be conducting water solubility experiments on rhyolite melts in precious metal (Au) capsules for calibration purposes. Construction of this experimental apparatus has provided me the opportunity to use skills I obtained as a tradesman to questions rooted in geologic research.

My advisor and I would like to thank the Geology Department and Dean Stauffer of the School of Science and Technology at Sonoma State University for supporting this project.
Robert A. Orgain, CPG-5047

East New Market, Maryland

January 17, 1946 - July 25, 2018

Excerpt from Robert's obituary

“Mr. Orgain graduated in 1974 from Indiana University with a major in geology. He served in U.S. Army from 1965 to 1969 during Vietnam. Mr. Orgain was president of the Environmental Consulting Services Inc. in Salisbury and in East New Market. He enjoyed fishing and gardening, and was a member of AIPG.”

John J. Amoruso, CPG-1745

Houston, Texas

February 14, 1961 - January 19, 2018

Excerpt from John's obituary

“Other than his family, geology was John’s passion! He was often heard saying, that he has never worked a day in his life, because he loved what he did so much. John was devoted and gave a lifetime service to the geologic profession including being the President of the AAPG in 1982-83 and also much involvement and President of GCAGS, SIPES and The Houston Geologic Society.

John Amoruso was a Certified Professional Petroleum Geologist. John has received numerous awards for his contributions and leadership including honorary membership in AAPG, GCAGS, SIPES and the HGS.”

Mr. Edward (Ned) T. Luther, CPG-419

Nashville, Tennessee

February 11, 1928 - September 28, 2018

Excerpt from Ned's obituary

“...after completing his freshman year at Vanderbilt University, withdrew to enlist in the Navy at the end of World War II. He resumed his education at Vanderbilt and graduated cum laude with a bachelor's degree in geology, and then received his master's degree in geology and chemistry, also from Vanderbilt, in 1951 (with a straight-A average!). He spent most of his professional life with the Tennessee Division of Geology, and reached the pinnacle of his career when he was named State Geologist of Tennessee in 1990. Ned was a Fellow in the Geological Society of America, and served as chair, vice chair, and secretary of GSA’s Coal Geology Division over the years. He was a charter member of the American Institute of Professional Geologists and was a registered professional geologist in Tennessee and a member of the Vanderbilt chapter of the Society of Sigma Xi. He was the author or co-author of more than 40 professional publications, but the publication dearest to his heart was “Our Restless Earth: The Geologic Regions of Tennessee,” an affectionate description of the state he loved and called home for 74 of his 90 years.

Brian Wayne Morris, CPG-11786

Reno, Nevada

February 14, 1961 - November 10, 2018

Excerpt from Kel Buchanan, CPG-6058

“I have some sad news. Brian Morris, an AIPG member who was a speaker at our AIPG Exploration Roundup two years ago when he was with Klondex Mines (now Hecla), was killed while being a good Samaritan at a car crash on the Mt Rose highway, not far from where we live. Another good Samaritan was killed as well at the site. One of the drivers they were trying to help was also killed. Brian’s wife’s name is Jan. The Geological Society of Nevada just informed us this afternoon. Brian was a GSN member as well.”

Weldon C. Doran, Jr., CPG-1676

Pittsburgh, Pennsylvania

February 14, 1961 - June 30, 2018

Excerpt from Weldon’s obituary

“Weldon served for three years during the Korean War in the United States Marine Corps. Upon receiving an honorable discharge, he returned to Huntington to complete his Geology degree from Marshall University. A job offer, in 1959, from Equitable Gas Company brought Weldon and his young family to Pittsburgh, PA. After 17 years at Equitable, many of them spent as manager of the company’s Geology Department, Weldon resigned from Equitable Gas and founded his own company, Doran & Associates, Inc. He and his company became a leader in the oil and gas industry.”
1. Recent dramatic igneous activity from Kilauea Volcano in Hawaii makes us think about the relative power of various eruptions on a global scale. Based on the volcanic explosivity index (VEI) and volume of ejecta, which of the following eruption types is most formidable and concerning?
   a) Hawaiian
   b) Plinian
   c) Peléan
   d) Strombolian

2. In our field work, we find a hill capped by a well-cemented conglomerate consisting of rounded pebbles. Which particle size diameter best describes the components of this lithologic unit?
   a) 1/16 to 2 mm.
   b) 64 to 256 mm.
   c) 2 to 64 mm.
   d) Dude, I are nut a sidiminitrity petritrigiligist! Motimurfic roks roole!

3. In our studies of sedimentology, we are concerned with determining the settling velocities of sedimentary particles in aqueous environments. Which of the following is useful to us regarding this matter?
   a) Kepler's Law.
   b) Gay-Lussac's Law.
   c) Stoke's Law.
   d) Murphy's Law.

4. Which of the following pelecypods is not a representative of the Paleozoic Era?
   a) Inoceramus.
   b) Colpomya.
   c) Aviculopecten.
   d) Man! You best interpret my silence on this one!

5. Pertinent to stress-strain curves in rock and soil mechanics experiments, what defines the “ultimate strength?”
   a) The total ductility of the sample being tested.
   b) The peak strength of the stress-strain curve.
   c) The point at the knee of the stress train curve beyond which deformation is permanent.
   d) Stress and strain? Dude, by now I am totally stressed out thinking about these mind-straining questions!
Take a starter job, gain experience and build your resume while you keep looking for your dream job.

**Competition**

As you advance through college towards graduation, it’s likely you’ll find yourself competing with your classmates and friends for scholarships, internships, and ultimately for entry level professional positions. This is the natural progression we all go through. Don’t let competition get in the way of friendships.

The friendships and relationships we make in college can and often do last for a lifetime. In the professional world, you’ll find that some of your friends are also your competitors. Consider them to be friendly competitors. Don’t let competition get in the way of friendships.

**Perfection**

The world isn’t perfect. Things aren’t all black and white. There’s a lot of gray matter in the universe.

None of us are perfect. No university, government, employer or corporate culture is perfect.

Look forward to what the future brings and what you can make happen.

**Take and then give back**

Charting one’s career path is a process that really begins when you choose your major, or even before. As students get closer to graduation and prepare for their professional careers, they face change and uncertainty that extends beyond the job market. It’s about lifestyle, security, satisfaction and fulfillment. Where am I going? Where will I live? Where am I headed? Where will I end up? Will I be able to support myself at a comfortable level? How will I manage my own affairs after my safety nets are gone? Perhaps most importantly, will I enjoy my work and find it interesting, challenging, rewarding and fulfilling? All these things and more become part of the thought process of students as they approach graduation and look to the future.

College graduation is an exciting time, a time to be cherished and celebrated, and a significant milestone in life. It can also be daunting and intimidating as you start down your career path into what may seem like the unknown. Don’t be apprehensive about uncertainty. It’s OK to be uncertain. We don’t all know exactly where we’re headed, certainly not all the time. Embrace change. Take chances. Learn, grow and develop. Strive to improve. Seek guidance from others. Chances are you’ll come to realize as I did that it’s not as difficult as it may have seemed.

Today’s students are tomorrow’s professionals and the building blocks of our profession. Tomorrow’s professionals are the leaders of the future. When your turn comes, please give something back to those who come after you.

**References**


Answers:

1. The answer is choice “b” or “Plinian.” Please refer to the table to the right.

2. The answer is choice “c” or “2 to 64 mm.” Choice “a” best applies to “sand-size” particles, while choice “b” corresponds to “cobble-size.”

3. The answer is choice “c” or “Stoke’s Law.” It expresses the settling velocities of small spherical particles sinking into a fluid medium.

\[ V = \frac{(2/9) \times (d_1-d_2) \times (g) \times (r^2)}{\eta} \]

For the above:
- \( V \) = settling velocity
- \( d_1 \) = density of the particle
- \( d_2 \) = density of the fluid medium
- \( r \) = radius of the particle
- \( \eta \) = fluid viscosity
- \( g \) = acceleration of gravity.

Gay-Lussac’s Law may refer to a series of principles or discoveries, but the most famous is the “pressure law.” It states that the pressure of a gas of fixed mass and fixed volume is directly proportional to the absolute temperature of the gas.

\[ P_1 T_2 = P_2 T_1 \]

Kepler’s Law refers to three principles of planetary motion. The first law states that all planets move in elliptical orbits with the sun as one focus. The second law states that a line that connects a planet to the sun sweeps out equal areas in equal times. The third law states that the ratio of the square of the revolutionary period (in years) to the cube of the orbital axis (in astronomical units) is the same for all planets.

Well, as you know, Murphy’s Law is commonly applicable to things that we do and no one is immune!

4. The answer is choice “a” or inoceramus; a concentrically wrinkled dysodot of Jurassic to Cretaceous age.

Aviculopecten is a long ranging (Silurian to Permian) pectinoid dysodont.

Colpomya is a mytilid dysodont of Ordovician to Silurian age.

“Pectinoid” defines a group of relatively large marine scallops. The term “dysodont” applies to a type of hinge definition found in bivalves, where the teeth are small and simple and located close to the dorsal margins of the valves. The term “mytilid” refers to marine pelecypods with dark, elongated shells that attach themselves to hard surfaces in intertidal zones.

5. The answer is choice “b” or “peak strength in the stress-strain curve.”

“Ductility” is defined as the total percent deformation before rupture. Earth materials that deform plastically exhibit ductile behavior. Brittle behavior is opposite to ductile deformation.

The point at the knee of the stress-strain curve beyond which deformation is permanent defines the “yield stress” or “yield point.”
Climate Change, Younger Members, and AIPG’s Membership

Some of AIPG’s membership (primarily older members?) remain skeptical of climate change for a variety of reasons. Other AIPG members (particularly Students and Young Professionals) are convinced of the reality of climate change. A problem can arise when one of the skeptics clearly expresses this skepticism as a Section or other leader in AIPG and these views (plus a leadership position) cause those convinced of climate change to wonder whether AIPG is a worthwhile organization for them. As an organization, AIPG cannot afford to drive away actual and potential younger members.

I asked Brandy Barnes, the 2018 Young Professional Member of the National ExCom, for her thoughts on the subject. She replied,

Our organization has specific goals to uphold professionalism and ethics in all types of geoscience professions. Communication, professionalism, and problem-solving skills are key skills for the young scientist (or scientists) as they seek growth in their careers. Having a firm grasp of these key components will ensure that the young scientist is successful navigating the most effective and efficient path when that path is not always clear due to differing opinions in the industry. There is a widespread generational gap in the geosciences; with that comes the understanding that geology is evolving, and scientific techniques are improving. Humans are very opinionated, and your colleagues, coworkers, and employers may not share your own views. This only gives you more opportunities to express and expand your skills in professionalism and communication.

A couple of things to keep in mind moving forward: we need to understand that the organization does not support specific views and we also should consider the context in which we present material. Be aware of your communication strategies and of upholding the values of AIPG. A young professional can benefit from mentorships and learning from the wisdom of our senior members and the growth and changes that have taken place throughout their careers. For those in our industry, we need to be patient as the young scientists learn and grow; they have different mind-sets and experiences from previous generations.

Ideologies may vary by generation, but as long as professionalism is at the forefront, progress can be achieved. They are the future of our organization and the geosciences, we can all work together to create a stronger foundation for our professional community.

A very interesting article, “Louisiana coastal loss drives "environmental disenfranchisement,”” in the September 2018 AAPG Explorer focused on the work of Sam Bentley of the Louisiana State University’s College of Science and the study of the changing coast line of Louisiana. Bentley points out that, “Conditions are dire for much of the coastal region of the Mississippi River Delta and our children will see a coastal landscape that we might not recognize.” The well-known changes in the Mississippi’s discharge point, the migration of deltas, have led to the buildup of land in one area and subsidence in others. More recently, human activity of various kinds has impacted this process. For example, Bentley notes that the damming of the Missouri River cut the sediment load delivered to the Mississippi River Delta by “50 percent or more.” Bentley states that the biggest factors affecting coastal Louisiana—erosion plus subsidence plus sea level rise—have led to shrinkage of the coast that negatively impacts coastal communities. People have been voluntarily leaving coastal areas because of flooding risks from hurricanes and subsidence.

In general, I believe this is an important topic and fabulous practice for all of our members. Always be an advocate for yourself and the profession, we all can grow and become even better communicators and professionals, which in turn benefits our future in the geoscience community.

The following topic, “Environmental Disenfranchisement,” discusses a related issue. Also, the articles, Climate Change: Are We Changing or Not? and William Greenslade’s review of What science reveals about the nature of endless climate change address aspects of climate change.

Environmental Disenfranchisement

To our students and young professional members, consider the same. Your mentors have walked a different path than you likely will. Do not be discouraged by people who think differently from you, but find new ways to encourage people to review your opinions or data. Do not create a habit of fleeing during disagreements; understand why people think the way they do and move forward. Make progress and practice those skills of communication, professionalism, and problem solving. The “art of listening” is a rewarding tool that can be utilized in every aspect of life. Consider this quote form Bryan H. McGill, “One of the most sincere forms of respect is actually listening to what another has to say.”

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Bentley calls this “environmental disenfranchisement.” Debates about how to deal with the issue and potential solutions that cost huge sums of money are heated and have not reached conclusions.

The impacts of hurricanes and sea level rise are not limited to Louisiana. They occur along the whole Gulf coast and much of the Atlantic coast. This Fall Hurricane Florence savaged the Carolina coast and Hurricane Michael essentially wiped out towns on the Florida panhandle. The projected damage to buildings and infrastructure are enormous. But the cost of insurance for hurricane damage in coastal areas is nowhere near high enough to cover the actual payouts. Florida law limits what insurers can charge in order to keep rates affordable. If the cost did cover actuarial losses, few if any could afford to live in the coastal areas. This would be another form of “environmental disenfranchisement” as defined by Bentley. On the other hand, what about the negative impact of higher insurance rates on the rest of us needed to cover the losses suffered by those pay less than actuarial rates? Given climate change and rising sea levels, should people be allowed to rebuild on these coastal areas? Should the following requirements be enforced if rebuilding is allowed?:

- The full actuarial cost of hurricane insurance should be charged.
- Building codes should require that buildings be able to withstand Category 5 storms (there was one example of such a home in Mexico Beach, FL).

These requirements will make homes very expensive, pricing most people out of the market. This exacerbates Bentley’s environmental disenfranchisement of people in the area but relieves the rest of us from having to pay for those same people to live in a known geohazard area.

The Primary Responsibility of Geotechnical Engineers and Hydrologists

The article, “Thoughts on the responsibility of geotechnical engineers and hydrologists in mining,” by R.J. Sheets in the September 2018 issue of Mining Engineering is an excellent and in-depth look (through the use of examples) at the responsibilities of geotechnical engineers and hydrologists (http://me.smenet.org/abstract.cfm?preview=1&articleID=8493&page=32, for a summary). Sheets maintains that their primary responsibility is the safety of all affected parties, on and off site, something not emphasized sufficiently in schools, which focus on learning professional tools more than their real-world application (including all the messy, conflicting, and missing data that are facts of professional practice and that are omitted from simplified school examples). I urge everyone to read this thoughtful article. Another article in the same issue of Mining Engineering, “Imminent Danger: characterizing uncertainty in critically hazardous mining situations,” by B.M. Elher, J. Hrica, and D.R. Willmer is also worth reading (http://me.smenet.org/abstract.cfm?articleID=84490&page=47, for abstract). While both articles deal specifically with mining issues, the observations are generally applicable.

Don’t Forget Your Hand Lens!

Editorial note: the text of this topic that is not italicized is from J. Bruce Gemmell’s article, “Don’t forget your hand lens!” published in the SEG Newsletter, October 2018, p. 6, and is included with permission from Gemmell and the SEG. Gemmell is the 2018 Society of Economic Geologists President.

Good exploration relies on expert knowledge and experience to identify ground with the potential to host substantial mineral resources. However, today’s exploration is ever more heavily relying on computer-aided analysis and portable field devices—to the detriment of good field skills—to derive information from which important, and costly, decisions are being made. This to me is a concern. Now is the time to put the geology back into economic geology. Fieldwork is critically important—be it field mapping, pit or underground mapping, or core logging. Many times in recent years, I have visited company field areas to examine outcrops or core and found (1) many of the recent graduates do not use, or sometimes do not even have, a hand lens, (2) many do not know how to use a compass for structural measurements, and (3) geologists and field technicians are not allowed to use dilute HCl to determine the carbonate species, due to company health and safety regulations. How have we come to this?

One of the many reasons is the reliance on portable devices (SWIR, pXRF) or core scanning technologies to provide basic observational information. While these tools can give valuable information, if the mineral geoscientist does not have the basic skills and knowledge to know if the information they are getting from these devices is right or useful, this can be dangerous. For instance, the early model SWIR devices would tend to identify paragonite as a common mineral in hydrothermal alteration, but a check of the lithogeochemistry of the same rock would show it contains no sodium (later models of this technology have rectified this issue), and if a pXRF is not calibrated and standardized properly you can obtain geochemical data, but it is meaningless—problem!

I believe that the most basic and fundamental observations for a minerals geoscientist to make are mineral and rock identification, followed by structural geology. These skills are sorely lacking in many new graduates simply because, through no fault of their own, they are not taught these skills in their undergraduate or graduate educations. Many of their lecturers and professors lack these skills, owing to their own education or experiences, and therefore they do not teach basic field skills and techniques to their students. In addition, many universities are dramatically scaling back fieldwork in their curriculum or abolishing it altogether, as it constitutes a liability they are not willing to risk.

As a consequence, the fieldwork component of many student research projects and theses can be poor or lacking altogether. Many recent papers in the economic geology scientific literature are devoid of good, basic geologic descriptions of the areas/deposits, and many do not have decent geologic maps and cross sections, espe-

Geologic Ethics & Professional Practices is now available on CD

This CD is a collection of articles, columns, letters to the editor, and other material addressing professional ethics and general issues of professional geologic practice that were printed in The Professional Geologist. It includes an electronic version of the now out-of-print Geologic Ethics and Professional Practices 1987-1997, AIPG Reprint Series #1. The intent of this CD is collection of this material in a single place so that the issues and questions raised by the material may be more conveniently studied. The intended ‘students’ of this CD include everyone interested in the topic, from the new student of geology to professors emeritus, working geologists, retired geologists, and those interested in the geologic profession.

AIPG members will be able to update their copy of this CD by regularly downloading the pe&p index.xls file from the www.aipg.org under “Ethics” and by downloading the electronic version of The Professional Geologist from the members only area of the AIPG website. The cost of the CD is $25 for members, $35 for non-members, $15 for student members and $18 for non-member students, plus shipping and handling. To order go to www.aipg.org.

The SEC’s Final Rule on Modernization of Property Disclosures for Mining Registrants

David M. Abbott, Jr., CPG-04570

The US Securities and Exchange Commission issued Release 33-10570, the final rule on Modernization of Property Disclosures for Mining Registrants, www.sec.gov/rules/final/2018/33-10570.pdf, on October 31, 2018. This 455-page release represents a substantial revision of the SEC’s proposed rules issued in June 2016 and brings the mining disclosure requirements much closer to but not in precise conformity to the internationally recognized CRIRSCO-templates definitions and disclosure guidelines such as the SME Guide for Reporting Exploration Information, Mineral Resources, and Mineral Reserves (2017). The SEC will not concede control of its disclosure rules. These new rules will become final 60 days after publication in the Federal Register (about January 1, 2019). Registrants engaged in mining operations must comply with the final rule amendments for the first fiscal year beginning on or after January 1, 2021. Industry Guide 7 will remain effective until all registrants are required to comply with the final rules, at which time Industry Guide 7 will be rescinded. This two-year delay for compliance will allow mining firms to become familiar with the new rules and prepare appropriate reports such as the Technical Report Summary that must be completed for all material properties containing estimated mineral resources and mineral reserves.

The full implications of these new rules are just beginning to be understood as are comparisons with existing internationally recognized disclosure systems. A committee consisting of members of the Society for Mining, Metallurgy, and Exploration (SME) and the National Mining Association (NMA) has been commenting on the SEC’s proposed rules for over 2 years and will be assembling comments, compliance suggestions, and related documents on the new SEC rules over the coming months. Those interested in the process should contact David Abbott, CPG, former SEC geologist, and member of the SME/NMA committee for further information, dmageol@msn.com.

www.aipg.org
The Professional Geologist & Ethics: A Cautionary Tale

W. L. Mathews

Your International Oil Company (IOC) employer had a very strong written business ethics and conflict of interest policy. Attendance was not mandatory at the company’s annual business ethics and conflict of interest seminars. You and some of your colleagues jokingly referred to these seminars as getting the annual “sheep dip”. Your company’s active enforcement policies were laissez-faire at best and you did not bother with industry and professional code of ethics. Management and employees did not bother with contractor gift disclosures regardless of the gift value. You were not concerned with the fact that unethical behavior and conflicts of interest could result in employment termination with serious financial and legal ramifications. From this lax environment you received your first expatriate assignment.

During that initial 3-year assignment you and your USA-based IOC employer were required to comply with the Foreign Corrupt Practices Act of 1977. You were aware that foreign governments have similar anti-corruption laws and regulations. Your thoughts were, “Why should I concern myself? These ethical and business practices laws and standards are for others.” Corporate profits, personal financial gains and professional success were your key motivators.

Initially you served as a functional manager in the IOC’s foreign affiliate. Within a short period of your arrival your company required trucking services from the sole local contractor. You executed the contract with Edgar, the owner of the local trucking company. The two of you shook hands. Before he released your hand, Edgar looked you in the eye and asked, “Who in your company must I pay the gasosa?”

The dual meaning of the expression “gasosa” was familiar. In the local language “gasosa” means ‘soft drink’. That expression was also the colloquial term for a bribe or a kickback. A sense of entitlement was deeply embedded in your psyche. This was in part due to the many challenges that had confronted you since you had arrived. These challenges included your contraction of malaria, safety, food shortages and the unbearable traffic even though you had an assigned vehicle and driver.

Feigning naiveté, you responded, “Edgar I don’t know what you mean.” Edgar politely asked, “Who must I pay the extra money for this contract?” He further explains, “It is customary to pay the boss when he gives a contract.” You could have proposed that Edgar discount his trucking rates by the value of the “gasosa”. Instead you pointed your faintly shaky index finger towards your chest and said, “The gasosa comes to me.” Edgar smiles knowingly. He passes a small envelope. That unmarked envelop established a bond between you and Edgar. Subconsciously you justified the acceptance of this benefit. You knew that Edgar would not have discounted his rates. In addition, this contract would help the joint venture achieve the mandated local content target.

From that point the word spread quickly that you were the contact person to open the door for local businesses to provide goods and services to this international company. You became their go-to-guy.

Reflecting back, all went well during your thirty years tenure with that international exploration and production company. You reached your mid-fifties and elected to take an early retirement. Within days of your retirement party you signed an independent consulting contract with a small Europe-based specialty oilfield equipment and service company. Your mission was to establish a joint venture affiliate in the emerging oil-producing country in which you had met Edgar. Details in your profession-
joint venture company and a very prominent government official. That arrangement had financial rewards for you and Walter. This new contract arrangement, to you, was business as usual. Or so you thought.

Throughout the country there was an increased demand to end corruption in your industry. These cries came from within and without the government, from the political parties, and from NGOs. The national intelligence agency was concerned with the increased unethical and corrupt activities inside the national oil company and the ministry of petroleum. The intelligence agents routinely interviewed and recruited local employees and managers inside the IOCs and the oilfield service companies. One such person was Frank, the first national that you added to your staff. You considered Frank your ‘right-hand-man’ and brought him along to that lunch. Little did you know that the State intelligence agents had convinced Frank that national loyalty and patriotism must take precedence over money and corruption.

Your arrest came swiftly but was kept out of the state-controlled media. You were arrested and charged with the violation of local and international laws. Luckily for you, someone persuaded the authorities to release you to your home country for prosecution. Rumors circulated that your ‘friend’ Edgar had a hand in your release from that hell-hole jail cell located just outside the city.

Today you sit just outside the USA federal courtroom. Your frayed nerves interfere with the thoughts and vivid memory of the first adrenalin rush you had got from illegal money, feeding your desire for self-gratification. You had known that the truly professional geologist would resist entering such a perilously seductive vortex. Your selfish attitude, flawed behavior and reckless actions paved the crooked trail that led you downward into this unprofessional, unethical and illegal spiral. Those temporary and fleeting gains should have been subordinated by your personal professional integrity, conduct, reputation, credibility and stature. Those hallmarks of the professional geologist were lost. Soon the loss will include your personal freedom.

In that lonely isolated hallway your phone beeps and interrupts the judgmental quiet. The message from an anonymous sender stated, “If you had only read and followed these guidelines.” ended with the link: http://aipg.org/codeofethics. The second and final text message arrived soon thereafter.

“A must-read/must-follow for all Professional Geologists”.

The principal lessons learned in this campaign have been:

- The only justification for an occupational licensing board in the current climate is that it is essential for the protection of the public health and safety.
- Boards must actually do something and be seen to do so: it is essential that licensed individuals bring abuses to the Board’s attention and insist that the Board acts. This requires the courage to face the usual risk of retaliation against whistleblowers.
- Boards governing numerically small and not highly visible professions are especially vulnerable to attack.
- It is expensive and involves a huge commitment of time to fight an attack on a Board.
- The findings were based on a lack of information about the profession and required much time and diligence to educate the legislators on the importance of the profession and the need for an independent board.

The Board of the Texas section of AIPG, on behalf of all Texas PGs, wishes to thank National AIPG, the Texas Geoscience Council, AEG, Houston Geological Society, GSA, and all the individuals involved especially those out-of-state who recognized that an attack on the Texas Board was the thin end of a very powerful wedge, for all their help, financial and otherwise, in combatting this threat to the existence of TBPG.

I personally would like to thank Barbara Murphy and Doug Bartlett of the Arizona Section, and Helen Hickman and Anne Murray of the Florida Section, for helpful conversations based on their experiences of combatting deregulation in their states. I also would like to thank Rusty Branch, President of the Texas Geoscience Council, for the Herculean effort that he put, and continues to put, into winning this battle.

Licensure, continued from p. 3

**CONGRATULATIONS TO AIPG’S AGI 2018 AWARD WINNERS**

On October 23rd, AGI announced its annual award winners. Two of the three are AIPG members:

Dr. Scott W. Tinker (CPG-10564) (Bureau of Economic Geology - University of Texas at Austin)

Dr. David Applegate (MEM-0002) (U.S. Geological Survey)

**AGI Medal in Memory of Ian Campbell for Superlative Service to the Geosciences**

Since 2000, Dr. Scott W. Tinker has led the Bureau of Economic Geology in Texas as the premier state geological survey, with over 250 research and support staff and students working on hundreds of international grants and contracts. His distinguished service – from his start in the petroleum industry to his more recent work as an educator and administrator – is superlative. Read more at https://www.americangeosciences.org/news/dr-scott-w-tinker-honored-agis-ian-campbell-medal-service-geosciences

**AGI Award for Outstanding Contribution to Public Understanding of the Geosciences**

As a USGS geoscientist and administrator, Dr. Applegate’s contributions are at the confluence of science, policy, and the public. He has been both a dynamic champion for the geosciences and a soft-spoken and assured communicator of scientific fact in times of crisis. Read more at https://www.americangeosciences.org/news/dr-david-applegate-usgs-geologist-honored-contributions-public-understanding-geoscience

**About AGI Awards**

AGI directly, or in cooperation with its member societies, makes a number of awards each year to recognize particular excellence in the geosciences. In addition, AGI works with its member societies to foster nominations of deserving geoscientists for consideration in a number of National Science Awards. To learn more about AGI awards, go to https://www.americangeosciences.org/awards.
As a geologist who has been following the public discussion of climate change, I have wondered why usually little or no information is presented about the history of climate on the earth and what it can inform us about the current and future projections of climate conditions. I am happy to say that a geologist has “stepped up” to fill this important gap, and in a book that is both informative and entertaining. While it contains significant scientific information and data, it avoids jargon and is written for a non-scientific audience.

Dr. Peters is a graduate of Princeton and Harvard in geology and an author and teacher. In this book she wades into the ‘climate wars’ with a strong geology foundation and an obvious love for our particular branch of science. “The Whole Story of Climate” is published by Prometheus Books®, and is available on Amazon in hard or electronic formats.

Dr. Peters lays the foundation of her principal thesis that climate is always changing—by taking the reader through a Who’s Who of historical naturalists and geologists and the contributions of each to understanding the Pleistocene and Holocene Epochs of earth history. If you are like me, you will remember a few of the names from your physical and historical geology courses, but this book will likely introduce some you have forgotten (or never learned about) and give you a new (or renewed) appreciation for the profession and the people who have formed our understanding of the earth and its history. In Dr. Peter’s march through the development of science’s understanding of the monumental climate changes in the Pleistocene you will meet and get to know Luis Agassiz, Charles Lyell, Charles Whittlesey, T. C. Chamberlin, G. K Gilbert, J. Harlan Bretz, Thomas Jefferson (very briefly), Baron Georges Leopold Chretien Frederic Dagobert Cuvier, Alexandre Brongniart, Gerhard Jakob de Greer, Ernst Jacob Lennart von Post, Andrew Ellicott Douglass (not a geologist but an astronomer and father of dendrochronology), Alfred Wegener (too briefly), Ernst Sorge, James Croll, Milutin Milankovitch (a Serb engineer), Harmut Heinrich, Gerald Bond, among others.

The book is organized more or less chronologically from the earliest understanding of the evidence for the enormous change in climate during the Pleistocene Epoch to the current debate about global warming. Its twelve chapters lead the reader through the scientific discoveries, successes and failings of the authors of much of what is known from the geologic record and related research about climate in the Quaternary. Readers will learn of glacial processes, varves, pollen in swamps, tree rings, ice cores, sea-bed cores and human development from hunter-gatherer to agricultural societies, and what information these processes and events yield about the history of climate on the earth.

In support of her thesis that climate is always changing, Dr. Peter’s introduces the reader to regular patterns of climate change that are named for the researchers that identified them, including Milankovitch, Heinrich, Dansgaard/Oeschger, and Bond cycles. Of particular interest to this reviewer is the evidence for Rapid Climatic Change Events (RCCEs—“Rickies”), where major regional or even global climate has changed in as little as few decades or over a typical human lifetime.

The last 10,000 years (Holocene Epoch) have seen a dampening of the cycles that occurred during the Pleistocene, with climate being generally warm (and even warmer than today) and relatively stable compared to the previous epoch. Dr. Peters notes that it is “certainly disquieting to meditate on the fact that the Holocene has already run for ten thousand years, longer than many of the warm periods that have occurred in the past two million years.”

While the bulk of the book is devoted to a review of what the geologic record says about climate during the past two million years, Dr. Peters does not ignore the current debate on the role of humans in climate change. She devotes a chapter to the hypothesis of William Ruddiman that the evolution of humans from hunter gatherers to an agricultural society over the past 5,000 years may have contributed to an unexpected increase in methane and carbon dioxide, powerful greenhouse gases, in a period when the sun’s energy striking the earth should be decreasing based on the Earth’s orbital variations around the sun. Using the detailed evidence from ice-core research and estimates of human agricultural and domestication of ruminant animals, Ruddiman concluded that methane and carbon dioxide produced by human activities over the past millennia accounts for an increase in global average temperature of about 1.5 degrees Fahrenheit; this is before the rapid growth in industrialization and population.

The last two chapters cover the scientific evidence for and against anthropological global warming as well as how the media, special interests and the political class have used, or misused, science to advance a point of view. Whatever your proclivities toward the current ‘alarmist’ or ‘denier’ views of climate change as expressed in the media, you will find something in “The Whole Story of Climate” to bolster your preconceived notions; you might even find something to change them! Regardless, you will appreciate the importance of geologic input to the debate, the evident love of the profession we have chosen and the clarity and entertaining prose of Dr. Kirsten Peters.
Macro or Micro—

The Devil is in the Details

William J. Elliott, CPG-04194, Engineering Geologist, Retired

How quick we are to come up with an answer to a question or solution to a problem!

But don’t be afraid to think beyond the box.

Some time ago, while compiling maps and articles for a geological field trip guidebook, I had an aha moment. The trip route I was following is not a new one. Numerous universities and societies have run field trips to this area over the years — so I had all of these previous road logs to draw from. With great patience and angst, I compiled the various road guides into one composite log. The obvious problem turned out to be one of trying to rectify the various mileages to the same stop — some being off by a couple of miles. Huh? Next was to decide which stops to include and which to eliminate. Then I had to go out into the field to re-run the trip logs to provide ground truth and verify mileages.

These older road logs kept referring to the Coyote Warp, without much explanation except that it could be seen from several vantage points along the trip route. I could see, sort of, that it was a physical bulge on the east side of the Sierra Nevada Mountain front. But that still did not tell me what I was supposed to be seeing and understanding from a geological perspective. It was a nice geomorphic/physiographic mega-pimple, but what was there beyond that that I was missing?

So, dutifully I kept the Coyote Warp notation in my new road log. But it kept bugging me.

It turns out that there are a number of mapped 15’ topographic quadrangles that cover the eastern Sierra Nevada, Owens Valley, and White-Inyo Mountains to the east. One of these United States Geological Survey mapping projects was an economic study of the Bishop Tungsten district, published in 1965 (Professional Paper 470). Fortunately for me, this mapping covered the area of the Coyote Warp. So, looking for a reference to the Coyote Warp in the Index (yes, in those days, these kinds of publications had a Table of Contents in the front and an Index in the back), voilà, I found a reference to the Coyote Warp on page 174.

Turning to page 174, I was eager to find a description and possible origin of the Coyote Warp. The author, an economic geologist, in an almost apologetic and perfunctory prose, described the geomorphology, rock types, faults, joints, and the like. The principal conclusion was that an old erosion surface had been somehow downfaulted, and “warped” in the process. It was a good physical description of what had been observed in the 1960s, by one whose principal interest was economic geology, but it was bit short on the genesis. Multiple Working Hypotheses might have been a better way to approach this enigma.

As I read through pages 174-177, I was salivating over the description of a monster landslide in crystalline rock. Then looking carefully at the geologic map and structure sections, I became convinced that the Coyote Warp was indeed more than just an errant bulge on the east side of the Sierra Nevada, it was in fact, a monster landslide that had moved down into the Owens Valley prior to its being filled with sediment. The geomorphology is compelling. Winning the lottery would provide money to drill a hole to find the basal slip plane — but not this week!

What is the point of this story? Look beyond the obvious. Think big. Do not be afraid to drool and dream. In this case, smaller landslides that had been mapped years after the Professional Paper came out were just micro pimples at the toe of the macro slide. Even the experts missed the obvious, and focused on the tiny pimples.

So what can you take to the bank? Be bold, think big, and don’t be afraid to share and publish what you see and believe to be correct based on the information at hand. Sometimes it takes a young person with fresh ideas, clear eyes, and exposure to the latest concepts to see the big picture. Without throwing the thought or idea — the mud — against the wall to see if it sticks, others will not have a chance to shoot at it and either agree or disagree. This is how science is done. It progresses toward a new answer that is acceptable to most workers, experienced and neophyte alike. That is when the mud sticks.
Getting the Most Out of LinkedIn as a Student/Young Professional

Zachary Burton - Ph.D. Candidate, Stanford University

When I was 19, I blasted off dozens of resumes for dozens of summer jobs remotely related to geology and environmental science. Not only did I not get a job, I did not even hear back from a single employer. You could say this process did not exactly erase my strong dislike of resumes and cover letters.

Now, a good handful of years later, LinkedIn has become my favorite social network. Using it, I have been in touch with and have arranged in-person meetings with quite literally dozens of individuals in the energy and space industries, with a success rate of one response for every three or four messages I send out. The secret: I never ask for a job, and instead offer whoever I am messaging some tangible benefit (e.g., a cup of coffee in exchange for “picking their brain” on some topic, or even a guest lecture at my department).

In their wonderful book, “Designing Your Life,” Bill Burnett and Dave Evans emphasize the importance of this very strategy: if you are searching for jobs, try to find out what others are interested in (especially individuals in the field you are interested in or potential future managers). Never ask directly for a job or internship, instead ask these people about their thoughts and experience in the industry, and then finish by asking them something along the lines of, “How might someone in my position contribute to a company such as yours?” Obviously, this will not always turn into an opportunity, but you may very likely be referred to a contact who is looking for someone to hire, and either way, you will have made a valuable connection.

So where does LinkedIn fit in with all of this? LinkedIn is the perfect platform to learn about the types of people in the careers you want to pursue. You can research their backgrounds, from education and work experience to volunteering and extracurricular activities, and most importantly, you can contact and set up meetings with people in your industry of choice. You do not need to be a Premium member to send messages, instead use this very simple “hack”: navigate to the profile of someone you are interested in meeting and chatting with. Click “Connect” to request that you become LinkedIn connections. A window will pop up that reads, “You can customize this invitation.” This step is critical. Click “Add a note.” Now comes your opportunity to use your own personal touch and creativity. You have a limited number of characters to briefly introduce yourself, express your interest in learning about the person’s particular industry, their career path, their thoughts on the future of the industry, etc., and to suggest meeting for coffee, a meal, etc. (or a call by phone!). End your note by expressing your interest in chatting with them soon, by thanking them for their time, or with a traditional closing (“Sincerely,” etc.). I have included below an example of a note that I wrote that resulted in meeting with the CEO of a space company.

Do not be discouraged. Tailor each message and be relentless. Celebrate responses, even if you do not always achieve a meeting. Your voice and message will improve with each message you send. Do not be afraid to experiment and to test what sort of message works best.

This ability to find, message, and meet up with people in literally any field in which you are interested is one of the strongest features of LinkedIn. Use it to your advantage, and do not be surprised if a chat over coffee turns into a job offer.

Since you will be messaging people who are working your dream job, you will want to leave a good first impression. And since you are using LinkedIn, that first impression is going to be your LinkedIn profile.

Here are a few critical tips on creating a strong LinkedIn profile (and nailing that first impression):

Take a professional profile picture: Smiling headshot with business casual attire, OR, since we are geoscientists after all, a good picture of you out in the field.

Write a great headline (it does not have to be your job description).

Write a Summary! This is critical. This is your chance to tell your story. Absolutely do not use third person (first person is much more personable). Bullets in a Summary can be quite effective. Grab your reader’s attention with the first few lines of your Summary. Stand out. (Think, “You might think licking rocks is child’s play, but it’s what I do every day. Welcome to the life of a geologist.”)

No on buzzwords, yes on numbers. Absolutely do not use empty buzzwords (none of this: “I’m a problem-solver who is detail-oriented and a great team player. I’ve spearheaded many brainstorming sessions and I love a challenge” – anybody could fit that description. It is not uniquely you.) Do, however, include numbers. Quantify your achievements right at the beginning of your Summary (“I’ve taught geology courses to over 150 students and have published 3 peer-reviewed scientific papers. I’ve had 2 industry internships and advised companies on millions of dollars’ worth of drilling projects.”). It is also critical to use numbers when describing your work experience achievements. Quantify your achievements.

Fill out the sections of your profile. Absolutely include your past work experience, your education, any publications (papers, conference abstracts), honors and awards, and volunteer experiences. Include two or three bullet points for each work experience. What were your duties? What were your accomplishments? Honors and awards show recruiters you are a high achiever. Volunteer experience can show you care for your community and for helping others, and highlight causes that are meaningful to you. This is often an important part of company culture!

And there you have it. First, beef up your LinkedIn profile. Then, start messaging people in the industry you want to be in! Remember that each connection and tidbit of advice you receive is moving you toward your dream job.
For the past 30 years or so I have been teaching at Florida State University here in Tallahassee as an adjunct professor in the Geology Department, then Geosciences, and now in the Earth Oceans and Atmospheric Sciences Department. The faculty has gone from 15 to about 60 in the new format and there is a $75 million building to be finished next year that has everyone excited. My role is to help with the understanding of the commercial aspects of our profession and to provide employment and career ideas for students. I have been a geologist for 53 years and have 40+ years in consulting across topic areas in water resources, petroleum, geohazards, mining, and coastal processes. Every project, person and concept that I deal with is a learning opportunity and those bits of knowledge end up in my personal toolkit. You just need to remain inquisitive.

What is the toolkit? For me it represents the information filed away (racked and stacked) that allows me to move through my geoscience world and my personal world as a human using past knowledge to assist in new situations. These experiences can be science and technical tidbits but by-and-large these experiences relate to human communication with your science team, your client or employer and the public who may be interested in a project outcome. The communication component is important because it is the basis of the network you use to find new challenges and better jobs.

You will graduate and have the academic credentials to start your life in geology. These credentials provide the formal structure to talk in technical terms to other professionals in the geospeak shorthand that speeds up our communication process. You will also have the personal understanding of earth processes to allow you pick a safe place to live or at least to understand risks. However, you may need to work on your communication skills to explain issues to non-geologists because there is a lot of explaining to do. The initial launch into the working world is a process of adding toolkit elements that at first may not seem to be true geoscience, but they are ideas, factoids, and other information tidbits and skills that you pick up as you begin to work on projects. My own toolkit assembly began in earnest in 1967, when I began work in the research laboratory of the Michigan Highway Department as one of three geologists in a group 70 engineers, technicians, chemists, and physicists. I worked full time and finished a MS and PhD concurrently. I worked on aggregates and rock quality issues to better design concrete for roads and bridges. Michigan’s glacial gravels are very heterogeneous, and quality varied widely. I was assigned to work with technicians to go to gravel pits, mines and storage yards to evaluate rock quality and to teach the “aggregate inspectors” how to obtain representative samples from stockpiles and to identify deleterious rock types such as chert, shale, and weathered metamorphics.

My technician and field partner for this work was Tom Taylor, a man 22 years my senior, a part-time farmer and WWII army sergeant. In four years Tom and I drove about 150,000 miles all over the State of Michigan. The field work allowed us to discuss life philosophies and I got to observe how Tom approached working. Tom called “working” a process of acquiring what he called “walking around skills”. This collective skill set for him included information from me, “the college boy” on sampling theory for how to obtain representative samples from a quarry wall, a sand bank or a stockpile. He got all that, it was intuitive from working on the farm. But, I was also paying my college boy dues as I worked with him. I signed his timesheet. What I learned from Tom was practical stuff about living on the road and fixing equipment and dealing with people. I learned how to live on the road for extended periods, how to cook canned stew for lunch on the exhaust manifold of our truck, how to unstick a stuck truck with a winch, how to run a drilling rig and service it, how to drive a front end loader and big trucks, how to fix a balky pump or chainsaw engine, how to work in cold weather, and most important how to “talk nice” to landowners, project engineers and mine operators to gain permission to work on their property. So, what does this mean for a new graduate from college? It means that we all are launched into new situations and we begin learning new and often practical information that we will use throughout a career and lifetime.

My suggestion is: don’t be satisfied with a barista job at a Starbucks because that doesn’t fit your immediate expectations of what being a geologist should entail. Start as a drill rig helper or helper on a survey crew to get started; talk to people, develop a network of individuals and learn the walking around skills. There are several former students and mentees that have gone from rig helper to rig manager in three years with great salary and benefits. The process works, just be patient, it’s fun getting there.
A Comparison of Nd, Sr, and Hf Isotopic Signatures for Late Cretaceous and Pliocene Plutonic Rocks in the Rico Mountains, Colorado: Insight into Magmatic Sources at 68 and 4 Ma

Authors
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Abstract
Plutonic rocks were emplaced in the Rico Mountains in southwestern Colorado at ~68 Ma and ~4 Ma. The Late Cretaceous plutons were emplaced during subduction related to the Laramide orogeny whereas the Pliocene magmas formed in a period of incipient extension and bimodal magmatism attributed to slab rollback after 25 Ma.

Bulk-rock (Nd and Sr) and zircon (Hf) isotope data were employed to gain insight into the evolution of melt sources over time. Late Cretaceous plutonic rocks are distinguished by εNd(t) of -0.6 to -1.7, 87Sr/86Sr(t) ratios of 0.704525 to 0.705631 and εHf(t) zircon signatures of -7.5 to 6.7. In contrast, Pliocene intrusive rocks have εNd(t) of -6.3 to -6.5, 87Sr/86Sr(t) ratios of 0.705736 to 0.706143, and εHf(t) zircon signatures of -4.7 to 2.8.

The isotopic signatures, and the presence of inherited Proterozoic zircons in the ~68 Ma plutonic rocks is consistent with partial melting of the 1.8 to 1.3 Ga lithospheric mantle or lower crust. The ~4 Ma melts originated from melting of a more “evolved” crustal source in a period of elevated thermal gradients and emplacement of mantle magmas into the upper crust. The results reveal a shift in melt sources over time. This shift probably influenced the types of mineral deposits that formed in the region from 75 to 4 Ma.

Keywords: Isotope geochemistry, magmatism, igneous petrology, San Juan Mountains

Introduction
Latest Mesozoic to Cenozoic magmatism on the Colorado Plateau and Southern Rocky Mountains (Fig. 1) is attributed to shallow subduction of the Farallon plate during the Laramide orogeny whereas the Pliocene magmas formed in a period of incipient extension and bimodal magmatism attributed to slab rollback after 25 Ma.

In this investigation, isotopic signatures (Sr, Nd, and Hf) for the two generations of plutonic rocks in the Rico Mountains (Pratt, 1968; Pratt et al., 1969) were employed to investigate trends in magma sources over time. The Rico Mountains are an ideal location to address temporal variations in magma sources given that plutons were emplaced at the start (~68 Ma) and end (~4 Ma) of magmatism in the region (e.g., Tweto and Sims, 1963; Armstrong, 1969; Cunningham et al., 1994; Gonzales, 2015; 2017) and are in close spatial proximity. Our investigation reveals a shift in magma sources from ~68 to ~4 Ma and provides insight into melt production during and after the Laramide orogeny.

Geologic Setting
The Rico Mountains are located within the western San Juan Mountains along the southwestern edge of the southern Rocky Mountains (Fig. 1 inset). These rugged mountains expose Proterozoic basement overlain by Paleozoic to Late Cenozoic sedimentary rocks (Pratt, 1968; Pratt et al., 1969). The stratigraphic section is intruded by numerous felsic to mafic dikes, sills, and stocks (Cross and Spencer, 1900; Pratt et al., 1969; Gonzales, 2015) (Fig. 1).

The ~68 Ma intrusive rocks in the Rico Mountain (Gonzales, 2017) are part of a generation of plutons that formed from 75 to 60 Ma during the Laramide orogeny (e.g., Cunningham et al., 1994; Humphreys, 1995; Chapin et al., 2004; Chapin, 2012; Gonzales, 2015). These rocks are dominantly calc-alkaline (Gonzales, 2017), porphyritic monzonite to diorite (Cross and Spencer, 1900; Pratt, 1968; Pratt et al., 1969), and distinguished by 3 mm to 1 cm phenocrysts of hornblende and...
plagioclase set in a fine-grained matrix of quartz and plagioclase.

The ~4 Ma plutonic rocks are the youngest felsic plutons in the western San Juan Mountains. They are distinctly porphyritic alkaline (Gonzales, 2017) granodiorites and monzonites with 3 mm to 5 cm phenocrysts of quartz, orthoclase, sodic plagioclase ± biotite in a fine-grained, felty matrix.

The Rico Mountains host extensive mineralization that formed largely from the interactions of plutons with Paleozoic to Mesozoic strata, causing thermal metamorphism and metasomatism. Skarn and epithermal vein deposits were mined for zinc, lead, copper, silver, and gold; porphyry Mo deposits contain several thermal springs situated along deep-seated, west- to northwest-trending faults (Pratt et al., 1969; Sare et al., 2009; Easley and Morgan, 2013).

Methods

Representative samples of ~68 Ma and ~4 Ma plutonic rocks were collected for this study (Fig. 1, Table 1). Reconnaissance field surveys were conducted to assess outcrop features and obtain samples for isotopic analyses. Mineral assemblages and textural features were compiled from detailed petrographic studies to classify and characterize the rocks. Sr and Nd isotopic bulk-rock data were complemented with Lu-Hf isotope analyses on individual zircons (Tables 2-3). Collectively, the bulk-rock and zircon isotopic data provide a basis to assess the sources of magmas that produced the two generations of plutons.

Sr and Nd isotopic data (Table 2) were obtained from bulk-rock samples at the University of Colorado using thermal ionization mass spectrometry (TIMS) with a Finnigan-MAT 6-collector solid source mass spectrometer. Details on the preparation of samples for analyses are reported in Farmer et al., (1991) and Mueller et al., (2017 a, b). A discussion of analytical errors associated with these analyses are presented in Gonzales and Lake (2017).

Zircons used for Lu-Hf analyses (Table 3) were extracted using standard separation procedures described by Gonzales (2017). The mounted zircons were analyzed at the University of Arizona LaserChron Center through laser ablation and inductively coupled plasma mass spectrometry (LA-ICPMS) using a Nu Plasma HR ICP-MS, together with a New Wave 193 nm ArF laser ablation system. The zircons were analyzed for \(^{176}\text{Hf}/^{177}\text{Hf}\) ratios at the same spots selected for U-Pb age determinations (Gonzales, 2017) to determine time-corrected ratios. Laser spots had a diameter of 40 microns and depth of ~40 microns. Eight standards were analyzed twice after every five analyses of zircon crystals in the samples. The standards ensured accurate Hf ratios, and were used to minimize the instrumental drift effects and assess the precision of the analytical results. The unknowns were adjusted to the measured standards and are represented with a 1σ error produced from a filtered table of results (Table 3).

A complete and detailed description of the analytical methods associated with the conducted analyses can be found online (University of Arizona, 2017).

Results

The measured \(^{143}\text{Nd}/^{144}\text{Nd}\) ratios of the Laramide plutonic rocks (Tables 1-2) range from 0.512513 to 0.512567 with time-corrected \(\varepsilon_{\text{Nd(t)}}\) signatures of -0.6 to -1.7 (Fig. 2). Pluonic rocks yield \(^{143}\text{Nd}/^{144}\text{Nd}\) ratios of 0.512300 to 0.512313 with time-corrected \(\varepsilon_{\text{Nd(t)}}\) values of -6.3 to -6.5.

Differences in the Sr isotope signatures between the two generations of plutonic rocks are less distinct (Fig. 2). Time-corrected \(^{87}\text{Sr}/^{86}\text{Sr}\) ratios for the ~68 Ma plutonic rocks range from 0.704525 to 0.705631 whereas the ratios for ~4 Ma rocks range from 0.705736 to 0.706143 (Fig. 2, Table 2).

Age-corrected \(\varepsilon_{\text{Hf(t)}}\) values are -4.7 to 2.8 for the Pluonic plutonic rocks, and -7.5 to 6.7 for the Late Cretaceous rocks (Fig. 3, Table 3). The initial \(\varepsilon_{\text{Hf(t)}}\) values for the ~68 Ma rocks are highly scattered and showed a greater range compared to the relatively tightly clustered \(\varepsilon_{\text{Hf(t)}}\) values of the ~4 Ma rocks (Fig. 3). The average initial \(\varepsilon_{\text{Hf}}\) value for the Late
Cretaceous plutonic rocks is 1.74 whereas the mean value for Pliocene plutonic rocks is -2.26.

**Discussion**

This study advances our understanding of magma production in the western San Juan Mountains over the past 75 Ma. The variations in Sr, Nd, and Hf isotopic signatures (Figs. 2-3, Tables 2-3) for the ~68 and ~4 Ma plutonic rocks in the Rico Mountains argue for distinct magma sources.

The presence of inherited Proterozoic zircons in the ~68 Ma samples (Gonzales, 2015; 2017) indicate the incorporation of 1.8 to 1.3 Ga basement rocks in the magmas. The isotopic data (Tables 2-3) are consistent with melting of mafic Proterozoic crust or continental lithospheric mantle (CLM) at ~68 Ma (Fig. 4). This is further supported by Nd time-evolution paths of 1.8 Ga mafic rocks in the region with signatures at ~68 Ma that are similar to those of Late Mesozoic plutonic rocks in the Rico Mountains (Fig. 2). A reasonable hypothesis is that subduction-related heat and fluids enabled melting of the CLM and lower crust (Fig. 4). This supports the idea proposed by Gonzales (2015) for the production and emplacement of calc-alkaline melts in the upper crust from 75 to 60 Ma.

Incipient extension in the western San Juan Mountains after 25 Ma was tied to slab rollback and formation of the Rio Grande rift (e.g., Lipman et al., 1970; Gonzales and Lake, 2017). Regional extension was accompanied by various stages of magmatism in the San Juan Mountains and surrounding region (Armstrong, 1969; Cunningham et al., 1994; Gonzales,
Mantle magmas that invaded the upper crust after 25 Ma elevated thermal gradients (Armstrong, 1969) which led to production of small-volume crustal melts and bimodal magmatism in the western San Juan Mountains (Gonzales, 2015; Lake and Farmer, 2015; Gonzales and Lake, 2017) (Fig. 4). We propose that the ~4 Ma plutons in the Rico Mountains crystallized from melts generated by partial melting of more evolved crustal rocks (Fig. 4). This is consistent with the mineral and chemical

### Table 3. Lutetium and Hafnium Isotope Data for Zircons from ~68 and ~4 Ma Plutonic Rocks in the Rico Mountains (continued)

<table>
<thead>
<tr>
<th>Sample</th>
<th>(^{176}Hf/^{177}Hf) (me)</th>
<th>(^{176}Lu/^{177}Hf) (me)</th>
<th>(\varepsilon_{176Hf})</th>
</tr>
</thead>
<tbody>
<tr>
<td>~68 Ma Monzonite and Diorite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elliot Mountain (EM)</td>
<td>0.282677 ± 28</td>
<td>0.001866</td>
<td>-3.7</td>
</tr>
<tr>
<td></td>
<td>0.282687 ± 22</td>
<td>0.009840</td>
<td>-3.3</td>
</tr>
<tr>
<td></td>
<td>0.282757 ± 22</td>
<td>0.011082</td>
<td>-4.9</td>
</tr>
<tr>
<td></td>
<td>0.282727 ± 20</td>
<td>0.008930</td>
<td>-2.9</td>
</tr>
<tr>
<td></td>
<td>0.282763 ± 27</td>
<td>0.008031</td>
<td>-6.7</td>
</tr>
<tr>
<td></td>
<td>0.282765 ± 32</td>
<td>0.010591</td>
<td>-2.7</td>
</tr>
<tr>
<td></td>
<td>0.282870 ± 31</td>
<td>0.009715</td>
<td>-6.1</td>
</tr>
<tr>
<td>Priest Creek (PR)</td>
<td>0.282669 ± 23</td>
<td>0.001585</td>
<td>-4.9</td>
</tr>
<tr>
<td></td>
<td>0.282683 ± 26</td>
<td>0.001165</td>
<td>-3.5</td>
</tr>
<tr>
<td></td>
<td>0.282710 ± 22</td>
<td>0.001436</td>
<td>-2.6</td>
</tr>
<tr>
<td></td>
<td>0.282718 ± 27</td>
<td>0.008489</td>
<td>-2.3</td>
</tr>
<tr>
<td></td>
<td>0.282767 ± 28</td>
<td>0.001360</td>
<td>-4.6</td>
</tr>
<tr>
<td></td>
<td>0.282719 ± 28</td>
<td>0.001226</td>
<td>-2.3</td>
</tr>
<tr>
<td></td>
<td>0.282869 ± 31</td>
<td>0.009795</td>
<td>-4.7</td>
</tr>
<tr>
<td></td>
<td>0.282871 ± 31</td>
<td>0.009879</td>
<td>-2.9</td>
</tr>
<tr>
<td></td>
<td>0.282864 ± 26</td>
<td>0.001294</td>
<td>-2.8</td>
</tr>
<tr>
<td></td>
<td>0.282861 ± 25</td>
<td>0.000705</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>0.282870 ± 30</td>
<td>0.001245</td>
<td>-2.8</td>
</tr>
<tr>
<td></td>
<td>0.282868 ± 25</td>
<td>0.001034</td>
<td>-3.4</td>
</tr>
</tbody>
</table>

Notes:
Time corrected initial \(^{176}Lu/^{177}Hf\) ratios were determined using the U-Pb zircon ages reported by Gonzales (2017).

2015; Gonzales and Lake, 2017). Mantle magmas that invaded the upper crust after 25 Ma elevated thermal gradients (Armstrong, 1969) which led to production of small-volume crustal melts and bimodal magmatism in the western San Juan Mountains (Gonzales, 2015; Lake and Farmer, 2015; Gonzales and Lake, 2017) (Fig. 4). We propose that that the ~4 Ma plutons in the Rico Mountains crystallized from melts generated by partial melting of more evolved crustal rocks (Fig. 4). This is consistent with the mineral and chemical

Figure 4 - Simplified model to explain the variations in magma generation at ~68 and ~4 Ma in the Rico Mountains. The 68 Ma magmas formed as partial melts from the lower Proterozoic crust or CLM as invading hot fluids were released from subduction of the Farallon plate. Mantle melts invaded a zone of weak extension in the western San Juan Mountain from 25 to 4 Ma. The intrusion of melt increased the regional thermal gradient and contributed to partial melting of upper crustal rocks at ~4 Ma.
compositions of ~4 Ma plutons, some of which are associated with molybdenite mineralization. There is no good control, however, on the exact melt sources of the ~4 Ma rocks. Contributions from felsic Proterozoic basement or re-melting of Laramide igneous rocks at ~4 Ma are feasible. The S-type characteristics, distinguished by normative corundum, of the Calico Peak sample (Fig. 1, Table 1) may also indicate melting of sedimentary or metasedimentary rocks in the crust (e.g., phyllite in the Proterozoic Uncompahgre Formation).

The results of this investigation offer new insights into the generation of magmas in the Rico Mountains at ~68 and ~4 Ma, from subduction-driven magmatism during the Laramide orogeny to regional rifting in the middle to late Cenozoic. The isotopic evidence (Figs. 2-3, Tables 2-3) reveals a shift from CLM or Proterozoic basement sources at ~68 Ma to those dominated by upper crustal rocks at ~4 Ma. These trends are similar to those documented in 28 to 26 Ma volcanic rocks in the San Juan Mountains, in which early magmas were created by melting of mantle and lower crustal sources, and then modified by melting and assimilation of upper crustal rocks at higher levels (e.g., Ricciutti et al., 1995). Variations in magma sources through time in the area also influenced the type and trends of mineralization in the western San Juan Mountains.

Acknowledgements

We thank Andrea Kirkpatrick for assisting with many different aspects of this project. A special thanks is given to Mark Pecha and Nicky Giesler at the University of Arizona for assisting with the Lu-Hf isotopic analyses at the University of Arizona LaserChron Center. We are also grateful for the assistance and guidance of Emily Verplanck at the University of Colorado for the Sr Nd analyses. We want to thank Patrick Lang and Swantje Berry for his review of the manuscript.

This project was funded in part by Fort Lewis College, the Geological Society of America, and the Colorado Springs Mineralogical Society. Otto would like to thank Patrick Lang and Swantje Quarder for supporting his undergraduate education and senior thesis research. He also thanks to his classmates Peyton Valko and Tanner Morgan for their assistance and company he received during his time in the field.

References Cited


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Foundation of the AIPG
Has Successful Silent Auction at AIPG Annual Meeting

The Foundation of the American Institute of Professional Geologists held a silent auction at the Welcome Reception of the AIPG Annual Meeting in Colorado Springs in September 2018. The silent auction event was held to raise money through the sale of donated items for the benefit of the Foundation and its programs, and to raise awareness of the Foundation. There was a wide range of donations from AIPG members as well as several of the exhibitors at the annual meeting. Donated items included several amazing mineral/rock specimens and fossils, historic geology books (including an 1844 edition geology book) and collector books, polished rock bookends and tumbled stones, handmade wood and stone carved pen, a 1939 Atlas Giant Powder box, jewelry, a silver Jefferson Cup, Minnesota Pancake breakfast basket, a set of BBQ sauces, Geologic Time coffee mug, stone wine chalices, geology-themed tote bags, and some brewery and distillery items. Three bottles of bourbon were kindly donated in memory of John Stewart. It was a nice assortment of items and a variety of values. There were several items that sparked exciting bidding contests during the welcome reception. At the end of the evening, the Foundation realized about $3000 from the silent auction and the guests had a fun evening.

The Foundation offers a big thank you to the AIPG members and exhibitors for the many wonderful donated items. And, another thank you to those who also participated in the silent auction by bidding and making a donation for that winning bid item. The money raised from the silent auction will go to the Foundations general fund for use toward Foundation-supported programs and scholarships.

The Foundation looks forward to another silent auction at next year’s meeting in Burlington, Vermont so start looking around for those items to donate and be sure to come to the annual meeting in September 2019!

Barbara Murphy, CPG-6203
Chairperson, Foundation of the AIPG

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Tom Van Arsdale
Shannon Williams
Nancy Wolverson

Sue Abbott and Doug Peters – waiting for the start of the silent auction bidding.

Calcite with chalcopyrite/marcasite, Brushy Creek Mine, Reynolds Co., Missouri.
Most days, the gently bubbling West Prong of the Roaring River in Wilkes County, NC (A; contours and 2010 imagery from www.nconemap.com) seems undeserving of its title, which dates back to at least 1785. Only after heavy rainfall does the reason became apparent—the sound of its waters during flash floods. Beginning as a bedrock stream in the Alligator Back Formation of the Blue Ridge Belt, the West Prong displays riffle (B), pool (C) and run (D) morphology in its lower stretches. The photos in this figure were taken in October 2018, two weeks after the passage of Hurricane Florence (B-F; u.s. = upstream, d.s. = downstream, and h.w. = recent high water). Drift lines and other hydrologic indicators suggest that water levels rose as much as 3 to 4 feet above stages shown here, when they had largely receded back to seasonal norms (in the area of the photos, on the order of 20 CFS with a watershed size of ~14,200 acres). Of special interest, high flows had scoured a bar along the pool-run (E), revealing a distinctive gravel layer in the otherwise fine deposits—an old storm revealed by the new (F). The West Prong’s flow is generally southeast and runs for about 12 miles before joining the Middle Prong and 5 miles later the East Prong to form the Roaring River proper. Extending the discharge time series for the downstream mainstem of the Roaring River (USGS 02112120, discontinued 2014) via linear regression with the nearby Reddies River (USGS 02111500), estimated mean discharge at the mainstem the day of Florence’s passage is 2,160 ft³/s (95% CI 1,490 ft³/s to 3,140 ft³/s; R² = 0.91; DF = 18,445); compare this to a typical November flow at the mainstem of less than 200 ft³/s and against USGS peak estimates for the region’s Great Floods of 1916 and 1940 at, respectively, 45,000 ft³/s and 31,000 ft³/s. The storm that generated the gravel deposit (F) is unknown, but the Great Floods, which devastated numerous mountain communities and generated much larger deposits, are unlikely culprits. Nevertheless, Florence’s high waters, and the deposit they revealed, demonstrated the destructive potential of even a small river under a hurricane’s wrath.

Cortney Cameron, YP-0539

Cortney Cameron earned a B.A. in earth science from Duke University and an M.S. from North Carolina Central University. She currently works for the Southwest Florida Water Management District as a hydrogeologist.
Career Tips for Young Geologists

Rasoul Sorkhabi, MEM-3005, University of Utah, Salt Lake City, E-mail: rsorkhabi@egi.utah.edu

It is a good thing to learn from the advice of the peers in your field. Recently I came across an AAPG publication entitled Heritage of the Petroleum Geologist (Sternbach et al., 2017) which included profiles and life lessons of some of the leading and prominent petroleum geologists of our time. The publication is actually a combined two-volume; the first volume was published in 2003. Overall, 109 geologists were featured in the publication, and what especially drew my attention was the item “My advice to you” at the end of each profile. I read, listed and categorized these suggestions; they amounted to 235 career tips, many of which were given by more than one person. It seemed to me the advice given by these living geologists and peers would be most useful if it is summarized in a statistical manner for the benefit of young geologists – hence this article. Below I have organized and annotated the recommendations and career tips made by the peers in the AAPG publication (Sternbach et al., 2017). I have chosen those tips made by at least three persons. Even though these tips come from petroleum geologists, they are equally applicable to all young geologists.

1. Enjoy Your Profession. Be Passionate (25 persons)

First and foremost, become a geologist if you really love it because your inner passion is the strongest force that will lead you through the ups and downs of the career path. It is equally important to show your passion for your ideas and projects in the workplace; if you are not passionate about your own work, do not expect others to appreciate it either.

2. Persistence and Patience (19)

Persistence and patience pay off. Don’t give up easily. Take an optimistic attitude toward your work – whether learning a new skill, conducting a project or looking for a job. Instead of having a fear of failure, ask yourself “What will it take to make this work?”

3. Technical Competency and Flexibility (17)

Get a strong technical knowledge and excellence in your field. Evaluate your knowledge and identify the gaps. Learn new skills as necessary. Be versatile and flexible.

4. Think outside of the Box. Welcome Challenges (17)

Do not merely follow the crowd. Prepare for new opportunities and changes. Welcome unusual challenges. Find links and patterns between seemingly different data and disciplines. One way to get out of the box and challenge the conventional wisdom is to ask “What if?”

5. Networking (14)

Do not isolate yourself; do not try to be a lone wolf. Friendship is richness. Associate, correspond, and collaborate with peers, colleagues, and classmates.

6. Membership in Professional Societies (14)

One important way of networking is to join professional societies like the AAPG, AGU, AIPG, GSA, and SEG. Read their publications and be involved in their activities.

7. Lifelong Learning (12)

Graduation from a university is not the end of schooling. We actually learn more after we graduate and while we work. Attending workshops and taking training courses are parts of continuing education.

8. Integrity and Ethics (11)

Maintain your ethical standards and integrity throughout your career. As the saying goes, “Rome was not built in a day but it can be ruined in a single day.” Do not ruin your credibility for a short-term interest. Be trustworthy: deliver what you promise to do, and do it rightly.

9. Be a Mentor and Educator (11)

We learn most when we teach because it is then that we learn to articulate what we know and also notice the gaps in our knowledge. Teach courses whenever you can and mentor junior students and colleagues.

10. Good Mentors and Supervisors (10)

Tip #3 is also related to schooling. What is emphasized here is to have good mentors and supervisors – those who are not only top experts but also care to train and help you. Indeed, graduate students often carry the imprints of their supervisors for the rest of their lives.

11. Hard work (10)

There is no free lunch; nothing is achieved easily, especially in our age of competition. Remember Edison’s famous maxim: “Genius is one percent inspiration, ninety-nine percent perspiration.”

12. Volunteer (9)

We owe all of our successes and achievements to the help, care and generosity of many others. Give back to your community. Serve in professional committees and projects. Volunteer to convene conference sessions or lead field trips. Review papers for professional journals. All these help your own professional growth as well.

13. Read Well and Widely (8)

This is actually part of tip Number 7: lifelong education. But several peers singled out reading as a very important method of learning, possibly because we can manage it in our own
time; moreover, reading is an engaging and reflective process of learning. Be curious and read not only the recent books in your own field but also books on the history and legacy of your field. Deepen your knowledge and broaden your perspective by reading good books and articles.

14. Beware of Booms and Busts (7)

Professional geology, like any other business, goes through the cycle of booms and busts. Try to save money or pay off your debts in good times, and try to learn new skills in low times as a way to prepare for the new challenges and changes in the profession.

15. Strong Knowledge of Geology and Industry (6)

As a geologist you must have a deep knowledge of your particular field. For example, if you are a petroleum geologist you must master the petroleum system – the source rock, generation, migration, reservoir rocks, traps, sealing, accumulation, preservation and so forth. Understanding the petroleum system should be founded on a solid knowledge of sedimentology, stratigraphy, structural geology, field geology, mapping, geochemistry, well logging, and seismic interpretation. Moreover, geology is only one part of the business and industry in which we are; it is essential to understand how your business and industry works and how your particular work fits in the overall operation of the company. In other word, get the “Big Picture.”

16. Attend Professional Conferences (6)

This tip goes well with tip #6 (joining professional societies) but several peers specifically mention that it is crucial to participate in meetings and conferences hosted by those societies and associations. Simply being a member does little good. By attending the conferences we update our knowledge and also identify new trends and problems. It is equally important to present papers in conferences as it bestows on you authority and publicity in your field of expertise.

17. Balance Work with Life (5)

Your career is important but it is only one aspect of your life. Balance your job with your family life, personal hobby, rest, joy and entertainment. Take vacations. A stressed and overworked body and mind actually hurts your job and performance.

18. Be a team player (3)

Consider these facts of life: Humans are social animals. Your job is always transactional. Projects and workplaces involve more than you. Therefore, even for your own interest, be a helpful and pleasant team player.

19. Become interdisciplinary (3)

Earth is not divided into disciplines and departments; it is a set of whole, interconnected, organic systems. It is always good to learn about other disciplines and be able to communicate with other experts. Moreover, projects often involve more than one particular discipline, and we sometimes have to multitask. In fact, at some point in our career it is highly desirable to work in a multidisciplinary team and environment; we learn a lot more this way than we did at school.

20. Learn from your mistakes (3)

Humans are fallible. There are times we make honest mistakes. The more important point is not to make the same mistake twice.

21. Know that you do not know it all (3)

Our knowledge is incomplete and our data are always limited. There are many things that we do not know but need to seek out; there are also still many things that science does not know. Science is an evolving and never-ending process of inquiry and discovery. No matter how great a geologist you are, at times the rocks will humiliate you. Do not be upset. Actually, the more we know the more humble we should be.

22. Listen objectively to other opinions (3)

Arrogance, narcissism and know-it-all attitude are not very admirable qualities even if people may not directly criticize us for any of these traits present in us. All perspectives have blind spots and all thought systems have holes. Listen objectively to the opinions, ideas and experiences of others. Listening is an essential art of learning; learn it well even if only to your own advantage.

23. Be Yourself (3)

It is a good thing to listen to and learn from the advice of others. But do not try to imitate or compare yourself with others. We come from various walks of life. Each person works and lives in a different situation. Be genuine, honest, a good learner and open to life. Be yourself. Examine things and see if they work for you. Learn from your own life as well.

This Requires Your Special Attention!

I would like to end this article with a tip that was suggested by only two persons in the AAPG publication but it is my most favored one: Visit Outcrops. Go on field trips; do field work. Listen to rocks. Remember the British geologist H. H. Read’s saying, “The best geologist is he [she] who has seen the most rocks.”
Comments on proposed rule: Modernization of Property Disclosures for Mining Registrants

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

If any of our readers have an interest in Military Geology, or the History of Military Geology, please contact The Editor at jlbasssoc@gmail.com.

If any of you have expertise in these topics, especially the influence of geology on the Revolutionary, 1812, or Civil Wars, and can submit a paper to TPG for the April-May-June issue (deadline 15th February) please let me know.

John Berry, CPG-04032, Editor
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**PFAS: Life Cycle, Regulations & Solutions**

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