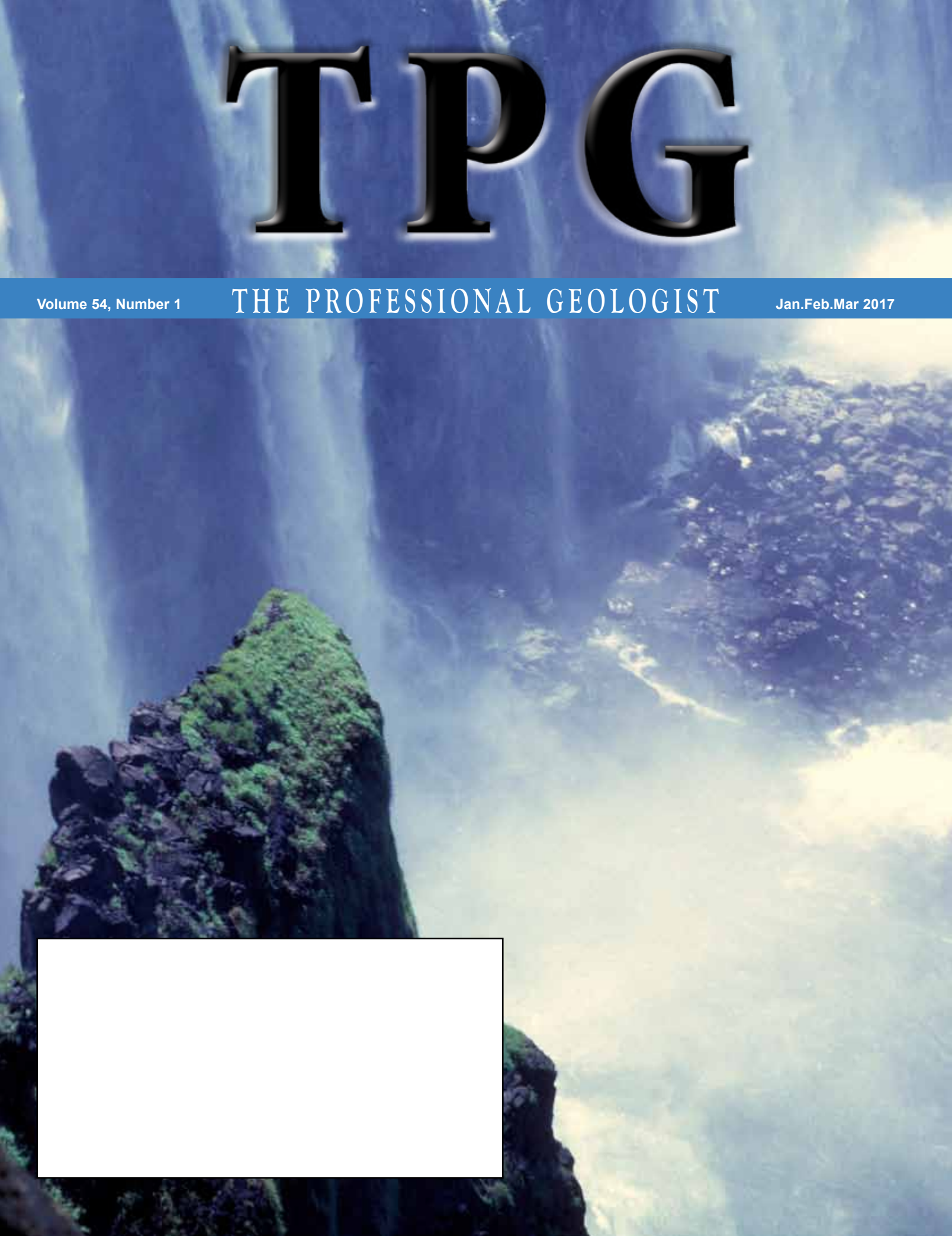

TPG

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GEOSCIENCE CURRENTS
No. 116

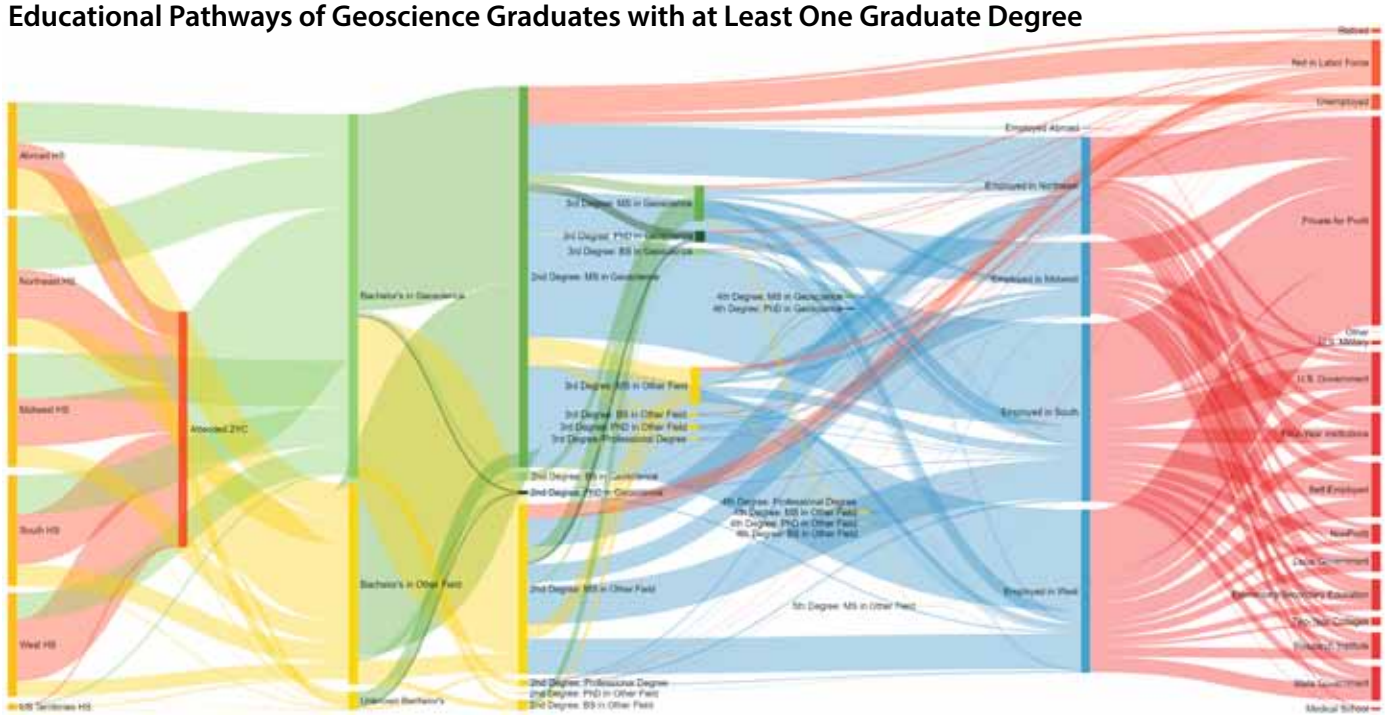
Education Paths of Geoscientists Currently Employed in the United States with a Graduate Degree

The figure below is a Sankey diagram, a flow diagram in which populations are shown proportionally along the flow paths. This visualization shows the educational paths of the current geoscience workforce, from high school location to their primary job industry, using the National Science Foundation's Survey of College Graduates 2013 data. The nodes (darker vertical lines) display the relative number of geoscientists in each position in their educational path and primary job position. The ribbons show the flow of geoscientists through the nodes. The data were sorted to include anyone with a graduate degree that also has at least one degree in the geosciences. It includes responses from geoscientists that received degrees from 1956 to 2013, which accounts for those that were retired or not in the labor force in 2013. Also the diagram does not account for secondary jobs held by geoscientists. Therefore, this diagram is focused on mapping the educational progression of geoscientists rather than their career progression.

The diagram was created to address a few frequently asked questions. For example, there has been some speculation that there might be regional differences (http://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf) in the location of high schools of geoscientists due to variations in exposure to earth science in high school. However there appeared to be a relatively equal distribution of geoscientists out of high schools from each U.S. region, which indicates potential regional sourcing when normalized for total populations. Most primary job locations tend to be in the South and the West. A few individuals earned as many as five postsecondary degrees throughout their education, but the majority of individuals completed a master's degree in the geosciences before permanently entering the workforce. This diagram also indicates the potential attrition from the geosciences through the flow of geoscience bachelor's graduates into non-geoscience graduate degree(s) and then out into the workforce. While it is possible that these individuals found a primary job in the geosciences, it is more likely their primary job is related to their graduate degree.

While complicated, this effectively visualizes the flow of the education paths of geoscientists and can be a tool to address questions related to the education and careers of geoscientists.

Educational Pathways of Geoscience Graduates with at Least One Graduate Degree



- Carolyn E. Wilson

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Cover: Victoria Falls, Zambia/Zimbabwe. Photo was taken looking east from half-way down the falls at the Zimbabwe end. The falls are located at 17:55:28S, 25:51:24 E and are 355 feet high and 1708M (5605 feet) wide. The average volume of water going over them is 1088m3/s, or 38,430cfs, but it varies during the year from 3,000 cfs to 105,000 cfs. By John Berry, CPG-04032.

FEATURES

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Dynamic Teaching of "Dynamic Earth" at Wright State University

Baylee Stark, SA-7520

STUDENT ARTICLE

Lectures accompanied with hands-on activities increase interest in the Earth sciences. To better facilitate these interactive experiences Wright State University has introduced the use of SCALE-UP (Student Centered Active Learning Environment for Undergraduate Programs/Upside-down Pedagogies) classrooms. During fall semester 2015, the first SCALE-UP style Earth science lecture was taught at WSU in the course "EES1050 The Dynamic Earth", an entry-level physical geology class.

This lecture took place in a classroom where students were placed at tables in groups of six. The students had access to laptops provided by Wright State, and were encouraged to use them during group activities. The walls of the classroom were lined with white boards, and there were multiple projector screens spaced throughout.

This type of classroom design was utilized to foster cooperation and interaction between students. The tables allowed for communication, the laptops were essential for doing research during in-class activities, the projector screens provided an immersive feel to the lecture, and the whiteboards promoted both student teaching and class-wide discussions.

Along with the design of the classroom, the teaching style was also unique. The majority of in-class time was spent on collaborative activities, hands-on specimen identification, and computer simulations. Lectures supported by PowerPoint were kept brief and focused on background information for the day's activity. To achieve the same level of content coverage, pre-session activities were assigned, such as pre-class videos, and readings.

Another defining feature in the SCALE-UP classroom was the presence of Learning Assistants (LA's), a type of in-class undergraduate teaching assistant. These were undergraduate Earth or Environmental sciences majors. They were responsible for facilitating in-class activities and tracking student progress at their assigned tables. The use of Learning Assistants greatly reduced the need for the professor to assist all of the students during activities, an impossible task in classes of one hundred plus students. The LA's helped create an environment of ease, as they interacted with the students individually or as a whole at their tables. As a Learning Assistant in this course myself I experienced firsthand the blossoming of communication, interaction, critical thinking skills, and understanding of Earth processes by the students.

To measure quantitatively and qualitatively how effective this classroom style actually was when applied to an earth science course, a research project was created to assess the learning gains and satisfaction of the students in the class. To accomplish this, both pre- and post- tests were given containing questions related to themes and content from the course. Students also completed the SALG (Student Assessment of Learning Gains) survey. At the end of the course, a comparison between the pre- and post- tests scores was made. In this comparison, score increases as a whole were analyzed, as well as increases related to specific hands-on activities that were completed during class time. With the SALG, questions were asked about the students' satisfaction with specific activities, the classroom design, group dynamics, and LA effectiveness. Overall, the students had a mean improvement of 13.1 points between the pre- and post- test scores. On the SALG students were asked to assess how well the in-class activities aided in their understanding of specific topics. These topics included: mineral and rock identification, plate tectonics, earthquakes, volcanoes, glaciers, relative and absolute dating, evolution, and fossils. The students were asked to select between: no gain,

a little gain, moderate gain, good gain, or great gain, for each topic. Across the eight topics assessed, seven had "great gain" as the majority response and "good gain" as the second highest response. In the eighth category, plate tectonics, the majority selected "good gain" with the second highest group selecting "great gain". Students also responded positively to the open ended questions with responses such as, "Once I began engaging in class discussions it boosted my grade and understanding of the subject. The rounded tables really truly helped push me to talk with others at my table", "I learned how to work with other students in the group on getting the correct answers and trouble shooting to obtain the correct answer and discussing why an answer was right if we were previously incorrect", and "I have a better understanding of how to now apply the scientific method in real world applications."

As a continuation of the initial research, pre- and post-tests will again be administered for the SCALE-UP section of "The Dynamic Earth" during fall 2016, and as a new addition pre- and post- tests will also be administered for a traditional lecture style class of the same course. A comparison of learning gains and satisfaction will then be conducted between the SCALE-UP and traditional lecture style classes. Also, differences in gains for specific demographic categories of students will be assessed to determine whether certain categories of students perform better with an interactive approach.

Throughout my involvement with SCALE-UP I have had nothing but positive experiences. As an LA, I have further developed my organizational skills, confidence, communication skills, problem solving abilities, and understanding of the Earth sciences. It has also afforded me an opportunity to give back by aiding students in their own pursuit of learning about Earth processes. For the students, the design of the SCALE-UP classroom has improved their understanding of concepts, as well as provided them with an avenue for application through activates and group discussion. The focus on interactive activities in the classroom allows students to learn in a cooperative environment, where confidence can be built and skills can be applied. Because of the initial success in this course using SCALE-UP, Wright State University will continue to use the interactive format with the goal of encouraging more professors to adopt this revolutionary teaching style.

Baylee Stark is a senior at Wright State University pursuing a BS in Environmental Sciences. Baylee is the Treasurer of Wright State's Delta Epsilon Chapter of Sigma Gamma Epsilon Honor Society. She is also a student member of AIPG, a Learning Assistant, and Earth sciences Tutor.

Safety for the Infrastructure Geologist - Expecting the Unexpected

George H. Davis, CPG-10951, R.G.

One of the most important responsibilities in any job is the constant unrelenting pursuit of a safe work environment by all employees. This is especially true for geologists, as it reflects upon our professionalism and commitment to the workplace and the work we do. Safe work conditions lead to increased work productivity by reducing the incidence of lost-time accidents and improving employee morale, and may lead to decreased insurance rates. The most important result of all: each and every employee returns home safely at the end of the day to families and children. Ethical behavior on the part of the geologist demands that safety be considered as an element of each and every job.

Safety needs vary by profession, but for geologists there is a wide range of subfields requiring separate considerations for all of the potential hazards present and how to mitigate those hazards. Work practices may change to address hazards and decrease their incidence. Some conditions by their very nature may not change (for instance, the propensity for loose rock to fall from the top of a quarry wall or to roll down a slope). When these events occur they are unexpected, and only through diligent preparation and study may unexpected hazards be sufficiently understood to prevent injury or fatality. Lack of understanding may increase the likelihood of incident occurrence. For instance, if a contractor removes the toe of a slope in a slide-prone area, that contractor is increasing the likelihood of a future mass movement, and may also be increasing the potential amount of damage that can occur. It is the responsibility of the geologist to seek and promote 'best practices' for damage prevention and minimize loss wherever possible.

Invisible unexpected hazards are the most difficult to prevent, though it is possible in almost all cases to prevent them from occurring. One subset of engineering geology where those incidents are present is in the field of infrastructure geology.

Infrastructure Geology and its Inherent Hazards.

What is 'infrastructure geology'? Simply put, it's those geological practices and endeavors which facilitate the civil construction of local, regional, and national infrastructure. A well-developed infrastructure precedes all other geological activities with transportation facilities and above- and below-ground utilities. According to Wikipedia.org:

> "**Infrastructure** is basic physical and organizational structures needed for the operation of a society of enterprise, or the services and facilities necessary for an economy to function. It can be generally defined as the set of interconnected structural elements that provide framework supporting an entire structure of development. It is an important term for judging a country or region's development. The term typically refers to the technical structures that support a society, such as roads, bridges, water supply, sewers, electrical grids, telecommunications, and so forth, and can be defined as "the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions.

Infrastructure geology in this contextual framework refers to the study and practice of geological principles and practices which support the technical structures that support society. Conducting geologic investigation in proximity to infrastructure is inherently dangerous, with exposure to traffic and above- or below-ground utilities, and may be hazardous for other reasons as well. Most geologists do not realize that the primary defense to these hazards is knowledge of the likelihood of their occurrence. Identifying potential hazards if you know they may occur is relatively straightforward. As geologists, it's essential to maintain professionalism and accept the responsibilities of hazard identification to earn the respect of those who work for you and develop an atmosphere of trust on the job.

Underground Utilities

At any time an excavation is conducted in the United States, the excavator or their designated representative (or a property owner if that property owner is doing an excavation on their property) is required by law to call the statewide one-call service. Anywhere in the United States, that one call service may be reached by dialing '811'. You should know and be ready to report the exact location of where you're planning on digging. This call should be made by the excavator; it is *their* responsibility to insure that all utilities are located and cleared prior to excavation taking place.

ANY geologist who engages in any kind of digging or subsurface exploration activities, especially engineering geologists, should know the basics of one-call. Simply put, "Call before you dig." The unknown and unexpected underground utilities out there can ruin your day. If you don't call, your likelihood of hitting and severing an underground line increases dramatically. Gas lines when struck or even scratched (even a glancing strike by an auger) can weaken the pipe enough for a rupture to occur, and have the potential for major disaster. In 2004 (the year for which the most current pipeline statistics were available (Gas Institute), the majority of pipeline incidents in the US were caused by digging around or near an existing pipeline. 95 out of 288 reportable 'incidents' were caused by excavation damage. That is nearly a third of ALL the reportable incidents for that year. The ten-year statistics are even worse (See Figure 1), and gas or petroleum lines/pipelines are but one of the myriad of underground facilities that you can hit and damage with poor planning.

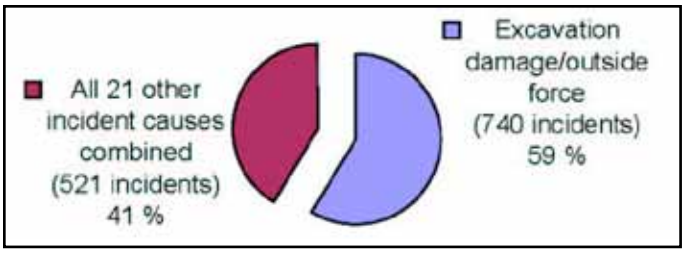

Figure 1. Natural Gas pipeline incidents in the US for the period 1995-2004. Source: American Gas Institute. "All Other incidents" includes corrosion, vehicles striking above-ground facilities, and surface fire.

Calling the one-call service starts the wheels in motion towards a safer work environment. You should mark in the field the location of any planned excavation with WHITE paint, and any survey points or drill location with PINK paint, as mandated by the American Public Works Association (APWA). The utility locator takes that information, compares it with his utility map, and identifies whether there is any conflict with your planned excavation. He or she will mark the area with paint or flags to identify the location of subsurface utilities. The colors used will depend upon the utility present, using the code established by consensus with the APWA. The entire list of colors used is shown in Figure 2.

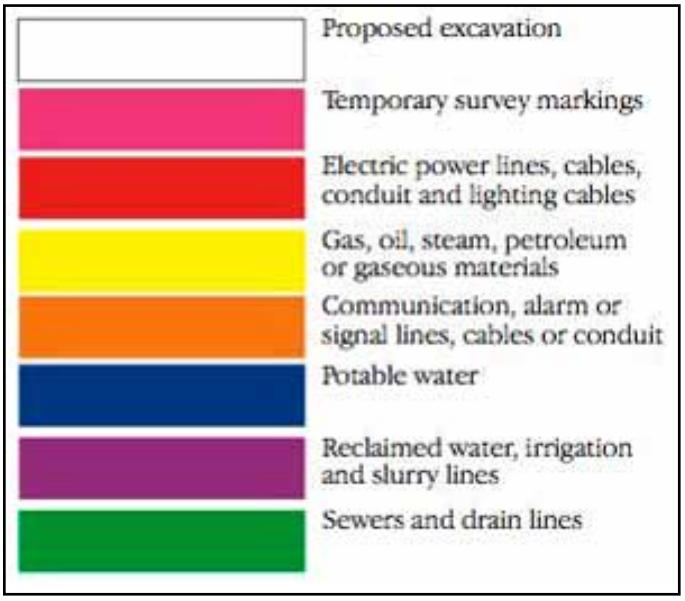

Figure 2. Color coding used as mandated by the American Public Works Association

Overhead Powerlines

Often simultaneously with the underground hazard an overhead hazard is also present, so looking up and being aware of ALL potential utilities is absolutely necessary. The vast majority of electrical power delivered to homes and businesses in the United States is carried by overhead power lines. When power lines are charged, inadvertent contact with those powerlines may be deadly. The Occupational Safety and Health Administration of the US Department of Labor recommends a 10-foot safety margin around power lines, unless those lines have been de-energized or shielded from contact. In addition, add to the initial ten feet an additional 0.4" for every 1 kilovolt (kV) of charge over 50 kV. As an example, if a 395kV electrical high tension line is present, the safe distance from that line is 10 feet + (345 times 0.4") = 21.5 feet away. (South Carolina Overhead Powerline Safety Initiative, 2006) Careful adherence to such standards may be misleading, but it's safest to take the most conservative figure and abide by that figure. Another organization, the American National Standards Institute, or ANSI, recommends that you stay a minimum of 25 feet or more away from ALL powerlines, more in the case of high tension lines. Ten feet may be the law, but 25 feet prevents incidental contact in the eyes of ANSI. If you are using a dump truck, always lower the bed BEFORE going under the power line. Never erect a drill mast within the approved distance, and be extra careful if using a backhoe or crane around a power line.

Once overhead power lines are identified at a job site, it's absolutely necessary to minimize their impact on what you're doing. Call the power company and request a meeting. Seek training. Get them to reroute the power, shield the lines, or de-energize the lines. Once protective services have been scheduled, get confirmation of what's been done BEFORE beginning work, and no matter what 'look up and live.' Confirmation from the local power authority adds to your safety.

Vehicular Traffic

One of the most hazardous experiences possible for a professional geologist is working close to busy traffic. Specialized training is a must-have for every person at the job site. Furthermore, coordination and communication between all parties concerned is not only recommended, it's essential to avoid tragedy. Principles and procedures of sound traffic control are found in the Federally-sponsored Manual on Uniform Traffic Control Devices, or MUTCD. The MUTCD is considered the legal standard by which work zones operate. (OSHA, 2009.) Continuing and refresher training is also highly recommended.

The overall goal is to avoid inhibiting the flow of traffic where possible, so when a work zone is set up, the 'footprint' of the operation should be minimized, thus minimizing its subsequent effect on traffic. Where possible, work should be done off the main lanes of the road and on the shoulder, but when necessary, a lane (sometimes multiple lanes) may be shut down. Lanes should only be closed during non-peak traffic hours, usually during the middle of the day or after dark. If a work zone is set up after dark, all workers should be wearing retroreflective apparel that accentuates their visibility on or near the roadway at all times. Portable light plants may be used; these should point away from oncoming traffic if possible. Safety of vehicular traffic and workers in the work zone is paramount.

State Departments of Transportation (DOTs) use the MUTCD either 'as-is' or adapt the manual to their needs. Each state DOT is different in their preference for traffic control devices (for example Illinois DOT uses a narrow high-top traffic cone when delineating lanes while Missouri's DOT uses a lower profile wide base cone); some states have lower or higher speed limits to respect the wishes of their residents. Nonetheless, the intent is still the same: the protection of the private and commercial vehicles as well as the workers in the vicinity of traffic control devices is an integral and high-priority element in the design of work zones.

Work zones should be checked periodically to insure that all traffic control devices are functioning as intended AND that traffic is relatively unimpeded. Adequate warning should be provided to motorists of changes in traffic patterns sufficiently

prior to the work zone so that appropriate adjustments or lane changes can be made. Finally, appropriate training should be provided to employees in work zones on what to do in the event of an emergency, and in the cases of impaired or distracted drivers. Workers should always face traffic when not occupied with the work at hand. Finally, good public relations should be maintained by sufficient advance notice for motorists to select alternate routes if available or convenient. Cooperation with local news media outlets and law enforcement is always a positive step towards a safer work zone.

Personal Protective Equipment (PPEs)

Personal Protective Equipment, commonly known as PPEs, are those things that protect you, the geologist, when you're on a job site. Some items are mandated by state and/or Federal law, or by your employer. Other PPEs are 'recommended'. Make sure you know the hazards that you're facing BEFORE you get to the jobsite. Items that are required by your job should be paid for by your employer.

If you're working anywhere near construction or heavy equipment, then a hard hat is REQUIRED. Hard hats should be clean, so that they may be visually inspected for potential defects. Discard and replace worn and/or excessively used hard hats. Make sure that the hard hat that you wear is approved for use in the type of project that you're participating in. If you're working on water, on a barge or a boat, you should always wear a personal flotation device. This is also required by law in the US.

A short list of PPEs and their recommended use is in Table 1. This list is by no means exhaustive, but it represents a good starting point for future discussions

Dust masks should also be included in personal protective gear and used, for example where bentonite is being mixed for drilling fluid, due to the dangers of respirable silica. DEET-based insect creams/spray for repelling mosquitoes and ticks that cause disease and permethrin-based spray for clothing (NEVER spray it on bare skin - permethrin is a synthetic pyrethrin which is not only poisonous if inadvertently digested, but fatal in cases of acute subcutaneous exposure). A first aid kit should always be available, and should be checked for restocking regularly. Fire extinguishers in working order (check them yearly or whenever discharged) and of the proper type should also be available around flammable materials. Know the location of the nearest hospital and how to get there before you even begin the job.

A Philosophy of Safety – Buying In to the Concept of "Zero Incidents"

Jobsite safety should be a primary focus for all geologists. Without a safe job site, productivity and profits suffer. Employee morale suffers, and workers are put in danger to the point where the job may become unprofitable

The goal is to not have incidents that threaten employee well-being. Note here that in this closing section incidents are not referred to as 'accidents'. This means that these so-called 'accidents' are incidents which may be prevented. The responsibility for prevention is shared by each employee, and this includes management and supervisors. This shared responsibility means that everyone is obligated to accept the task of preventing incidents. With this shared responsibility, workplace risks can be minimized and exposures to risk limited. Communication is essential, so that successful prevention information is shared with all. To achieve open communication, the individual work groups are focused together on preventing the risks. Teamwork develops and eventually, a heightened awareness of the risks present leads to employees looking after one another.

At this point, the phenomenon of 'unit integrity' develops. Employees who protect each other and work with each other daily develop trust in one another. Incident levels

Personal Protective Equipment Need	When it's Needed
Hard hat	In proximity to any kind of safety hazard of drop; on construction sites and in mines; whenever you're around drilling equipment or cranes. OSHA requirement.
Eye protection	Recommended in both field and lab where exposures may occur.
Retroreflective Safety Vest	Required in DOT rights-of-way; recommended for any high traffic area.
Steel toed boots, steel metatarsal protection	Recommended or required dependent upon jobsite.
Ear plugs	Recommended for high noise conditions
Life vest	Required on US waters in boats and on barges
Climbing harness	Required wherever scaffolds or ladders are in use over 8' in height.
Self-contained breathing apparatus (SCBA)	In confined spaces and where toxic inhalants may be present.

Table 1: Personal Protective Equipment requirements for certain jobs.

drop, employees work together seamlessly, and productivity increases. The responsibility of management and supervisory personnel throughout this process is to keep communication levels high, provide and encourage the use of PPEs, and provide training to employees in the performance of their work functions. Any mandated safety policy MUST be accompanied with training. Any state, Federal, or government safety regulations will be included in training, and management must lead in this process, providing immediate follow-up to employee concerns. Supervisors must lead by example, committing themselves to safe work practices and wearing appropriate PPEs.

Once a safe work environment is achieved, focus on safety is maintained by continuing an emphasis on safety, and by recognizing those who have achieved safe work practices in the long term and have contributed to their safe work environment. The commitment must be ferocious, but the reward is huge. Everyone goes home at night, safe and sound, to enjoy life with their family. The responsible and ethical geologist should be a major contributor to that effort.

There are some who might think that it can't be done, that no one person can see into the future sufficiently to protect every person from every incident that can happen. Additionally, each incident is unique. With experience, most geologists are able to prevent incidents by learning to recognize and avoid what CAN go wrong, and take appropriate steps to prevent tragedy. Applied common sense can help sort out the most serious and imminent hazards so that they may be avoided or mitigated against. Then, when the work day is done, you can go home intact to your family. That may be the greatest motivation of all.

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George H. Davis is both the Central District Geologist and the Central Office Geologist for the Missouri Department of Transportation in Jefferson City, Missouri. He graduated in 1985 with a B.S. in Geology from Middle Tennessee State University in Murfreesboro, Tennessee and received his M.S. in Geology from the University of Missouri in Columbia, Missouri in 1989. Besides being a full-time employee of the Missouri Department of Transportation, he is also an advisory board member at the Center for Underground Infrastructure Research and Education at the University of Texas in Arlington as well as an adjunct faculty member at Missouri State University in Springfield, Missouri. He has been an AIPG member since 2008, and is also active in GSA, AEG, and the Association of Missouri Geologists, whose annual meeting he has not missed in 24 consecutive years. Finally, in the fall of 2016 he began PhD studies in geology at the University of Missouri.

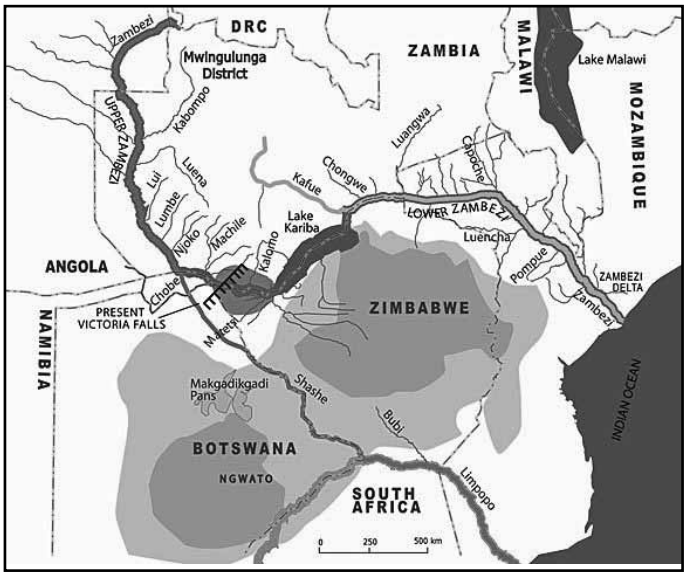
Section News

Can now be found on the AIPG website at
http://aipg.org/sectionnews

More about Victoria Falls

John Berry, CPG-4032

The Zambesi River flows from the northwestern tip of Zambia 1000 km (625 miles) to the Falls across Pan-African (550Ma orogeny) metamorphic rocks. Just above the Falls it flows across 180 Ma basalts of the upper Karroo system. These were extensively broken by E-W faults (with very small offsets) during the break-up of Gondwanaland. Weathering widened the fault planes, and sand and clay filled the weathered zones. Until the Miocene, the upper Zambezi flowed SE along the Zimbabwe/Botswana border to join the Limpopo River. Uplift of central Zimbabwe at about 15 Ma gave rise to a large lake (perhaps as big as Lake Victoria in East Africa) in the area of the present falls. This was drained by headward erosion of the ancestral lower Zambesi, which integrated the Zambesi drainage into its present form and gave rise to the Falls. Since then the Victoria Falls have excavated a series of eight narrow E-W gorges as they retreated 3 miles across the weathered fault zones.



Reference:

Brett Hilton-Barber and Lee R. Berger. Copyright © 2010 Prime Origin. Map accessed at http://www.siyabona.com/explore-victoria-falls-geology.html, 2017/02/09.

Practice of Geology

William J. Elliott, CPG-04194

If you are new or fairly new to geology, say a freshman with only one or two geology classes under your belt, or a junior about to begin work on your senior thesis, there are some aspects of being a professional geologist that you probably have not thought about or encountered yet in your academic studies. There is more to being a geologist than just what you have learned in text books, on field trips, or in professional meetings. The following is what may lie ahead after graduation.

If you are going to go out in the world to become a practical geologist, some of what follows should be of interest to you. The practice of geology is about more than just being able to identify rocks, work a three-point problem, and program a computer to solve a geophysical problem. It is also about being able to do all of these things well,

1) make sound judgments and decisions,

2) communicate information to your supervisor,

3) be a compatible team member.

The following paragraphs have been abstracted from and modified after an article by Burwell and Roberts, in the famous Berkey Volume (1950), one of the first monographs devoted to Engineering Geology. They remain as valid now as they were then.

"Doing all of these things well, in a word, translates to being a competent geologist. Without competence, there is no justification for occupying a position of responsibility in any organization. When you are the "go-to" geologist, your peers and supervisors expect you to provide the very best information, conclusions, and recommendations possible, oftentimes with very little hard and reliable data.

The "go-to" geologist must have the ability to render sound judgments and make important decisions. Sound judgment (opinion) requires understanding that there is a significant difference between established facts, inferences, and untested hypotheses. Separating the known from the unknown can sometimes be a daunting task, but keeping an open and critical mind can help the geologic investigator sort the wheat from the chaff.

The geologist of record must be able to simplify his/her discoveries and interpretations into everyday language that is easily understood and useful to his or her peers and supervisor. This ability to communicate does not come with more and more geological knowledge, but with a better understanding of the company or institution for which she or he works, and of the particular kinds of investigations and projects the company is hired to complete. It is imperative that the geologist step up to the plate to make these important decisions and interpretations, lest others less qualified will be forced to leave their comfort zone and make these decisions for him/her.

And now to the part of being a geologist they will never teach you in school. These are the psycho-social aspects, or personal qualities, that you will take to your work place every day. You may be the smartest and greatest geologist that ever lived, but if you cannot get along with your peers and supervisor, cannot convey and receive information with humility and gratitude, then you will likely be constantly looking for work. Make it a habit to approach your job and those you work with, with diplomacy, coolheadedness, tact, good judgment, and humility. These priceless personal qualities will pay bigger dividends than all the geologic knowledge you are currently stuffing into your head."

Reference

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Development of an Earthen Dam Break Data Base

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LTC Randy Boucher

STUDENT ARTICLE

Introduction:

A frequently used approach in the assessment of earthen dam-break outcomes is to use regression equations that are developed from data collected following various dam-break events. Several regression equations have been reported in the literature, and the resulting equations are not necessarily developed from the same dam-break data sets. Furthermore, data corresponding to a dam-break not already part of the data base may not fit well within the selected regression equation. Because dam-breaks and the ensuing floodplain inundation are a significant influence on many other water resources related factors, such as landslides, sediment transport, flooding, and mud flood propagation, providing another tool to aid in the assessment of the applicability of a particular dam-break regression equation may be a valuable contribution towards better understanding the connectivity between the various related water resources factors.

Objective of the Project:

Our project is an ongoing assembly of earthen dam break event measurements into a comprehensive data base of 146 earthen dam failure events with relevant measurements related to the regression equations of the in-situ situation. These measurements consists of over 23 different parameters as seen in Figures 2 and 3. In addition, a web based application is under construction that provides two-dimensional "slices" of the multi-dimensional data base, in order to visualize 2-dimensions of the selected parameters in the data base. For instance, a graph of dam height can be measured against the peak outflow.

Description of the Project:

Because the data base is intended to evolve over time, some of the data point entries do not have values and consequently those particular events will not appear in the respective marginal distribution scatter plots. The various marginal distributions can be used to examine the positioning of test case data against the measured data contained in the data base. Such a visualization may be useful to indicate the relevance of the data base with respect to the test case under examination, and therefore indicate the possible applicability of the published corresponding regression equations. Sources of the earthen dam break data include reports from the U.S. Department of the Interior Bureau of Reclamation Dam Safety Office, articles published in the Journal of Geotechnical and Geoenvironmental (©ASCE) and Journal of Hydraulic Engineering (©ASCE), and reports submitted to the National Dam Safety Review Board. The data collected is as recent as 1996. Contributors to the data base include Dr. Tony Wahl, Dr. Steven Abt, and Dr. Limin Zhang who are foundational in the literature in the development of earthen dam break assessment methodology and data compilations. The data base will be downloadable from the web page.

	Dam and Location	Built	Failed	Failure Mode	Construction
1	Apishapa, Colorado	1920	1923	Piping	Homogeneous earthfill, fine sand
2	Baimiku, China			Overtopping	
3	Baldwin Hills, California	1951	1963	Piping	Homogeneous earthfill
4	Banqiao, China			Overtopping	
5	Bayi, China			Piping	
6	Bearwallow Lake, North Carolina	1963	1976	Sliding	Homogeneous earthfill
7	Big Bay Dam,USA			Piping	
8	Bradfield, England	1863	1864	Piping	Rockfill/earthfill
9	Break Neck Run, USA	1877	1902		
10	Buckhaven No. 2, Tennessee			Overtopping	
11	Buffalo Creek, West Virginia	1972	1972	Seepage	Homogeneous fill, coal waste

Figure 1. Illustration of the data base

Embankment Dimensions								Hydraulic Characteristics					
Dam Height	Crest Width	Base width	Average width	Upstream slope	Downstream Slope	Length	Peak Outflow		Reservoir Storage	Surface area	Volume stored above breach invert	Depth above breach	Breach Formation Factor
h_d	W_c	W_b	W	Z_{eu}	Z_{ed}	L	Q_p		S	A	V_w	h_w	$V_w h_w$
m	m	m	m	Z:1(h:1)	Z:1 (h:v)	m	m^3/s	Method of Determining Peak Outflow	m^3	m^2	m^3	m	m^4

Figure 2. Assembled embankment dimensions and hydraulic characteristics used in the data base

Breach Characteristics							Time Parameters			
								Maximum		
	Height	Top width	Bottom width	Average width	Average side slopes	Eroded volume	Formation Time	Failure Time	Development Time	Breach and empty Time
	h_b	B_{top}	B_{bottom}	B	Z	V_{er}	t_f	t_f	t_f	t_f
Breach Shape	m	m	m	m	Z:1(h:v)	m^3	hr	hr	hr	hr

Figure 3. Assembled Breach characteristics and time parameters used in the data base

The web application depicts the data base as a set of two-dimensional scatter plots, including a scatter plot display for each possible two-dimensional selection of data base variables, and highlights the positioning of the test prototype data. These displays will demonstrate the possible appropriateness of the global data base in enveloping the test data situation. A common problem in the use of published regression equations can be the lack of a clear depiction as to how well the data used to develop the considered regression equation fits the situation of the test data point. This web application will provide such a demonstration and may be another useful tool for aiding evaluation of earthen dam break assessment.

The project is evolving with the addition of data over time and modification of data base entries if required.

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A Computational Model of Groundwater Mound Evolution Using the Complex Variable Boundary Element Method and Generalized Fourier Series

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The full length article is available on the AIPG National website http://www.aipg.org/TPGPublic.

STUDENT ARTICLE

Abstract

Overview

An emerging issue in topics of computational engineering mathematics is the general use of groundwater computational models for solving problems in groundwater flow. Although computational groundwater models are useful for understanding and visualizing groundwater flow, computational errors can often result in significant design errors. In this work, an important problem in groundwater flow planning and design is considered, namely, the modeling of unsteady groundwater flow in a groundwater mound located below a groundwater recharge basin.

The actual problem setting is recast into two prototype problems that are suitable for computational assessment. The two test problems are mathematical formulations of unsteady groundwater flow and are designed to assess (1) the ability of computational groundwater models to develop descriptions of the potential surface (groundwater surface), and (2) the ability to develop the associated streamline vector trajectories. Testing the accuracy of computational groundwater models may lead to increased confidence in computational results and may possibly facilitate identifying computational modeling issues before the modeling outcomes move forward towards design and planning actions.

In addition to providing and explaining the two proposed test problems, we also propose a numerical solution technique for this problem. The numerical scheme uses the standard procedure of resolving the global initial-boundary value problem into a steady-state component and a transient component. The steady-state component is modeled by application of the Complex Variable Boundary Element Method (CVBEM), and the transient component is modeled by application of an approximation function that is a linear combination of basis functions that are the product of a two-dimensional Fourier sine series and an exponential function. The accuracy of this coupled procedure is proposed as a benchmark standard for comparison with other computational models.

Test Problem A: Potential Surface Modeling

The computation of a changing water table due to the creation of a groundwater mound is important since such mounds can rise sufficiently such that the mound reaches the base of the recharge basin and interferes with the recharge process. Another possible complication (among others) is the mobilization of pollutants that are stored in subsurface soils, and the transport of these pollutants to other locations.

In Test Problem A, the steady-state flow situation is modeled as flow around a 90-degree bend. The initial condition is specified as the superposition of the background flow (steady-state flow) and a two-dimensional single-peaked mound geometry. This geometry is picked for its simplicity, however, it is noted that a wide variety of geometric shapes can be specified. For model times t>0, the mound is continuously reducing in spatial coverage due to downward and lateral drainage of the stored groundwater in the mound. This flow regime is associated with difficult-to-solve spatial distributions for both the potential and streamline functions, and hence provides a possibly interesting case where the analysis must predict the dissipation of the flow regimes corresponding to the specified background flow superimposed with the groundwater mound.

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Test Problem B: Streamline Development

Another situation often encountered in groundwater flow analysis is the identification of sources of groundwater contamination. Computational models are typically developed and applied to the flow situation to estimate flow streamlines from which possible locations for sources of groundwater contamination are identified. The analysis procedure presented in Test Problem B uses the flow field streamline function trajectories to work upstream along streamlines toward possible locations for contaminant sources. Here, the initial condition is specified as the superposition of the background flow (which is planar in this case) and a two-dimensional single-peaked mound. It is assumed that a groundwater recharge mound is present, however the steady-state flow situation is a plane rather than fluid flow around a 90-degree bend.

Assumptions

The problem domain is assumed to be homogeneous and isotropic, thus reducing the need for parameter specification in the problem formulation. An initial condition for the groundwater surface is defined that is approximately the situation encountered, and includes a groundwater mound that is draining into the groundwater regime located below the mound. The flow situation involves unsteady flow of the groundwater mound resolving itself towards the steady-state conditions of the problem. Therefore, the conceptual problem can be decomposed into two components: (1) an unsteady flow component of the groundwater mound reducing in vertical extent over time, with flow moving into the underlying groundwater regime modeled by a two-dimensional Fourier sine series, and (2) a steady-state component representing the considered test situation after the groundwater mound has fully drained into the groundwater regime, which is modeled by the Complex Variable Boundary Element Method procedure using complex variable monomials as basis functions (see Wilkins et al, 2016).

Evaluation Procedure for Common Numerical Methods

Typical groundwater computational models involve thousands, or even more, of finite elements or finite difference grid nodes. Here, the procedure used to test the veracity of such large models is to apply test problems designed to represent realistic and important problems in groundwater flow modeling. Generally, a portion of the target computational model is isolated and the test situation is applied and examined. It is assumed that if the computational model performs adequately for the test situations, that the computational model will perform similarly well for the actual problems at hand.

A Numerical Scheme Using the CVBEM and Two-Dimensional Fourier Sine Series

The numerical scheme proposed in this work involves decomposing the global initial-boundary value problem into two sub-problems, namely, a steady-state component and a transient component. The steady-state component is governed by the Laplace partial differential equation (PDE) and the transient component is governed by the diffusion partial differential equation. The steady-state component is solved by application of the CVBEM and the transient component is solved by application of a linear combination of basis functions that are the product of a two-dimensional Fourier sine series and an exponential function. It can be shown that the global solution, which is the sum of the modeling outcomes from the steady-state and transient sub-problems, satisfies the governing PDE.

The boundary conditions of the global BVP are satisfied by the CVBEM approximation of the steady-state solution. Thus, the unsteady component is specified with homogeneous boundary conditions. The initial condition of the transient problem is specified as the difference between the global initial condition and the CVBEM approximation of the steady-state situation. Consequently, when the two outcomes are summed, the global initial condition is appropriately modeled.

Numerical Test Modeling Results

The spatial domain is identical for both test situations considered in this work. For the planar steady-state of Test Problem B, the specified groundwater mound is superimposed upon a steady-state condition of a geometric plane. Such a geometry may be appropriate for many problems even outside of the testing situation because within a relatively small distance of the mound, the groundwater regime may be significantly linear. For Test Problem A, the background groundwater flow is assumed to be similar to a flow field in a 90-degree bend. This more difficult flow regime is solved by the complex variable quadratic polynomial function and the potential is readily determined to be the real part, or x^2-y^2 in the first quadrant of the two-dimensional coordinate axis plane.

Conclusion

This work shows that test problems can be applied to large-scale groundwater models to check the modeling veracity of the groundwater model utilized. Such tests are a necessary but not sufficient condition in order to develop an accurate model of the problem being assessed.

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Note to Readers: Calls from MultiView

Some AIPG members have been contacted by a seemingly aggressive company called MultiView. This is a legitimate corporation doing legitimate work for AIPG in an attempt to develop revenue sources which will lessen the Institute's dependence upon dues. Successive Executive Committees strive to improve services to AIPG members. All services require a competent and adequately trained staff, and of course the staff must be compensated fairly.

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Field Trip Insurance and Safety

David M. Abbott, Jr., CPG-4570

Field Trip Liability Insurance

Field trips are a fundamental part of geoscience education and of continuing professional development during one's career. Field trips are sponsored by both geoscience departments and professional organizations. They are an integral part of professional organizations' annual meetings. Field trips also were part of AIPG's 2016 Annual Meeting in Santa Fe. I would estimate that hundreds of field trips are held each year by geoscience departments and professional organizations. The Rocky Mountain Association of Geologists (RMAG) is the largest regional geoscience organization in Colorado and has been sponsoring field trips for many years. In recent years, those signing up for a RMAG field trip have had to submit a signed liability release form as part of registering for a field trip. In addition, RMAG developed a 2-page check list "Accident and Emergency Plan" for field trips. I was therefore quite concerned when I read 2016 RMAG President John Ladd's "President's Letter" in the May '16 *Outcrop*, RMAG's newsletter.

Ladd reported that issues concerning insurance coverage for field trips were initially responsible for a decision to cease RMAG sponsorship of field trips after 2015. Ladd noted that a few years ago, RMAG's auditors "noted that our liability insurance did not cover such events and if someone got hurt on one of our trips, RMAG could be sued for every cent we had, no matter what kind of liability waiver we made participants sign." Initially RMAG was able to obtain separate liability coverage for field trips, but then the insurance company stopped issuing this policy. So RMAG was able to get AAPG to sponsor the RMAG field trips under AAPG's field trip policy. However, AAPG's "insurance company started getting nervous, and beginning this year they were requiring that each trip would have to have a trip leader who not only was an AAPG member but also had so many health and safety certifications that they might as well be an EMT. They even required certification in small marine craft safety!" Colorado is a long way from a Quaternary marine body. White water rafting is an entirely different topic—I went on a RMAG-sponsored 10-day trip down the Grand Canyon in 1993. Susan Wager, CPG (2016 Colorado Section President and 2015 RMAG field trip chairperson) noted that AAPG field trip leaders would be required to obtain all these health and safety certifications at the leaders' individual expense.

Ladd noted that the problem for insurance companies results from the fact they have no experience with such policies and therefore have no idea of what's involved or the likelihood of claims being made. Unfortunately, the probability of claims being made will increase if liability insurance exists providing a known pot of money that can be pursued in a liability suit. AIPG members whose practice involves estimating mineral resources and mineral reserves have faced similar issues when trying to obtain professional liability insurance for their work. If such policies can be obtained, they are prohibitively expensive. RMAG has been able to find more reasonably priced coverage that allows RMAG-sponsored field trips to continue this year.

RMAG's experience prompts the question, what should AIPG do about field trips lead by Sections—the Colorado Section has one or two per year—and during annual meetings? AAPG is a very large organization with significant assets and one can understand AAPG's desire to have adequate insurance coverage. But if the health and safety certification requirements for leaders of AAPG field trips remain as reported by Ladd and Wager, I doubt whether RMAG will be sponsoring many future field trips. RMAG is much smaller than AAPG but still has more assets than AIPG. One approach for AIPG would be to continue our current practice of not having field trip insurance and hope that no one is seriously hurt on an AIPG-sponsored trip and that no liability suits are brought. Past experience indicates that injuries occurring on field trips are rare and that suits have not been brought. But is this approach still viable and prudent? I don't know. I have raised the question.

Field Trip Safety Issues

Aside from the liability insurance questions, should more attention be paid to the potential health and safety issues that may occur during field trips? I've noticed increasing requirements that field trip participants have personal safety equipment including hard-toe boots, high-visibility vests, hard hats, safety glasses, and hearing protection. The need for this equipment is more obvious for some trips than others. I go on field trips at operating mines and quarries and having the foregoing personal safety equipment is standard operating procedure. With the exception of the hard-toe boots, the foregoing equipment is generally pretty cheap. Having your own high-visibility vest ensures that you have one that fits well over whatever you may be wearing and may have convenient pockets for various field related items. But I also think that the requirements to have such equipment be intelligently applied. I've always wondered why flaggers on highway projects need hard hats. They usually are located some distance away from work areas and hail is the only thing likely to fall on their heads—a hard hat is nice in a hail storm.

Injuries have happened on field trips. David Glater, CPG, reported a case in which a student was severely injured on a university-sponsored field trip in western Kansas during which students were digging fossils from the Ogallala Formation. They were recklessly undercutting a cliff, with predictable results. The seriously, permanently injured student sued for a large settlement and won. Rocks can fall off cliffs and steep hills. Roads through the Colorado mountains frequently traverse rock fall areas and the incidence of falling rocks is particularly acute in the spring as snow melts and temperatures vary from warm days to freezing nights with the resultant ice-wedging in cracks in the rocks. Being hit by fall-

ing rock while driving on a public road is one thing. Standing beneath a cliff during a field trip is something else. However, is a hard hat really sufficient protection in such cases? Skiing and motorcycle helmets with crushable liners provide better protection than hard hats but the size of the falling rock still is very important.

Other field trip hazards included slippery areas due to mud, snow, ice, or loose pebbles; nasty plants like cholla cactus or those with thorns; dangerous local fauna such as rattlesnakes; grizzly bears, and zika- or malaria-carrying mosquitos; high temperatures; severe storms (hail and tornados); etc. These are hazards the field trip leader should know about and should provide potential participants with appropriate information and hazard-avoidance instructions. The strenuousness of a trip is another aspect that should be included in the trip's description. Is a steep or long hike involved? Is this a trip that the physically handicapped can participate in? Are accommodations for such participants provided? Are food allergies accommodated in lunch and snack offerings?

RMAG's "Accident and Emergency Plan" for field trips is worth considering and perhaps formally adopting. Its checklist form items are:

Pre-Trip Plans

- Leaders will have advance experience with the trip route.
- An outline of geology and trip logistics will be provided for participants.
- Materials include a map showing the route and stops (with Lat/Lon locations).
- Show Route itinerary, with times and diving-distances.
- Advise as to weather potential and necessary protective clothes.
- Encourage participants to arrive physically fit. Participants may need to hike more distance than described, prepare for temperature extremes, and be ready to assist all who may need help. Those who have medical issues should have written instructions prepared for the Leaders – to be returned at trip-end and no incident.
- Declare principal contacts (usually Field Trip Leaders and RMAG logistics people) and make phone numbers and emails available.

Field Trip Day

- Leaders or RMAG Logistics volunteers: organize a Pre-Trip meeting with all participants to review the route, stops, timing, distances, unscheduled stops, and overall tour—as made available in Pre-Trip Plans.
- Leaders or RMAG Logistics volunteers collect participant data-sheets (which includes: participant names, phones, addresses, a contact-person, and RMAG release of liability)
- Leaders or RMAG Logistics volunteers distribute this Accident and Emergency Plan to Participants – advise all to read and know the contents.
- Leaders or RMAG Logistics volunteers identify location of a first-aid kit and a case of bottled water. At least one first-aid kit will be included with the field trip. Leaders, RMAG Logistics volunteers, and Participants may not be trained in First Aid or CPR, though they may provide First Aid and CPR to the best of their abilities as the situation requires.
- Leaders or RMAG Logistics volunteers advise participants of potential hazards through the trip.
- Leaders or RMAG Logistics volunteers make a head-count; note vehicle association and vehicle drivers.
- Drivers – be ready to account for whereabouts of your passengers at head-counts, Leaders or RMAG Logistics volunteers designate and describe the Lead Car and Trailer Car.
- Participants inform Leaders or RMAG Logistics volunteers of mobility and health issues; condition for the trip.
- Leaders or RMAG Logistics volunteers advise the group as to stops for food, hydration, and relief.

During the Field Trip

- Leaders or RMAG Logistics volunteers make sure adequate parking space is found for vehicles at stops. Trip vehicles interfering with public traffic flow is unacceptable.
- Leaders or RMAG Logistics volunteers assess mobility and condition of participants – adjust accordingly.
- Leaders or RMAG Logistics volunteers take a head-count before moving to the next stop; collect all missing people.
- Participants who need to slow or stop - find a Helper who will also stay behind; and be sure to inform the trip Leaders or RMAG Logistics volunteers
- All - increase awareness, anticipate elements of the hike, and note others' conditions through the trip.

Driving

- Drivers carry precious cargo – so drivers will use extra caution and practice defensive driving through the day.
- Drivers will minimize passing and speeding through the day; obey posted speed limits.
- Seat belts on for all while in motion.
- Driver responsibility – Be Alert! Yield driving to a passenger if Driver is drowsy or unfocused.
- For any unplanned stop, or departure from the trip—inform a Field Trip Leader or RMAG Logistics volunteer.
- Passenger responsibilities – monitor the Driver and other Passengers for safe conditions; anticipate moves of people and gear into and out of the car.
- On the return-trip, stop for refreshments before moving on.

Alpine Sports and Geologic Processes

Jeffrey Frederick, CPG-10989

Alpine sports do not necessarily require a very deep understanding of geology or geologic processes. Mountains, Rock, and Ice can simply be climbed "because it is there," in the famous words of Sir Edmund Hilary. Mountains can be skied and trails ridden without a single passing thought as to what lies beneath your feet, how it came to be, or what it will look like in 10,000 years. In my younger years, I became obsessed with rock climbing while studying for my undergraduate degree in central New York, and it was a passion of mine for many years. I found a tremendous outlet for rock climbing, and various other alpine sports, while I lived and worked as a geologist in Oregon.

During my time there, I studied and certified as a technical mountain rescue operator on the evenings and weekends. I ultimately participated in many rescues, and even more "recoveries," in the Cascade Range and beyond. We trained on towering desert basalt columns, welded tuff cliffs in central Oregon, and the basaltic andesites and diorites typical of the high Cascade Range.

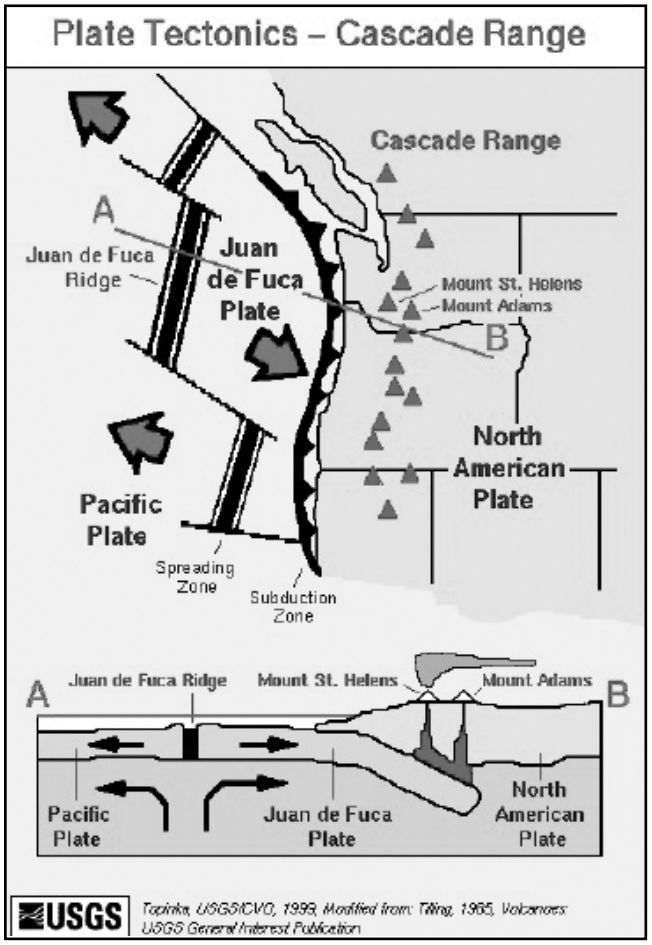

Figure 1: Subduction of Juan de Fuca plate and location of Cascade volcanoes. Source: Topinka, Lyn, USGS/CVO General Interest publication, 1999. Accessed Jan 17, 2017.

The Cascade Range is the product of rather typical active subduction, with an orogenic uplift belt punctuated by strato-volcanoes, calderas, and intrusive and extrusive igneous rocks of primarily intermediate composition (poor in quartz and potassium feldspar). Mt. St. Helen's epic eruption on May 18, 1980 captivated the nation, showing the destructive and unpredictable nature of the region. But the geologic record of the region shows us that what we have seen in recent history is nothing compared to what this pressure cooker is capable of. For example, the Columbia Plateau located in northern Oregon, southern Washington, and western Idaho covers approximately 190,000 mi^2 with basalt. For a little perspective, that's more area than all of California (158,000 mi^2), and a bit less than Texas (266,000 mi^2). Did I mention nearly 40,000 mi^3 of basalt, most of which was extruded during a 1.5 my window between 17 and 15.5 mya? That's enough basalt to cover all of New York, one mile deep!

Or slightly east of the High Cascades lies Newberry Crater, a massive shield volcano approximately 20 mi in diameter that has erupted felsic, intermediate, and mafic lavas throughout its history. Its central crater collapsed approximately 500,000 years ago, yielding the beautiful Newberry Caldera with deep alpine lakes and obsidian domes. While dormant, this monster draws tourists, hikers, and bikers , although it remains a potentially active volcano.

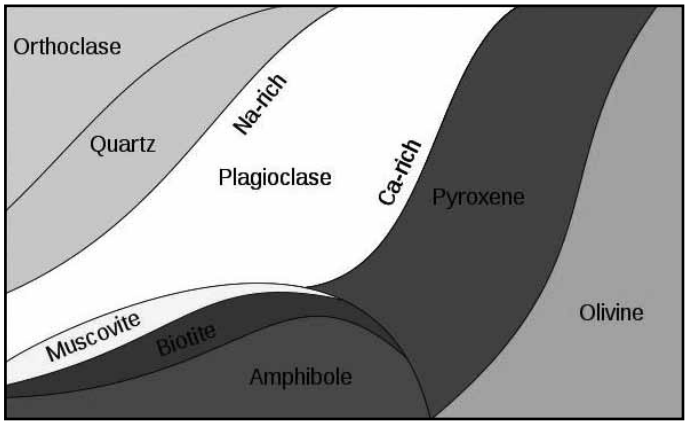

Figure 2: Mineral and Chemical composition of igneous rocks, including the diorite and andesite mentioned in this paper. Source: Earth Science Australia.http://earthsci.org/mineral/mineral.html. Accessed Jan 17, 2017.

While these high mountains are strikingly beautiful, they are also known to the climbing community for their poor rock quality. Loose, fractured, and heavily weathered andesitic rock often provides extreme objective danger, which is another term for "rockfall," Climbers like to divide the dangers of their chosen obsession into neat buckets: subjective dangers include all of the things I can control; objective dangers are equivalent to the finger of God. In terms of risk management then, choosing your weather window not only entails picking some

decent weather for your day or weekend, but it also includes considering the state of the snowpack and/or glaciers. Warm weather preceding a climb can mean additional rockfall, as the unrelenting freeze-thaw cycle unleashes a fresh round of bombs and missiles. So, the popular vision of climbers working out in the gym, running hills, and sharpening ice axes is more realistically expressed as a religious addiction to weather websites, radar images, snowpack reports, and temperature plots.

It was a rare weekend when all of the influences appeared to come together to provide three team-mates and me with the opportunity for an attempt at Mt. Washington of the High Cascades. We determined that we had a 24-hour window to attempt the 3,000' generic approach hike through typically soggy, mosquito infested lake country in order to attempt the 500' technical ascent of the volcanic plug that comprised the summit structure. The weather would turn to rain on Sunday, so we had one day to make it happen. We studied the routes, and chose our plan of attack. The four of us would climb in two rope teams, ascending in series to the summit, followed by a rather precarious rappel-descent back to the shoulder of the mountain. We would walk out to the car in the late afternoon, in the failing light of an early summer's evening. The plan was to take 12 hours roundtrip, from the car.

Figure 3: Mt. Washington in the High Cascades of Oregon, USA. Source: Gary Halvorson, Oregon State Archives.

A typical oh-dark-thirty start: strong coffee and little else to eat as we drove up into the mountains on a cold early summer morning. We parked in a wilderness area at 5,000 above sea level. The mosquitoes were living up to their end of the bargain, so we bathed in the strongest repellant money can buy. Anyone with enough blood left to stay conscious at the end of the approach hike gets to climb! As we hiked, we talked of the route ahead, and all of the special precautions we knew we must consider for this route, on this mountain. The rock quality is not highly regarded, meaning the protection we would place along the route (camming devices and soft metal chocks designed to arrest a fall) would have to be carefully considered. We had all heard more than one story about perfectly placed protection pulling 500lb chunks of weathered andesite free, with tragic results.

We weaved along the gendarmes of rotten rock along the arching ridge that lead to the summit pinnacle. As we crested the last rise, we all noted the brightly colored backpacks lying at the base of the route. Nuts! Other climbers got there before us, and were already on the route… meaning we would now have to worry about the objective dangers posed by an unknown party dislodging rocks above us. This can be a show-stopper, and we all knew that our climb was in doubt. After another minute of hiking, one of my partners stopped dead in his tracks, stiff and staring.

"Those aren't bags… they're bodies!"

We all stared for a hot second. He was right: two bodies lay beneath the route, a coiled mass of ropes around them that stood out in bright relief against the snow. We all knew instantly that our climb was over as we rushed closer to see exactly what had happened. At 25 yards out, one of the bodies moved… and then yelled to us.

What we found can only be described as a mess of human suffering. They had begun climbing the route, the same that we had intended to climb, on Wednesday morning. Into the second pitch (rope length), the lead climbed while the belay remained at the anchor that he had built. The lead fell, all of the protection he had placed, failed. He whizzed past the belay, shock loading the anchor. The belay failed, and they plummeted the remaining 150' together, landing in a broken heap of twisted rope and agony.

It was now approximately 11:00 AM on Saturday. Seventy-two hours had passed, and there they were, exposed, lying on the snow, no water, broken bodies. But they somehow managed to stay alive, and the four of us knew precisely what to do. A cell phone with barely a signal, we called Mountain Rescue HQ, at the Sheriff's Dept., and were patched through to the Oregon Air National Guard. We needed air support or they were going to die. A patient attendant was assigned to talk to them, constantly talking, assessing their injuries, and providing what little care we could. They were scared, and they knew they were not yet "out of the woods". Broken tibias, fibias, femurs, pelvises, a humerus, internal and external bleeding. Compound fractures, no less. A ledge needed to be excavated in the steep snow terrain to provide a stable platform to work on, and a "bomb-proof" anchor needed to be prepared to lower the litter and attendant once we began the evacuation.

The less injured climber confided in us that after the fall, he decided that he would just have to "suck it up" and walk out. His tib/fib (lower lef) fracture had actually broken through the skin (compound) and had been driven into the gravel upon impact, plus he had lost a lot of blood. He took one step, and promptly passed out. That was when they realized neither of them was going anywhere. He made an insulated ground pad with the rope, he braced his partner's broken femur by tying his good leg to it, and they settled in for the long wait. If no one had come to climb this weekend, this last day before the Sunday rain, they would have died there.

Figure 4: The Oregon Air National Guard Pavehawk hovers uncomfortably close. Source: Jeffrey Frederick © 2000

The four of us might have been the luckiest random encounter of their lives. Two hours after we had spotted them, the Air National Guard Pavehawk arrived on scene. We were right beneath the towering peak above, so they hovered at eye level approximately 100 yards away and dropped 2 Pararescue Jumpers (PJs), which are the Air Force equivalent of Special Forces field medical technicians. While I was staring at the pilot, awed by his steady control of the now impossibly close airship, my climbing partner (retired USMC) leaned in and yelled, "one gust of wind, and we're all finished!" The PJs now standing on the mountain below us, began their climb up to our position. Thankfully, they took over the direct patient care, which quickly included morphine drips for each of the broken men. "More," they cried. "Any more, and your heart will stop," replied the medics.

We were now free to focus on the logistics involved in moving the patients. The anchor to lower the litter, with attendant, ended up being one of the more challenging aspects of the rescue. The rock quality was terrible, with only a few small fractures capable of providing a solid placement. So, we improvised. We excavated deep, narrow slits in the lip of the "bergschrund," which is the crevasse that forms between a snow field or glacier and the rock headwall. The snowpack was extremely consolidated into what is called "firn ice," an intermediate substance somewhere between snow and glacial ice. Once the slots were cut, we anchored to our hiking poles which were situated perpendicular to the slot in the ice. The rock had failed once, and we were not about to give it a second chance.

Once we had established the anchors, we had to do the unthinkable. We had to move each of these men into a litter, to be lowered away from the cliff and hoisted into the hovering Pavehawk. We started with the patient in the worst shape (broken femur, pelvis, humerus, and internal bleeding). Despite the morphine, he was in excruciating pain. To this day I can't believe he didn't just pass out, if not from the lack of oxygen caused by the guttural screams as we very gently loaded him into the litter, then from the pain of a shattered pelvis and femur that no longer provided a structure for us to lift. We lowered him (and his attendant PJ) without incident, they were hoisted away, and we later learned that he was in surgery before the Pavehawk returned for the second climber. His injuries were less severe, but still life threatening and he knew what was coming because he watched the process unfold only 45 minutes earlier. They too were lowered, the pair was hoisted aboard, and they were gone. Surreal silence, the sun setting out over the coast range, and piles of gear, ropes, and anchors surrounded us. Did all that just happen… and why didn't we catch a ride home in the helo?

After cleaning up some of the mess, we were greeted by the official Mt. Rescue deployment that had been dispatched following our first phone call. They stayed behind and finished cleaning up the site, while we began our long walk out. We walked out in silence, in the failing light, each of us lost in our thoughts and replaying in our minds the event we had just witnessed, participated in. Thinking hard about the two lives we just saved. "They were so lucky," I kept thinking. But maybe, we were lucky too. Rock quality can change year to year, and who knows what we would have encountered had we climbed that route. The High Cascades are beautiful, they are a pleasure to explore, and the geology is complex and always interesting. I will always believe that understanding where the terrain comes from, of what minerals the rocks are comprised, and the weathering mechanisms at work are powerful tools in the kit of any outdoor or Alpine enthusiast!

Figure 5; The patient and attendant (dark objects in lower part of picture, directly below the helicopter) are winched aboard for transport to the trauma center. Source: Jeffrey Frederick © 2000".

Post Script: Both men physically recovered, although it took multiple surgeries, months of intravenous antibiotics, and exhaustive rehabilitation. They published their story in Rock and Ice Magazine in the early 2000s.

Jeff is a CPG with over 20 years of professional geologic experience. In his previous life, he was an avid mountaineer and spent many days and nights suffering above 10,000 feet. Since the birth of his son, he spends much more time exploring the south shore of Long Island, NY on the family sailboat. Currently, he serves as a Program Manager at Louis Berger US, where he provides sound project management, technical advice, and litigation support to his clients in the private and public sectors.

New Applicants and Members

Can now be found on the AIPG website at
http://aipg.org/newmembers

Letters to the Editor

Re: De-Licensure of Geologists in Arizona

A different Perspective

In response to R. Douglas Bartlett's article in the recent issue of TPG, Volume 53, No.4, entitled "De-Licensure of Geologists: Coming Soon?"

Mr. Bartlett's article provides a backdrop of 2016 Arizona legislative efforts to eliminate registration for geologists, efforts that resulted in recent legislation in Arizona that amended the State's licensure requirements for Geologists. While it did not eliminate the need for professional registration in Arizona for geologists, the existing statues were amended to provide exceptions to registration for a "Trained Geologist". The resulting amendments to licensure for geologists in Arizona are, in my opinion, an appropriate revision – let me explain.

Registration in Arizona is based on professions and occupations, and includes Geologists with Architects, Engineers, Home Inspectors, Landscape Architects and Surveyors. The Arizona statutes provide the following definitions of "purpose", "geological practice", and "geologist":

> ARS Title 32 Article 1, 32-101 Purpose; definitions
>
> "A. The purpose of this chapter is to provide for the safety, health and welfare of the public through the promulgation and enforcement of standards of qualification for those individuals who are registered or certified and seeking registration or certification pursuant to this chapter."
>
> "14. "Geological practice" means any professional service or work requiring geological education, training and experience, and the application of special knowledge of the earth sciences to such professional services as consultation, evaluation of mining properties, petroleum properties and groundwater resources, professional supervision of exploration for mineral natural resources including metallic and nonmetallic ores, petroleum and groundwater, and the geological phases of engineering investigations."
>
> 15. " Geologist" means a person, not of necessity an engineer, who by reason of special knowledge of the earth sciences and the principles and methods of search for and appraisal of mineral or other natural resources acquired by professional education and practical experience is qualified to practice geology as attested by registration as a professional geologist. A person employed on a full-time basis as a geologist by an employer engaged in the business of developing, mining or treating ores and other minerals shall not be deemed to be engaged in geological practice for the purposes of this chapter if the person engages in geological practice exclusively for and as an employee of such employer and does not represent that the person is available and is not represented as being available to perform any geological services for persons other than the person's employer.

I have added the underlining to emphasize the points I present here that: (a) not all geological work has bearing on the safety, health, and welfare of the public, and (b) the existing regulations, prior to the current amendments, were indeed biased or exclusionary and a discriminatory burden on some geologists seeking to earn a living in Arizona, specifically consultants and those not full-time employees of a mining company.

I am an Arizona resident, Registered Geologist in Oregon (G-313) and CPG-9565; I am not a Registered Geologist in Arizona. My entire career has been as a geologist employed in the mineral exploration and metal mining business, both as an employee of major and junior exploration and mining companies, as a member of a mining consulting company, and as an independent geologist consultant. Most of my +40 years of geological employment has been involved with mineral exploration, including some work here in Arizona. None of the mineral exploration I conducted in Arizona, or elsewhere for that matter, had any direct impact on the safety, health, or welfare of the public. I am speaking of exploration activities such as geological mapping, soil and rock sampling, ground geophysical surveys, construction of trenches and drill access roads, and rotary or core drilling activities in search of mineral resources – all conducted in rural non-populated areas. Such work, "evaluation of mineral properties" is part of the definition of "Geological practice" by Arizona statutes, requiring registration as a geologist.

I would argue two points. The first is that mineral exploration activities as described above do not have direct impact on the public safety, health, and welfare. I am speaking of that work alone, not the downstream development of a mineral property that indeed may impact ground water, infrastructure, etc.; which will require engineering work and permit applications that may require a registered geologist to sign-off, typically work done by someone other than the exploration geologist. Registration still is relevant in Arizona, and required for those geological functions that have direct impact on the public welfare, such as public works projects including highways, bridges, dams, environmental remediation, etc. Geology covers a broad spectrum of "geological practice", much more diverse than the work of Architects, Landscapers, and Home Inspectors, and perhaps should not be lumped with those professions for registration concerns. And not all forms of "geological practice" require the need for registration.

The second point is that the definition of a "Geologist" in Arizona has the exclusion for such mineral exploration as described above, if the geologist is a full-time employee of a company "engaged in the business of developing, mining or treating ores and other minerals"; I presume, an apparent nod to the copper mining companies active in Arizona at the time the statutes were developed. Since the statutes were enacted in 1956, the employment status of many geologists and the types of companies conducting mineral exploration have changed. Currently many geologists in mineral exploration are not full time employees; rather, they are independent consultants or contract geologists to junior exploration companies (often Canadian or Australian domiciled) and they would be required to be registered as a geologist if not for the recent amendments. The current amended statues now allow for a consulting geologist who is not a full-time employee of a mining company to conduct mineral exploration evaluations without the need for registration, provided the work is done by a "Trained

Geologist" – an appropriate clarification to the regulations, in my opinion.

Thus, from my perspective, the current amended licensure requirements in Arizona should perhaps be viewed as a necessary updating of the State requirements, keeping registration where needed. The definition of a "Trained Geologist" has some similarities to CPG status from AIPG. Perhaps AIPG should consider this a positive change; whereby States such as Arizona can defer to national organizations such as AIPG for technical and ethical oversight of "Trained Geologists" relating to geological work that does not have direct impact on the public safety, health, and welfare – an opportunity for AIPG to step in and assist Arizona.

Allan V Moran Consulting LLC
CPG-09565
allan@avmc.us

De-Licensure of Geologists

Dear Douglas,

You have my sympathy with politicians and bureaucrats. In Illinois the governor vetoed our licensing bill twice in two years, so we waited a year, got enough votes to over-ride his veto, and then he signed it. Several years ago we got an amendment to provide for GIT, but the Department of Professional Regulation is still dragging its feet on implementing regulations so that it can function.

In my opinion, licensing is stronger than certification because it requires an examination and is controlled by states. Practice acts are stronger than title acts (as in Virginia). Certification is useful in states that do not require licensing (although Alaska does use state certification, identical to AIPG), and for recognition in Canada and other foreign countries.

I think that AIPG should continue with the certification program. I was opposed to the most recent changes that were made to increase the requirements for CPG. They were well-meaning, but were adopted at a time when the number of CPGs was decreasing, and they are still decreasing. Required continuing education is cumbersome and expensive. Texas is having problems with licensees being punished for not complying. If you don't keep up with advances on your own, clients catch on quickly, or you could be reprimanded for malpractice. I also think that AIPG should take on a function similar to that of the National Society of Professional Engineers (NSPE) and have a licensed/registered member in addition to the professional member.

AIPG could also be more participatory with ASBOG on the examination workshops. Several attendees are AIPG members, but not official representatives. It would be good if official representatives from AIPG were present at these workshops.

Bill Dixon,
CPG 3659

In Memory

Lee A. Hogg
MEM-0420
Member Since 2003
April 18, 2016
Monrovia, MD

Bjarne Holm
CPG-06646
Member Since 1984
October 9 2016
Sisters, OR

William H. Kay
CPG-00026
Member Since 1964
November 6, 2016
Thornton, CO 80241

Curt Simmons
CPG-10136
Member Since 1997
Lakeland, FL

Derek D. Tatlock
CPG-01471
Member Since 1967
Williamsburg, VA

Passed away in 2016 - Derek was proud to have been associated with all of his professional organizations.

Thomas Wright, CPG-02812, who, for nearly four decades, guided the Standard Oil Co. of California in its search for oil deposits in the Western United States.

Mr. Wright, of San Anselmo, died Nov. 17 in Greenbrae after a stroke. He was 86.

Considered an authority on the petroleum deposits and on the plate tectonics and geological faults of the Los Angeles area, Mr. Wright published a highly regarded monograph on the subject in 1991. He extensively studied the 1994 Northridge earthquake.

A native of San Diego, Mr. Wright grew up in Glendale (Los Angeles County) and earned his bachelor's and master's degrees in geology from *Stanford University*. In 1952, he joined Standard Oil, working in Salt Lake City, Salinas, Seattle, Alaska, South America and Southern California. He was known as an expert stratigrapher, or specialist in the study of layers of rock.

In 1993, he received the distinguished service award from the *American Association of Petroleum Geologists*.

A lifelong member of the *Sierra Club*, Mr. Wright enjoyed backpacking in the Sierra Nevada and hiking with his wife, Louise, on Mount Tamalpais. In the 1940s, he hiked the *John Muir Trail*, toting a backpack full of the non-high-tech equipment of the day.

Mr. Wright was an accomplished gardener, landscaper and a devoted reader of historical novels. He was also a world traveler, making extended visits to Europe, South America and New Zealand. And he had an encyclopedic knowledge of the back roads of California, frequently poring over obscure maps for the fun of it.

Please remember to notify AIPG National of any changes you may have.

- ***Employer***
- ***Address***
- ***Email***

Tales From the Field: The Darien Gap

David Brown, CPG-07130

As a 23 year old geologist fresh out of college with an M.S. degree in geology, I went to work for Texasgulf Inc. in 1972. At the time Texasgulf's North American operations included the Kidd Creek massive sulfide mine in Canada, the Newgulf sulfur mine in Texas, and the Lee Creek phosphate mine in North Carolina. Mineral exploration in North and Central America included gold, uranium, and porphyry copper projects led by a team of "commodity" managers, including myself as porphyry copper manager. In September of 1973, working under recently promoted Exploration Manager Leo J. Miller, I accompanied Leo on a brief one week field visit to evaluate a mineral property in Panama, known as Cana. The purpose of this brief preliminary visit to the Cana Property was to assess whether this long abandoned 1800's era British gold mine venture in the Darien Province might have potential as a porphyry copper target. As a greenhorn exploration geologist with experience only in the desert southwest of the United States, I was totally unprepared for the underlying dangers, challenges, and obstacles of working in the Darien Region of Panama, which was a drug trafficking corridor in a remote rain forest area with no roads (only footpaths) and virtually no infrastructure. At the time of our initial visit, the property was largely enveloped by thick jungle vegetation, with rusted remains of mining equipment scarcely visible in a few places. We slept in jungle hammocks during a rainy and bug-infested night.

The property was fast-tracked into a Texasgulf exploration project, due to Leo Miller's influence and reputation as a successful exploration geologist. The relatively short-lived Cana project required extraordinary team and individual efforts in a location with scarce outcrops, frequent rains, steep slopes, and occasional earthquake-triggered landslides. I was assigned to map and evaluate the Cana area as a potential porphyry copper target during a two month period in the fall of 1973. Access to the property at the beginning of the project was by helicopter, provided by the Panamanian military. Later it was accessible by fixed wing aircraft, including Leo Miller's Cessna Skymaster 337. Camp meals eaten by the local workers were supplemented by locally hunted game, which included macaw parrots (guacamayas), ñeques (a large rat-like animal),

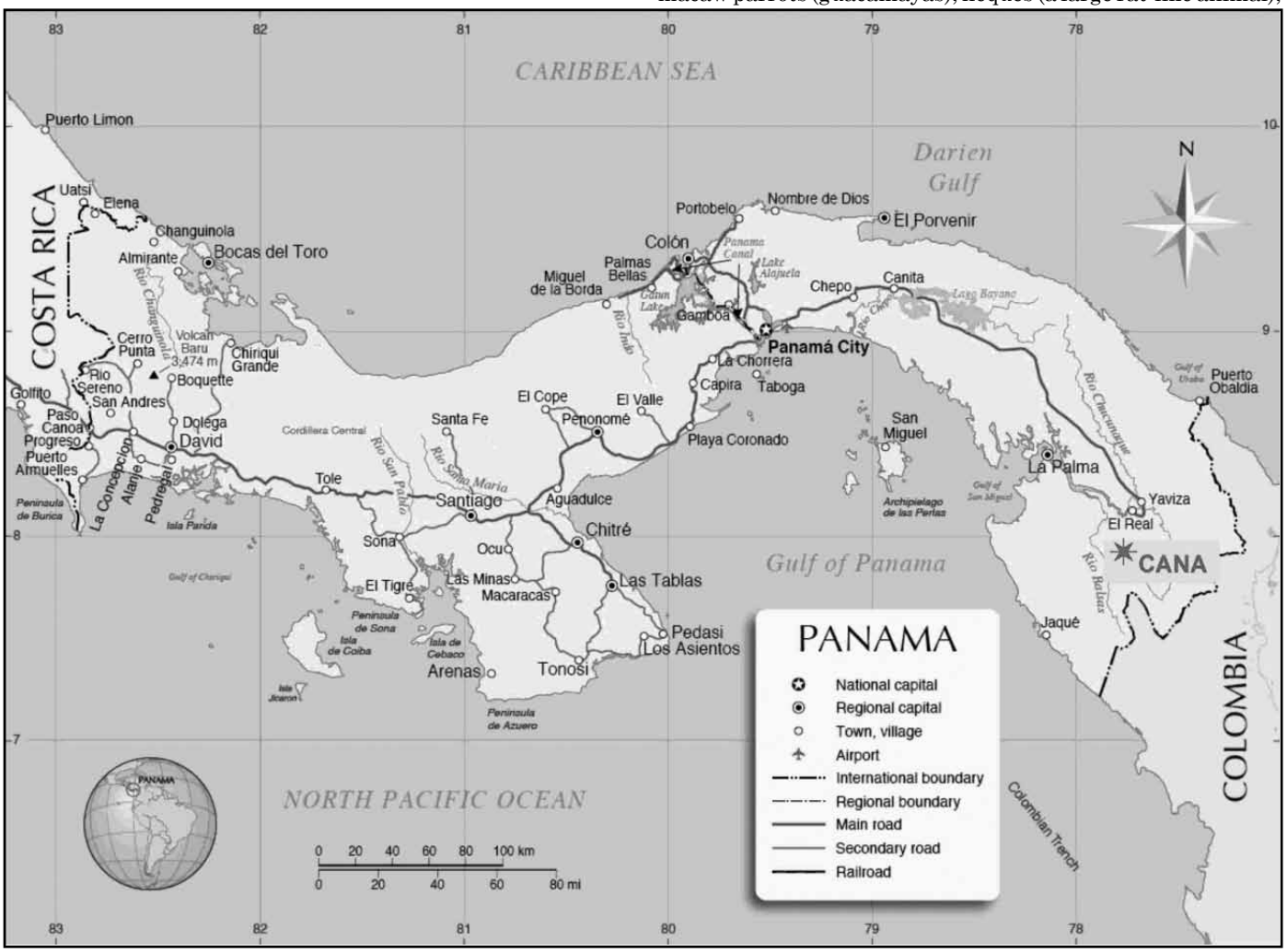

Figure 1. Location of Cana Project

jaguars, and monkeys. Snakes were commonly found in camp and in the field, including boa constrictors and lethal varieties such as the fer-de-lance and bushmaster. There was even a fresh water eel that plugged up the camp water supply system after it crawled into the plastic pipe feeding the drinking water supply from the creek. The project continued for two campaigns but ultimately Texasgulf ceased work and optioned the property to another company.

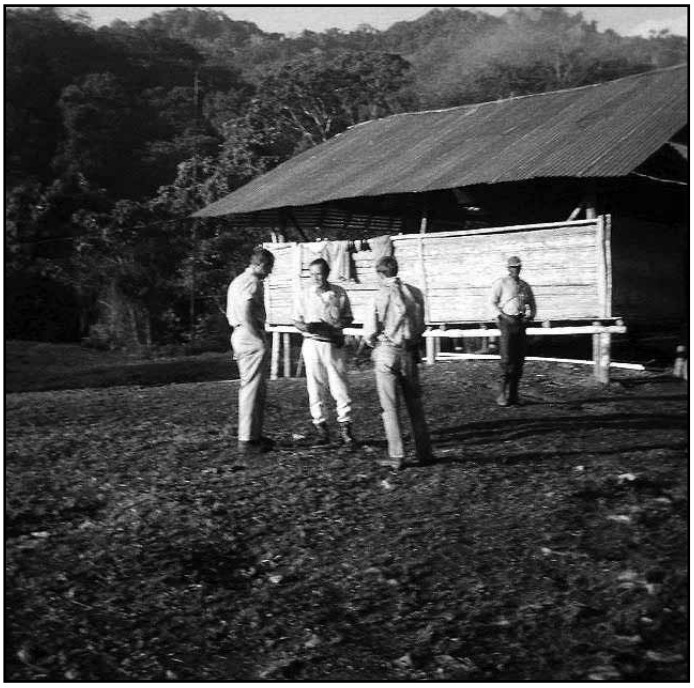

Figure 2. Cana, Panama Field Camp, 1973
Foreground From Left to Right: Leo Miller, Harry Williams, and the Author

The champion and proponent of the Cana Project was Harry Enrique Ruiz-Williams, a Cuban-born mining engineer who believed the area had potential for large placer gold resources. He was project manager, responsible for camp construction, local labor hires, logistics, and legal matters. Harry was a jack of all trades, and as a young geologist I was impressed with his abilities to organize, coordinate, and efficiently manage an exploration project in such a difficult and remote location. After working with him for a while, a connection between his abilities and his past career emerged. Harry was one of the planners for and a participant in the failed Bay of Pigs invasion of Cuba during the 1960's. He was wounded, captured, and eventually released by the Castro regime. Leo Miller and Harry Williams were both strong figures and natural leaders, but with contrasting styles. Leo was an advocate of the rugged individualist model as being more central to exploration success, as opposed to the team concept stressing cooperative efforts. Leo was an avid runner, tennis player, and skier who insisted that geologists working under him be in excellent physical condition. Harry, on the other hand, was a very social person and a good networker with important political connections in Latin America stemming from his early career. He loved his Beefeater martinis and "café con leche bien caliente".

This part of the Darien Province is currently off limits to mining and mineral exploration. It has been a National Park since 1980 and a UNESCO biosphere reserve since 1983. Apparently it is now visited by eco tourists who pay to be flown into a modernized version of the same camp which Harry

Figure 3. Bedraggled Field Crew Back in Camp
Author Third From Left, Harry Williams Fourth From Left

Williams and his loyal indigenous workers carved out of the jungle back in the early 1970's. Twenty first century visitors to the camp can view and photograph flora and fauna from the comfort of their cabins and short guided excursions. I look fondly back on my experience in this special place under more demanding and primitive conditions before the existence of modern computer and satellite technology. My recollections include slogging through mud, drizzle, and murky jungle canopy day after day on machete-carved grid lines without benefit of GPS or handheld digital data collection devices. We were working in a very different world at that time, pre-Internet and prior to the concept of global resource sustainability. We considered ourselves to be explorers, innovative thinkers, and professionals first, and subordinately as agents to enhance the corporate bottom line. I am fortunate to have spent time in this fascinating place and to have worked with such an interesting and dedicated team of people.

Figure 4. Cana Camp Cook With Dinner

David Brown graduated from New Mexico Institute of Mining and Technology with an MS in Geology. He has specialized in volcanology and economic geology, and has worked in exploration for metallic commodities in southwest USA, Alaska, Mexico, and South America for various companies including Texasulf, Billiton, Newmont, and Lowell Mineral Exploration.

Zoning of the Willow Creek Pluton, Hatcher Pass State Historic Recreation Site, Talkeetna Mountains, Alaska.

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STUDENT ARTICLE

Abstract

The Hatcher Pass Management Area is located in the Talkeetna Mountains 60 miles north of the city of Anchorage, Alaska and includes the Independence Mine State Historic Park. The area has been known for its gold-bearing deposits since the early 1900s and has produced approximately 624,000 ounces of gold. The mining district around Hatcher Pass is historically Alaska's third largest lode-gold producing region and continues to be explored for further mining possibilities. Mother Lode vein-style gold mineralization is largely found in the ca. 72 Ma Willow Creek pluton, which is intruded by a younger (ca. 70 Ma) non-mineralized pluton to the west.

New field-based mapping has subdivided the Willow Creek pluton into four distinct units based on variations in grain size, color index, and mineralogy: the Fish Ridge unit, the Archangel unit, the Gold Bullion unit, and the Independence Mine unit. The spatial relationships between the units suggest that the pluton may be zoned. Our preliminary field work, combined with previous geochronology on the pluton, indicates that the intrusions in the outer margin of the pluton are generally older and more mafic and that intrusions in the center of the pluton are generally younger and more felsic.

Key Words: Willow Creek pluton, Willow Creek mining district, Hatcher Pass Alaska, zoned pluton

Introduction

The Willow Creek mining district is located in southern region of the Talkeetna mountain range in southcentral Alaska, 60 miles north of the city of Anchorage. The Willow Creek mining district ranks as the third largest gold lode mining district in the state of Alaska, producing 624,000 oz. of gold (Harlan et al., 2003). The majority of lode gold is found in quartz veins in the Willow Creek pluton. Pelitic schist to the south of the Willow Creek pluton contains discontinuous gold-bearing veins that are economically insignificant (Harlan et al., 2003). There has been no economic mining of gold in the plutons to the west or east of the Willow Creek pluton. The region is now part of the Hatcher Pass Management Area which includes the Independence Mine State Historic Park. This management area is considered the Willow Creek mining district and there are currently active claims and exploration in the district. The purpose of this study was to map and classify differences within the Willow Creek pluton in an effort to learn more about its intrusive history and attempt to sub-divide the pluton into discrete intrusive units based on variations in composition and texture. Field mapping was conducted over the summer of 2016.

Geologic History

Like much of the state, the southern margin of Alaska is an amalgamation of accreted terranes (Figure 1; Colpron et al., 2007). The Talkeetna Mountains span two of these terranes, Wrangellia and the Peninsular terrane, and the mountains are dominated by the remains of the Jurassic Talkeetna arc (DeBari and Coleman, 1989; Greene et al., 2006; Rioux et al., 2010).

Previous mapping in the Willow Creek mining district has defined three Cretaceous quartz diorite to tonalite plutons and a Cretaceous pelitic schist (Bleick et al., 2012). The Hatcher Pass fault zone separates the Willow Creek pluton and the pelitic schist (Harlan et al., 2003). The Willow Creek pluton is the oldest pluton in the immediate area; U-Pb in zircon ages range from 79.1 ± 1.0 Ma - 72.4 ± 0.4 Ma (Bleick et al., 2012). $^{40}Ar/^{39}Ar$ in hornblende ages range from 72.8 to 70.5 Ma and biotite ages range from 70 to 67.9 Ma (Harlan et al., 2003). Ore mineralization in the Willow Creek pluton post-dates intrusion: $^{40}Ar/^{39}Ar$ dates from sericite associated with the Au mineralization range from 66.9 to 65.6 Ma (Harlan et al., 2003). The pluton east of the Willow Creek pluton is a quartz diorite that commonly contains mafic enclaves and is also known to contain orbicular structures (Ray, 1952). This "eastern" pluton has a single U-Pb in zircon age of 75.8 ± 0.7 Ma (Bleick et al., 2012). The pluton west of the Willow Creek pluton is also a quartz diorite and has a single U-Pb in zircon age of 70.5 ± 0.2 Ma (Bleick et al., 2012).

Unit Descriptions

Mapping during the 2016 field season allowed the delineation of 4 distinct phases within the Willow Creek pluton (Figure 2). These phases were distinguished from each other in the field based on composition, grain size, and texture.

Fish Ridge Unit - Kfr

The Fish Ridge unit (Kfr) is located on the southernmost boundary of the Willow Creek pluton (Figure 2). The unit is in contact with the pelitic schist (Kps) to the south via a fault defined by Bleick et al. (2012). This unit is made of highly altered medium-grained quartz diorite and tonalite and has a color index of up to 30. Hornblende and biotite have been almost completely altered to chlorite (Figure 3). Quartz and plagioclase are white in color, fine grained, and anhedral.

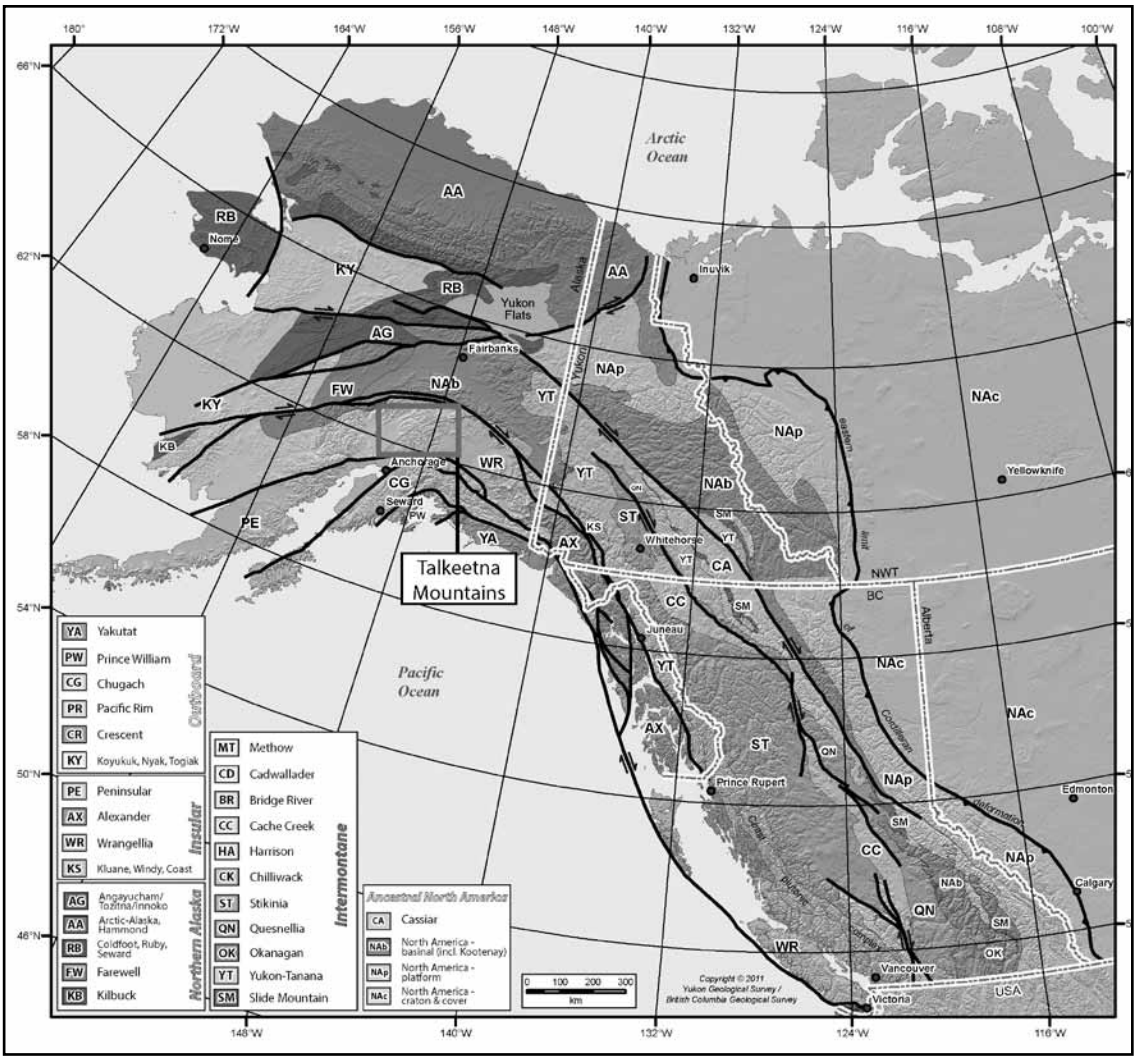

Figure 1: Map of southern edge of North American cordillera showing terrane locations and location of Talkeetna Mountains. Modified from Colpron and Nelson (2011).

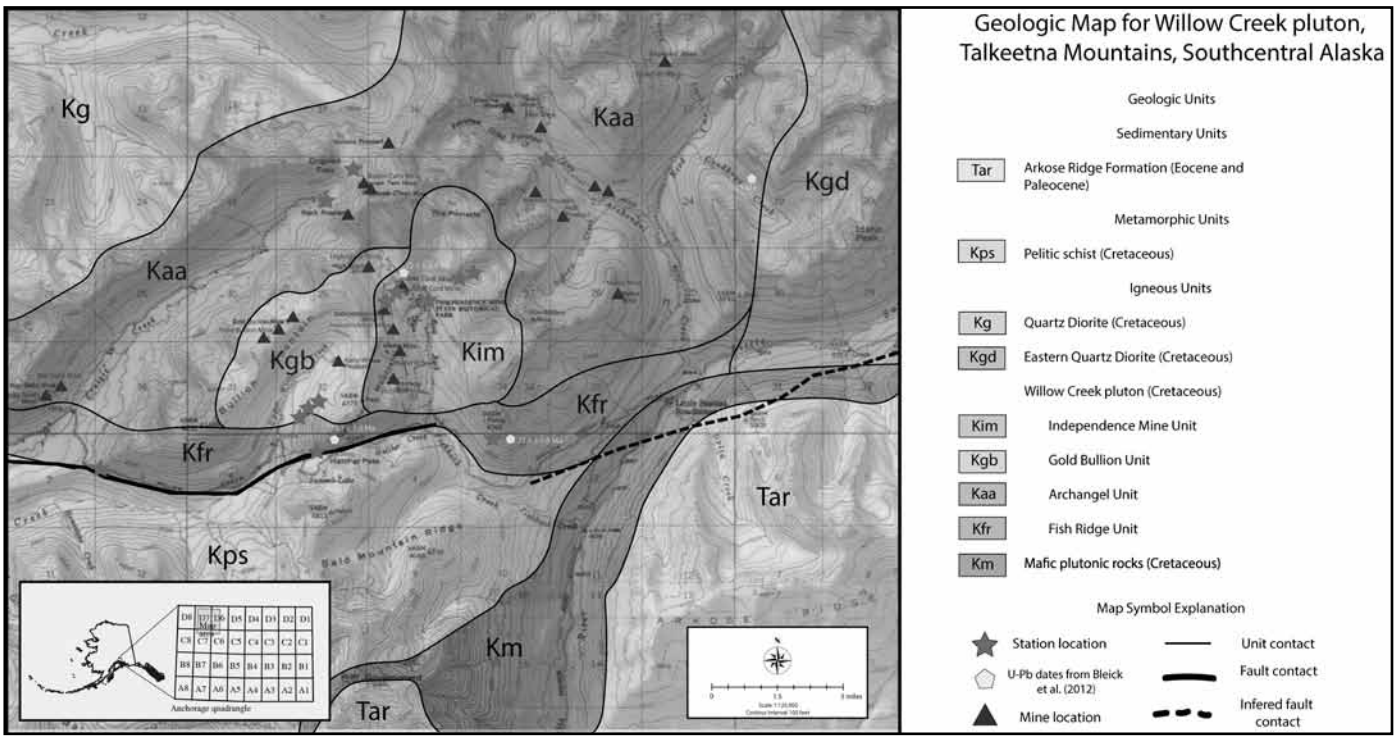

Figure 2: Map of the Willow Creek pluton based on previous research done by Harlan et al. (2003) and Bleick et al (2012) and field work done in the summer of 2016.

Plagioclase is partially altered to sericite. This unit is distinguished from the other units within the pluton by the high level of alteration and may not represent a discrete intrusive phase (see Discussion). This unit also has areas of gneissic texture, likely due to its close proximity to the fault, however this texture is not continuous throughout the unit.

Archangel Unit – Kaa

The Archangel unit (Kaa) is located on the eastern margin of the Willow Creek pluton (Figure 2) and is in intrusive contact with the quartz diorite pluton (Kqd) to the east defined by Bleick et al. (2012). The "eastern" quartz diorite pluton

Figure 3: Outcrop typical of the Fish Ridge zone showing the high degree of alteration of hornblende and biotite to chlorite (green) and plagioclase to sericite (white).

appears to be a younger intrusion into the Archangel unit and the apparent contact between these two bodies is mixed. The Archangel unit is made of medium- to coarse-grained tonalite and quartz diorite and has a color index of up to 30. Fine-grained elongate enclaves with quartz dioritic composition are present throughout and are characteristic of the unit (Figure 4). The largest enclave measured was 10 cm in length. Major minerals are hornblende, quartz, biotite, and plagioclase. Hornblende makes up roughly 60% of the dark minerals and is subhedral to euhedral. Euhedral crystals were measured up to 2 mm long in hand sample. Biotite crystals are subhedral.

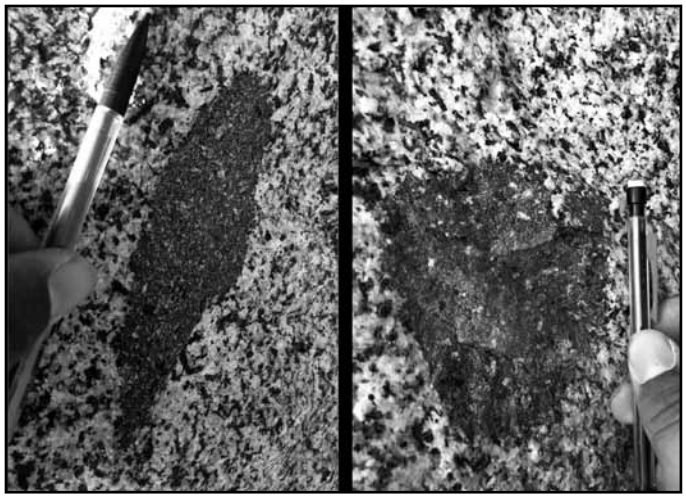

Figure 4: Two examples of enclaves found in the Archangel unit. Both have fine grained hornblende, biotite, quartz, and plagioclase with phenocrysts of euhedral plagioclase.

Quartz grains are clear to white in color and are anhedral. Plagioclase are white and anhedral. Small amounts of iron oxidization can be seen on fresh surfaces.

Gold Bullion Unit – Kgb

The Gold Bullion unit (Kgb) is located on the western half of the mapping area (Figure 2). The unit is made of coarse-grained tonalite and quartz diorite and has a color index of up to 30. The major minerals are biotite, quartz, hornblende, and plagioclase. Hornblende and biotite are present in equal abundance and represent all the dark minerals, both are subhedral to euhedral with the largest crystals being 1-3 mm. Quartz is grey to white in color and anhedral. Plagioclase is white in color and predominantly subhedral. This unit can be distinguished from other units by the presence of large euhedral mafic minerals (Figure 5).

Independence Mine Unit – Kim

The Independence Mine unit (Kim) is located at the center of the Willow Creek pluton (Figure 2). The unit is made of

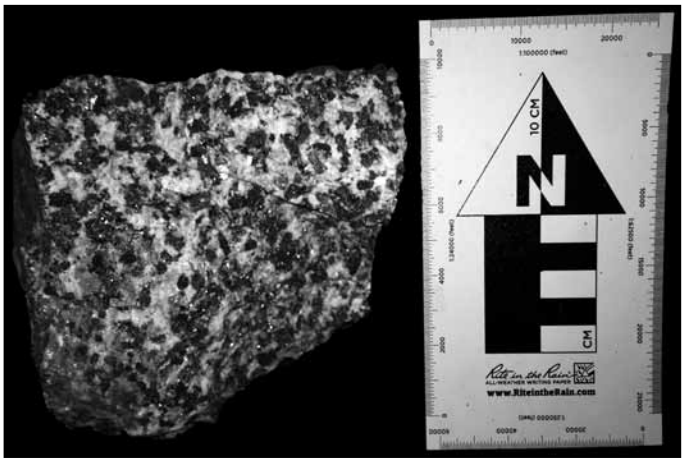

Figure 5: Gold Bullion unit with coarse grained euhedral biotite.

medium-grained tonalite that has a color index of up to 25. Major minerals are biotite, quartz, hornblende, and plagioclase. Biotite makes up roughly 60% of the dark minerals and is subhedral to euhedral. Hornblende is 40% of the dark minerals and is subhedral. Quartz is clear to white in color and anhedral. Plagioclase is white and dominantly subhedral, although some small euhedral crystals are present. This unit is distinguished by presence of euhedral biotite and relatively low color index (Figure 6)

Discussion

Plutons in the Willow Creek mining district post-date the majority of igneous activity in the Talkeetna range by nearly 100 m.y. and therefore are not part of that island arc event. This makes the area unique to the range and raises the question of what Late Cretaceous event these plutons can be associated with. These rocks have been associated with the Alaska Range (Hudson, 1979), but further study is warranted to confirm this connection.

The Tuolumne Intrusive Suite in the Sierra Nevada mountain range of California is a classic example of a zoned pluton. The suite is a quartz diorite on its outer rim and moves progressively more felsic into its center (Bateman, 1992). Additionally,

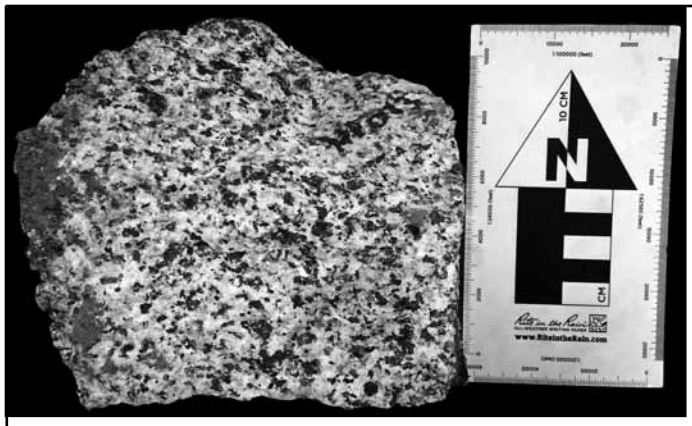

Figure 6: Independence Mine unit. Dark minerals are predominantly euhedral medium grain biotite.

the suite becomes progressively younger towards the center (Coleman et al., 2004). If the Willow Creek pluton is in fact a zoned pluton it would need to have these two characteristics: 1) Progression from more mafic outer rim to more felsic center. 2) Intrusions on the outer rim will be older than intrusions in the center.

Most of our newly-defined units were dated using U-Pb in zircon by Bleick et al. (2012), which offers further insight into the intrusive history of the pluton. The Fish Ridge unit includes two samples dated at 79.1 ± 1.0 Ma and 77.8 ± 0.8 Ma (Bleick et al., 2012). The discrepancy in these ages suggests that the Fish Ridge unit may contain more than one intrusive phase, however the deformation characteristic of this unit makes it difficult to map. The Archangel unit has one date from eastern margin at 76.1 ± 0.9 Ma (Bleick et al., 2012). There are no U-Pb dates from the Gold Bullion unit. The Independence Mine unit has one sample dated at 72.5 ± 0.4 Ma (Bleick et al., 2012). These dates support the idea that the Willow Creek pluton may be zoned; preliminary mapping and existing geochronology suggests that the Willow Creek pluton has a more felsic, younger interior, although it does not appear that the zoning follows a simple pattern. We find no correlation between our map units and mineralization within the Willow Creek pluton, which is expected since mineralization is believed to post-date intrusion of the pluton (Harlan et al., 2003). There also seemed to be little to no occurrence of mineralization in the neighboring plutons to the east and west.

Our mapping and existing geochronology suggest that the "eastern" quartz diorite pluton (the pluton east of the Willow Creek pluton) may be a part of the Willow Creek pluton (Figure 2). Previous work separated the two intrusions based on the abundance of mafic enclaves in the "eastern" quartz diorite pluton (Bleick et al., 2012). Our findings showed a similar abundance of enclaves throughout the Archangel unit in the Willow Creek pluton. Outcrops near the mapped contact between these two intrusions show a large variation in color index, texture, and grain size, as well as structures suggestive of magma mixing (Figure 7). The single U-Pb date from the "eastern" pluton (75.8 ± 0.7 Ma; Bleick et al., 2012) falls within the range of ages for the Willow Creek pluton (79.1 ± 1.0 Ma -72.4 ± 0.4 Ma-; Bleick et al., 2012). One major difference between the two units is the absence of any major mineralization found in the "eastern" quartz diorite pluton. Further study is warranted to investigate the connection between these intrusions and mineralization.

Figure 7: Evidence for mixing between the "eastern" pluton and the Archangel unit.

Future Research

Future work focusing on mapping, particularly along the eastern and western contacts, the interior, and in the northern region of the pluton would offer more insight into the zoned nature of the pluton. In addition, whole rock geochemistry and more detailed geochronology would allow a deeper understanding of the magmatic history.

Conclusion

The Willow Creek pluton is a Late Cretaceous intrusion that can be divided into four different units based on minerology: the Fish Ridge unit, the Archangel unit, the Gold Bullion unit, and the Independence Mine unit. These units represent a minimum of four intrusive episodes in the pluton. Field relations and geochronology by Bleick et al. (2012) indicate that the outer rim of the pluton is relatively older than the center. The pluton also transitions compositionally from an intermediate rim to a more felsic at center, roughly following the pattern of a zoned pluton (e.g., the Tuolumne Intrusive Suite; Bateman and Chappell, 1979). However, further mapping and analyses are necessary to understand the pattern of this zoning.

Acknowledgements

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Mine State Historical Park. Field assistance was provided by Tina Westfall, Gabby Bejarano, Fred Transburg, and Rachel Carraway. Brittany Meagher provided assistance with ArcGIS and Adobe Photoshop.

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INTRAW scenario workshop: the world of raw materials in 2050

PRESS RELEASE | BRUSSELS | DECEMBER 2016 – In the framework of the first *EU raw materials week*, the INTRAW project consortium organized, on 30 November 2016, a scenario workshop in Brussels where three scenarios describing the world of raw materials in 2050 were discussed.

The EU-funded INTRAW project was launched in early 2015 with the aim of mapping best practices and boosting cooperation opportunities related to raw materials between the EU and five technologically advanced non-EU countries (Australia, Canada, Japan, South Africa and the United States).

In a truly cooperative approach, the INTRAW project has recently developed three scenarios that describe the world of raw materials in 2050. After having elaborated the scenarios in a series of workshops run by the European participants of the project consortium in mid-2016, the current version of the scenarios was discussed in Brussels with more than 30 participants during the *EU Raw Materials Week* that took place in Brussels from 28 November to 2 December 2016. Participants from various nationalities and backgrounds – including researchers, policy-makers, and raw materials practitioners – had the opportunity to learn more about the scenarios, to provide their perspectives and to discuss the plausibility of alternate futures.

Given the current uncertainties that global politics have to deal with, scenarios are an excellent means to prepare for the future and to safeguard against developments that are not desirable, but yet still plausible. The workshop results will help to refine the scenario story lines and to make them more robust. The final scenarios, named "*Unlimited Trade", "Sustainability Alliance" and "National Walls"*, will be available through the INTRAW website in early 2017.

The workshop was also an excellent opportunity to raise awareness for the launch of the *International Observatory for Raw Materials* which is foreseen for 2017/2018. The Observatory will be a permanent international body that will remain operational after the end of the project aiming at the establishment and maintenance of strong long-term relationships with the world's key players in raw materials technology and scientific developments.

Service to Others

Charles Dimmick, CPG-03886

Every summer from 1946 through 1952 I attended a YMCA camp in the mountains of northwestern New Jersey. Either written upon or carved into the mantle over the very large fireplace in the middle of one side of the main lodge was this inscription "We are born not for ourselves but to help others". Seeing this message every day for two or three weeks every summer, the words became embedded in my mind, and I have never forgotten them.

Putting this message into practice is not always easy. Sure, it is no problem if you assume that all you have to do is be nice to those people around you that you like anyway, but what about people who you don't like, or who don't like you, or who do things that you find to be hateful or disgusting? The Golden Rule says we should do unto others as we would that they should do to us. It doesn't say we should do unto others only if we like them. And don't forget the other version of the Golden Rule: Do not do unto others what you don't want them to do to you. And in scripture we find clear instructions about this. We are told "You have heard that it was said, 'Love your neighbor and hate your enemy. I tell you, love your enemies and pray for those who persecute you."

There must be some good in every person if only we would make an effort to find it. And yes, sometimes it is a real effort. E.W. Hoch*, about 100 years ago, said:

> "There is so much good in the worst of us,
>
> And so much bad in the best of us,
>
> That it hardly behooves any of us
>
> To talk about the rest of us."

But we need to go beyond talk, and seek to find and serve the good in even the worst of us. This will not be easy, and often we will fail, and find ourselves confessing "we have left undone those things we ought to have done, and we have done those things we ought not to have done". Nevertheless let us continue to strive to seek good in all persons.

Finally, it turns out that there is a reward for us in doing this. Several studies have shown that being kind and helpful to others has benefits for our own mental and physical health, whereas being mean and selfish may contribute to unhealthy conditions for us.

*Editor's Note: Newspaper owner and Governor of Kansas, 1905-1909

Charles Dimmick CPG-3886 was awarded Honorary Membership in AIPG in 2003. He has degrees from Colorado School of Mines and University of Florida, and a Ph. D. from Tulane. He retired from Central Connecticut State University as full Professor of Geology in 2005, and from his hydrogeological consulting business in 2012. Charles was extremely active in AIPG, both in the Northeast Section and in National, having served as Editor in 1993-1994. During his term AIPG published its "A Citizen's Guide to Geological Hazards." Charles has been very active in community service throughout his career; he continues to serve as vice-chair of the Cheshire Inland Wetlands Agency, starting his 44th year with the agency, and is also treasurer for the Connecticut Association of Conservation and Wetland Commissions. This short article summarizes, for those entering the profession as well as those already in it, his belief in the importance of service to others.

Fundamentals of Professional Ethics: Elements and Examples

Live Webinar - March 28, 2017 @ 1:00pm Eastern Time (1 hour)

Presenter:

David M. Abbott, Jr., AIPG Certified Professional Geologist 4570

Everyone is in favor of good moral and professional ethical behavior but few have thought about them rigorously. What constitutes common morality and professional ethics? This webinar will explore the basic concepts and definitions of and the differences between common morality and professional ethics. This includes the distinction between moral rules and moral ideals. What steps are used to determine the legitimate basis for an allowable violation of a moral or ethical rule? What is the relationship between ethical behavior and integrity? Case histories will illustrate the concepts presented and the methodology of ethical analysis.

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- $20 for Students

Register online

Ethics Biography

This short course is offered by David M. Abbott, Jr. Mr. Abbott's first paper on professional geoscience ethics was published in 1989. Since then, he has presented many papers and talks on the subject. Beginning in November 1995, Mr. Abbott began compiling a column, "Professional Ethics & Practices," for the AIPG's magazine, The Professional Geologist, and the column has appeared in each issue since. Mr. Abbott serves as the Chairman of AIPG's Ethics Committee, which is responsible for inquiring into allegations of ethical misconduct by AIPG members and, when appropriate, prosecuting cases charging violations of AIPG's Code of Ethics. Mr. Abbott is also a member of the Australasian Institute of Mining and Metallurgy's Ethics Committee.

Mr. Abbott holds an AB in Earth Science from Dartmouth College and an MS in geology from the Colorado School of Mines. He spent 21 years as a geologist for the US Securities and Exchange Commission in Denver assisting natural resources entities to comply with the SEC's disclosure requirements and investigating and assisting in the prosecution of mining and oil and gas frauds. Since 1996 he has been an independent consultant specializing in natural resource disclosure issues, resource and reserve classifications and their application to specific deposits, and professional geoscience ethics. He is a Certified Professional Geologist by AIPG, is a Chartered Geologist by the Australasian Institute of Mining and Metallurgy and the Geological Society of London, holds the European Geologist title, and is licensed as a Professional Geologist by Texas, Utah, and Wyoming.

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What We Do and Why.

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

I moved to Denver in June, 2016. I've grown to appreciate the beauty of the Front Range, the diversity of the city, both in terms of its architecture and its populace and the broad array of opportunities the City has to offer. Being new to the area, I meet many new people and without fail we end up talking about families, hobbies, and our careers.

As I've visited with people in my neighborhood and beyond I've been struck by the degree to which people don't understand what it is that geologists do. When I mention that I'm a geologist, the responses fall into three categories: 1. 'Oh, so you look for oil?' (This statement often is followed by a disapproving grimace and loaded question about hydraulic fracturing); 2. 'I bet you have a big rock collection!' (I do, but that's beside the point); and, 3. *Puzzled look* followed by, "Oh, that must be interesting." I've come to realize that even though Denver is a great place for geologists, the vast majority of people with whom I come in contact don't really know what geologists DO. They don't realize that geologists are critical to providing the clean water they use every day. They are unaware that in addition to fossil fuels and coal, geologists provide crucial expertise with respect to finding and procuring the mineral resources that are necessary to provide the technology we take for granted every day. Most don't realize that geologists play an important role in remediating environmental issues, in predicting and mitigating natural hazards, or in working with city planners and developers to predict and minimize impacts related to new urban and suburban development. In most cases the conversation becomes a chance to enlighten my new friends and neighbors; the conversation becomes an impromptu outreach opportunity. Generally, I am able to learn a little bit about the kinds of concerns my neighbors have, and my new friends learn that the landscape they love depends on the underlying geology and also that society as we see it today, couldn't exist without geologists.

You may wonder why this is relevant to professional geologists. The reason is simple: numerous studies (e.g. Carson, 2013; Gibson et al., 2014; Gibson, 2015) indicate that most non-scientists have little understanding of geology and the role geologists play in today's increasingly technological society. This means that in addition to our friends and neighbors, our elected officials and many of our policy makers are not well versed with respect to the geosciences.

The upshot is that outreach is critical. Indeed, since 2005, agencies that provide research grants have encouraged recipients to devise ways for their research to engage wider audiences (Andrews et al., 2016). These 'broader impact statements' have become a key component of academic research in the sciences. However, a similar enticement does not exist for the professional geologist. This fact is of concern because professional geologists are uniquely qualified to bring geology to others. Professional geologists can provide a window into the skills and technology that are utilized to provide potable water to large populations, or to reconstruct habitat for game birds, or to procure mineral resources. Student members are especially adept at reaching out to K-12 students and teachers. Students, we need your efforts too.

Ultimately, outreach opens a dialog between people who may seem at first to be on opposite sides of an issue. My experience with geologists has been that we love the outdoors too, that we value our world, and that we work diligently to minimize impacts whenever we can. When we engage the public, we are able to show them that our values aren't THAT different from theirs. We can find common ground and provide clarity on a broad range of potentially difficult issues.

To that end, AIPG is engaging in two important efforts. First, AIPG has proposed a session titled "Public Perception of the Geosciences" at the 2018 Resources for Future Generations Conference, organized by the Canadian Institute of Mining, Metallurgy, and Petroleum, the Geological Association of Canada, and the Mineralogical Association of Canada. I hope that this session will provide insight into public perception and allow us to refine our efforts to reach out at all levels, from the elementary school classroom to the halls of congress or parliament. Second, our staff at the National Office is working to provide a session that focuses on outreach at the National Meeting in Nashville this September. This effort is in the conceptual stage. If any of you would like to be involved, please contact the National Office. Watch the AIPG e-news for more information as we move forward with planning.

I hope the rest of winter is gentle, and I wish each of you a verdant spring.

Best regards,

Aaron

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Diverse Articles by and For Students.

John L. Berry, CPG-4032

It is with great trepidation and also a great deal of anticipation that I look forward to being your TPG Editor for the next year: trepidation because it is a great responsibility for a great organization, and anticipation because I hope to learn much more about AIPG, about you, our members, and what you expect from TPG. I also want to thank Jean Patota, your retiring editor, for all the help and advice she has given to me during the transition: she has been a pillar of strength and a fount of good advice. Thank you, Jean!

Let me introduce myself: I have been a member of AIPG since about 1978 (my CPGS certificate was issued by "The Association of Professional Geological Scientists" – who remembers that era?). I joined because I had been, for a couple of years, an independent consultant, and I had run into a couple of situations that had made me aware that I might, at some point in my career, need access to ethical advice and, perhaps, support. I was also much concerned, at that time in my life, about both the poor reputation that some prospectors (who called themselves geologists) had given to the profession, and about the powerlessness of geologists in the industry vis-á-vis engineers and others: only chemists had a lower status! However, even though I have been an Associate Editor of TPG for a long time, this is the first time that I have ever held office in the Institute: I have tended to focus my energies on my local geological societies. Therefore, TPG has been very important to me: it has been my only regular contact with AIPG, and I have been an avid reader, particularly of David Abbott's ethics columns.

I trained as a geologist, oceanographer and geophysicist at the University of Pennsylvania and at Columbia. I have had a very varied and satisfying career doing mineral exploration on four continents and hydrocarbon exploration on every continent (except Antarctica) and in every ocean, as well as more academic work in the Arctic Ocean, on chemical weathering in the southeastern USA, on the structure and tectonics of western China, and on various remote sensing techniques. I taught environmental science for a couple of years at a technical institute in western North Carolina. In 1999 I became an independent remote sensing consultant but am now semi-retired. Since leaving the corporate world I have also been an avid intercontinental cyclist and a woodcarver: a background in structural geology, always thinking in 4-D, is good preparation for making sculptures out of wood! I hope this diverse background gives me the breadth of experience necessary to select content for TPG that will appeal to everyone.

My ambition is for TPG to be the go-to place for useful information on the practice of geology, on the status of geology as a profession, and on the ethical quandaries that we sometimes find ourselves facing, as well as a place for conversation on the issues we face and future opportunities for the profession. I hope, particularly, that young people entering the profession will find, through TPG and through AIPG, information and support that will enhance their careers and lead them to new opportunities. Please, if you have had interesting, exciting, or learning moments in your career that would thrill your colleagues, make them laugh, or help them in their career or business, take up your pen and submit an article or a brief note: it's not fair to keep all the good stuff to yourself!

This particular number is the annual Student Edition of TPG. We include student articles on a new way of teaching introductory geology courses that is being tried at Wayne State University, and on some interesting carbonate rocks in the foothills of the Himalayas. This work demonstrates the use of fossils - in this case giant foraminifera – and textures to determine the changes in water depth and environment of deposition during a relatively short time interval. We also have a student's reactions to her first state Geological Society field trip, and to giving her first professional paper at a meeting, as well as a delightful poem about the southern Appalachian mountains. Two papers from students at West Point are quite groundbreaking, one in its use of mathematical modeling to describe some complicated groundwater flow situations, and the other in its approach to collection of comprehensive data on dam failures, so that safety analyses may be better founded. The final student paper describes the petrologic evolution of a gold-mineralized pluton near Anchorage, Alaska: it makes me jealous just to read about the field work!

Jeff Frederick recounts a rather spectacular adventure in the High Cascades, and another describing an adventure in the Darien Gap, an area that is now inaccessible. Not every geologist is a mountain climber, but many of us have had other types of thrilling experiences and it is often the prospect of these adventures that draws us to the profession. Students will be reassured by two papers that are concerned with various aspects of risk and safety, as well as how to avoid accidents and how to insure against them. Safety on the job has come a long way since my early days in the mining industry, now 50 years in the past, and it is indeed a good thing that it has. Charles Dimmick, and the Letters to the Editor remind us that idealism and service to the public are among the things that motivated many of us as students.

I encourage you to send your suggestions for content, your ideas for improvement of TPG, and your criticisms, to me through Head Office (aipg@aipg.org) or at jlbassoc@flash.net. This is especially important if, for you as it was for decades for me, TPG is your main or only contact with your organization, AIPG. We need to know what you want and expect from your Institute and from your magazine!

Answers on Page 30

Robert G. Font, CPG-03953
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1. Two of the main landmarks on the island of St. Lucia in the Lesser Antilles are the "Gros Piton" and the "Petit Piton." These constitute erosional remnants of impressive lava domes consisting of "dacite." Which of the following statements best describes this rock?
   a) "Dacite" is the volcanic counterpart to "diorite."
   b) In "dacite", "orthoclase" feldspar generally dominates over "plagioclase" feldspar.
   c) "Dacite" is intermediate in composition between "rhyolite" and "andesite."
   d) What in the world is a "Piton"?

2. In the metamorphic process, chemical reactions may result in "decarbonation" where the rock or mineral loses carbon. For example:

   $CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$

   For the above reaction, on the right side of the chemical equation, what mineral compound is formed along with the carbon dioxide?
   a) "Diopside."
   b) "Wollastonite"
   c) "Spodumene."

3. Which igneous pluton is typically lenticular or funnel-shaped with a depressed center and generally concordant with the intruded strata?
   a) Laccolith
   b) Sill
   c) Lopolith

4. The minerals "nepheline" ($NaAlSiO_4$) and 'leucite ($KAlSi_2O_6$):
   a) Structurally belong to the "tectosilicates."
   b) Are very resistant to acids.
   c) Belong to the feldspars family.
   d) Man! And I called myself a mineralogist!

5. Consider a hypothetical mining operation where 50,000 pounds of subbituminous coal must be brought up from the bottom of a railroad car to the top of a storage bin located 20 feet above the bottom of the car. If a ten-horsepower engine is available to do the task, how long would the process take? Please recall that "work" (W) is force times displacement (F * d), "power" (P) is the time rate of doing work (P = W/t) and that one "horsepower" (hp) is equivalent to 550 foot-pounds per second (550 ft-lb/sec).
   a) 9.09 minutes
   b) 6.06 minutes
   c) 3.03 minutes
   d) I don't mine coal, so this does not apply to me. Ha, ha! None of this "high math" for me, dude!

Adding Value - Spreading the Word.

Adam Heft CPG-10265
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Greetings to all AIPG members! I hope that everyone had a happy, healthy, and prosperous 2016 and that your 2017 will be even better. I'd like to thank everyone again for the privilege to serve as your National President this year. I am honored and looking forward to advancing the Institute's mission and working with the other members of the National Executive Committee and Headquarters staff to provide increased value to all of our members.

As an example, this is where we have started to provide additional value this year. One of the agenda items that was discussed and approved at the first Executive Committee meeting on January 21st was the change to increase the length of time an individual can qualify as a Young Professional from the current three years to five years. This will encourage those individuals to remain as members while they gain the experience necessary to become members and eventually, CPGs.

We are always striving to add value to our members and will continue to do so in the future. AIPG would be an empty shell without our members and ensuring that we are providing value is critical to our very existence. As we continue to move the organization forward, this is a key function. The National Executive Committee has worked on identifying ways to provide value to our members for several years, and this remains a priority for the future. Each of our members are an important part of AIPG, and the Executive Committee values you and what you have to offer.

As an organization of professionals, we need to get the word out to the public and the government about why geologists are important. Most people have no idea what it is that geologists do and how we contribute to society. We need to educate those individuals about our vital roles in the responsible development and management of our precious natural resources, including minerals, energy, and water. As AIPG professionals, we represent our profession and conduct ourselves with ethics and integrity, which is something that appears to be in short supply in today's society.

We live in a time of change in today's world, where science in general is being questioned or ignored in policy decisions and general issues facing the public. As professionals, we have an obligation to tell the public and policy makers why geologists are important and why they need to be consulted. We need to be united and speak with one voice about this; we need to get this information out there. More than anyone else, we hold the keys to knowledge of the history of the earth. We know how its processes work and how those processes affect us all. When professional geologists have not been consulted, there have been serious consequences that have affected the lives and property of our nation's citizens.

As professionals, we have the ability and the responsibility to make a difference in our states, our country, and the world. There are many ways to do this, but the first step is to become involved and active. The first steps are always the most difficult, but they can be taken if our will to do so is strong. We can start small in different areas and build on those first steps to have a big impact. I challenge each of you to take that first step and join us in this endeavor.

Remember, *communication is key*. Not just within our organization, but outside it as well. Let's truly make AIPG the voice of the profession!

AIPG Membership Benefits Include:

- Career Center
- Liability Insurance
- GeoCare: Medical, Term Life, Disability Income, Dental, Cancer Expense, Auto, Home, and Supplemental Plans
- Annual Convention
- Active Sections/Chapters
- CPGs are preferred in cases where expert testimony is needed.
- CPGs are considered "competent or qualified persons" in the US and several international locations for preparing important mining documents, including with the SEC, Canada and Australia.
- A CPG is also a credential recognized internationally by Geoscientists Canada, the European Federation of Geologists and the Geological Society of London, where it is considered equal to a Chartered Geologist.

For full list of AIPG Membership Benefits:
http://aipg.org/benefits

Answers:

1. The answer is choice "c" or ["Dacite" is intermediate in composition between "rhyolite" and "andesite"]. "Dacite is the volcanic counterpart of "granodiorite." Typically, it is gray and porphyritic in texture. Its mineral composition includes an abundance of "plagioclase" feldspar, along with amphibole, pyroxene and quartz.

   Choice "a" best describes the "andesite" as the volcanic counterpart to "diorite."

   Choice "b" could describe rocks such as "rhyolite" and "trachyte" rather than "dacite."

   By the way, in French, "piton" may refer to a "mountain peak."

2. The answer is choice "b" or "wollastonite." "Wollastonite" ($CaSiO_3$) is a calcium silicate that occurs mainly as a contact metamorphic mineral in crystalline limestone.

   Choice "a" constitutes "diopside" ([$CaMg((Si_2O_6)$] which is a calcium-magnesium pyroxene that is also found as a contact metamorphic mineral in crystalline limestone.

   Choice "c" or "spodumene" [$LiAl(Si_2O_6)$] is a lithium aluminum silicate that may be found in very large crystals in pegmatite dikes.

3. The answer is choice "c" or "lopolith."

   Choice "a" or "laccolith" is also a concordant pluton, but with a flat floor and a rounded roof that has pushed overlying sediments into a dome.

   Choice "b" or "sill" describes another concordant pluton, but tabular (rather than massive) and generally close to horizontal.

4. The answer is choice "a" [Structurally belong to the "tectosilicates].

   These minerals, along with "cancrinite", "sodalite" and "analcite" are "feldspathoids." "Feldspathoids" are readily attacked by acids. They appear in place of feldspars in magmas that are alkali-rich and deficient in silica.

5. The answer is choice "c" or "3.03 minutes." The proof follows:

   We are given:

   $F = W * d$ (1)

   $P = W/t$ (2)

   1 hp = 550 ft-lb/sec (3)

   The "work" done in lifting the coal is:

   $W = F * d = 50{,}000 * 20 = 1{,}000{,}000$ ft-lb (4)

   Based on (3), a 10 horsepower engine can do, in 1 second, "work" of:

   10 * 550 ft-lb = 5,500 ft-lb (5)

   Substituting (4) and (5) into (2) and solving for time (t):

   $t = W/P$ = 1,000,000 ft-lb / 5,500 ft-lb/sec

   t = 181.82 sec = 3.03 minutes (6)

Member in the News

James A. Jacobs of California recognized for contributions to increasing understanding of groundwater

(WESTERVILLE, OH — November 3, 2016) James A. Jacobs, PG, CHG, CPG, CPetG, is among the first five to receive the National Ground Water Association's new Fellow designation in recognition of outstanding credentials, professional accomplishments, and commitment to promoting the increased understanding of groundwater science and water well system technology.

Jacobs is with the Clearwater Group in Pt. Richmond, California.

"James A. Jacobs has a career of substantial achievement within the geologic and hydrologic industries, academic environment, and political tapestry," stated nominator Stephen J. Baker of Operation Unite, Nevada City, California. "His achievements are represented in many venues including sharing knowledge and contributions through outreach activities, technical publications, leadership roles in groundwater associations, and elected positions."

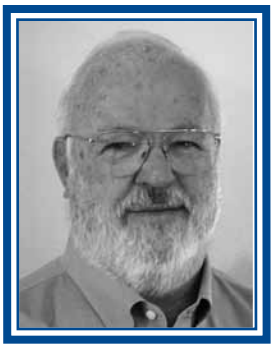
Among Jacobs' many groundwater industry accomplishments are:

- Winning four Fulbright senior specialist grants in environmental engineering and sciences; his tours helped to support undergraduate and postgraduate students in Jamaica, Israel, and India
- Developing, coauthoring, and editing four technical books on environmental topics
- Writing more than 100 technical articles on hydrogeology, groundwater treatment, and environmental issues
- Delivering key lectures to the general public through European, Caribbean, Central American, Alaskan, and Hawaiian cruises
- Mentoring geology students by giving talks in local K-12 schools, judging the California State Science Fair junior and senior geology sections, and developing programs sponsored by the American Institute of Professional Geologists for the University of California, Davis, and other college campuses.

"All of these outreach platforms have accelerated public awareness of groundwater quality and quantity issues," continued Baker.

The NGWA Fellow designation will be presented to Jacobs during NGWA's 2016 Groundwater Week December 6-8 in Las Vegas, Nevada.

NGWA, the leading worldwide advocate for professionals teaming to provide, protect, manage, and remediate groundwater, conveniently and promptly delivers an extensive range of resources contributing to member success through relationships, leading edge and emerging practices, and credible new ideas and solutions.



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

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

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Transitioning from Student to Young Professional Status

Student members have been an increasing percentage of total AIPG membership since 1998 and currently comprise 38% of the total membership, as shown in Figure 1.[1] The next step in AIPG membership is the Young Professional (YP) category. While YP membership has increased each year since 2011 and stands at 83 members, this is only 1.15% of total AIPG membership (includes student and associates) and 2% of the CPG and Professional membership. More than 83 Student members graduate each year with the degree they will use to enter the geoscience profession but they are not converting to YP status. There are probably several reasons for this conversion failure but a main one is that YPs pay dues and Students do not. A related reason is that it often takes the recent graduate a period of time to land a professional position.

AIPG is currently undertaking a review of its Bylaws, one of those things that is periodically needed. I'm heading this effort. One of the potential changes is to create a Transitional membership category, possibly with reduced dues, that allows recent graduates to maintain AIPG membership as they are transitioning into the geoscience workforce. Do you support this idea? What should be the requirements? For example, should it only cover the period from graduation to the beginning of a geoscience job, or should it cover a longer period?

Alternatively, should Student membership include a grace period—perhaps 6 months—before transfer to YP status? Given that most students graduate in June, this grace period would allow Student member status to continue until the beginning of the new year. AIPG membership can commence at any time but once begun, runs on a calendar year basis. Therefore, Student member status that was renewed in the fall will "begin" on January 1st and can potentially run for the full year, which essentially grants a 6-month grace period. However, at the individual's choice, a Student member can upgrade to YP status shortly after a June graduation. In either case, the individual would be billed for a full year of YP membership in the fall dues billing cycle; that full year beginning in January. This 6-month grace period is effectively now with no changes required other than applying for YP status at the beginning of the year.

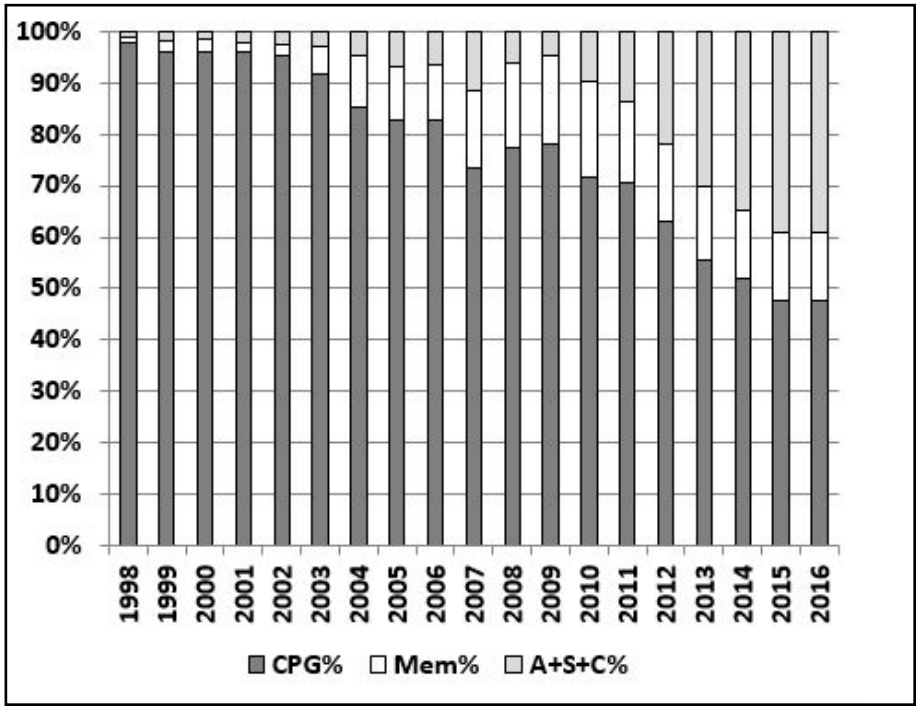


Figure 1. Percentage of AIPG's membership groups from 1998 through May 2016. CPG are Certified Professional Geologists, Mem are Professional and Young Professional members, and A+S+C are associates, students, and corporate members.

Should Transitional status be permitted more than once? For example, Maggie Boos receives her BS degree and enters Transitional status for 9 months prior to getting her first professional geoscience job and applies for YP status.[2] Three years later, Ms. Boos returns to school for her PhD and returns to Student membership status. Following receipt of her PhD, should Ms. Boos be able to re-enter transitional status while seeking a geoscience position? Should there be a limit to the number of months allowed for Transitional status? If so, what should the limit be?

1. I've been compiling AIPG membership statistics for several years. The data are taken from the May issue of the TPG each year. The A+S+C category is essentially student members; there were 2,782 student members, 45 associate members, and no corporate members as of May 2016.
2. The fictional Maggie Boos is named in honor of Margaret Fuller Boos, who attended AIPG's organizational meeting and was a Charter Member as CPG-711.

A related question was asked by some of our younger members at the Annual Meeting in Santa Fe. Why is the Young Professional category limited to 3 years when most of the states which license geoscientists require 5 years of experience?[3] Should the YP category be made available for 5 years (or 60 months)? As with the Transitional category, should one be able to break one's total YP time into different groups separated by a return to school for an advanced degree?

Should there be different status for mid-career Professional Members and CPGs who become unemployed as a result of one of the periodic industry downturns? Affording dues can be an issue for these mid-career professionals. Should a reduction in dues be available? I would very much appreciate receiving your thoughts on these questions.

Harassment, Discrimination, and Bias

The Joint AGI/GSA Affiliated Societies meeting at the GSA Annual Meeting in Denver on September 26th focused on harassment in the geosciences. Although close relationship to the prohibited forms of discrimination and bias was acknowledged, "harassment" was defined as:[4]

> Harassment due to a person's sexual identity, gender, race, or other protected class, consists of a single intense and severe act or of multiple persistent or pervasive acts which are unwanted, unwelcome, demeaning, abusive, offensive, and/or create a hostile professional or workplace environment. These acts may include epithets, slurs, or negative stereotyping; threatening, intimidating, or hostile acts; denigrating jokes and display or circulation of written or graphic material that denigrates or shows hostility or aversion toward an individual or group identity. Sexual harassment, in addition, may include any unwanted and/or unwelcome sexual solicitation, physical advance, or verbal or non-verbal conduct that is sexual in nature.

The focus of this meeting reflects a continuing number of incidents of harassment, discrimination, and bias in the geosciences. The problem is particularly troubling at some field camps but exists in a variety of other ways. A fundamental solution to these problems will come when sufficient numbers of people will speak out about incidences of harassment, discrimination, and bias when they occur. By "people" I specifically include those who witness the harassing, discriminatory, or biased act, not just the victim of the act. It may be that the offensive nature of a particular act or statement by the perpetrator is not fully recognized until the act or statement is challenged by witnesses of the act. In such cases, the challenge may lead to revised behavior, the desired goal. [5]

Explicit statements opposing harassment, discrimination, and bias in societies' codes of ethics are also recommended. Such explicit statements are lacking from AIPG's Code of Ethics although they fall under the provisions of Canon 4, "Obligations to Professional Colleagues: Members should respect the rights, interests, and contributions of their professional colleagues." And Standard 4.1, "Members should respect and acknowledge the professional status and contributions of their colleagues." Suggested amendments to the Code of Ethics on this issue are welcomed and will be considered.

The Joint AGI/GSA Affiliated Societies meeting proposed draft principles that state,

> *We oppose discrimination in scientific learning and practice based on factors such as ethnic origin, race, religion, citizenship, language, political or other opinion, sex, gender identity, sexual orientation, disability, age, or economic class. Discrimination and harassment reduces the quality, integrity, and pace of the advancement of science by marginalizing individuals and communities. We affirm that harassment in any scientific setting is unacceptable.*

The European Federation of Geologists (EFG) updated its Code of Ethics on December 6, 2016 to include the following statement:

> *A respectful and fruitful working environment is fundamental for maintaining a high level of professionalism. Therefore, discrimination or harassment, either sexual or of any other kind, is unacceptable because it offends the dignity of persons and seriously undermines the atmosphere of trust essential to the work of all geologists. Such actions should be denounced immediately to authorities. It is unprofessional and unethical to condone any kind of discrimination or harassment or to disregard complaints of harassment from colleagues or staff.*

I prefer the tone of the EFG's statement. I believe that either of the two statements above, or something very similar, could be added as a new Standard under Canon 4 or as a revision and amplification of Standard 4.1. Which do you prefer? Should a definition of harassment, like the one quoted at the beginning of this topic, be included as well, perhaps as a footnote. Please let me know your thoughts on this proposal.

In addition, I believe that publication of case histories may be the most effective way of illustrating the ways in which harassment, discrimination, or bias occur and solutions to the problem. Nancy Price's "Field Safety—Revisited" Student's Voice column in the May/Jun '08 *TPG* provides some examples related to field safety. Price notes that her initial reflections on the topic responded to the murder of Alyssa Herberton-Morimoto, a graduate student doing field mapping in Colorado.[6] Reflections on this murder may start along the lines of "should women be alone in the field?" But those reflections should quickly move beyond the gender-related "women alone" to the gender independent, "doing field

3. *According to the State Matrix of November 2014 on www.asbog.org, the required post-BA/BS work experience for licensure is 4 years in the ASBOG model bill, is commonly 5 years, and varies from 3 years for Missouri to 7 years for Arkansas and Maine.*
4. *Based on the definition of the American Sociological Association.*
5. *It is argued that requiring the direct victim to report the harassment, discrimination, or bias constitutes re-victimization. Clearly, the reporting of serious cases can be traumatic, but the right of the accused to face the accuser is a fundamental part of our legal system. The victim of a robbery can feel very traumatized both at the time and at the trial of the robber, but the victim's testimony is usually required. The focus of the September 26th meeting was on the actions that could be taken by witnesses, not the direct victim.*
6. *While murder differs from other types of assault or harassment, this doesn't detract from the general discussion of all types of unwarranted behavior and potential solutions thereto. Also, "harassment" covers a wider range of unwarranted behavior than the subset of sexual harassment.*

work alone." Early in my career, I spent many days working alone in the Colorado mountains conducting EM and magnetic surveys. I never had any accidents but if I had, things could have gotten serious quickly. My "lifeline" was an end-of-day phone call to my boss that if not made, could trigger a call to a county sheriff's office.[7] Sending two people into the field together increases the cost in terms of billable hours and expenses. But safety should demand this as a standard practice.

I would appreciate receiving anecdotes relating to this topic that can help sensitize all of us to the present and persistent problems of harassment, discrimination, bias, or other unwanted behaviors. Further discussion of this issue can be found at https://eos.org/opinions/steps-to-building-a-no-tolerance-culture-for-sexual-harassment.

GSA's Events Code of Conduct

The Geological Society of America adopted a detailed Events Code of Conduct in September 2016. This code can be downloaded from http://www.geosociety.org/gsa/events/conduct.aspx. The code is in addition to the provisions of the GSA Code of Conduct and applies to all registrants, guests, volunteers, exhibitors, GSA staff, service providers, and others in attendance at a GSA meeting or GSA-sponsored event. It therefore covers a much wider group of people than the GSA Code of Conduct that applies only to GSA members. This Events Code of Conduct lists expected behaviors; a partial list of unacceptable behaviors that include harassment, discrimination, intimidation, and disruption of an event; examples of unacceptable behaviors; the consequences of unacceptable behavior; instructions on reporting unacceptable behavior; and procedures to be followed in an emergency situation.

AIPG's meetings and events are much smaller than GSA's but similar unacceptable behaviors may well have occurred at past events and unfortunately may occur in the future. Should AIPG adopt a similar or virtually identical events policy? The advantage of having such a policy is that it clearly states what is and is not acceptable behavior and what will be done about unacceptable behavior. This makes taking action, should it be necessary, much easier. I urge you to review the GSA Events Code of Conduct. Let me and the National Executive Committee know if you believe AIPG should have a similar policy.

First Aid Training: Part of Continuing Professional Development

The larger geoscience organizations' rules on field trip safety, which stem from concern over potential liability should something go wrong, are increasing. This was brought to my attention last spring by Rocky Mountain Association of Geologists President John Ladd's article, "Keeping members 'On the Rocks'" in the May 2016 issue of RMAG's *Outcrop*. Ladd was discussing the problems of obtaining insurance, which RMAG had obtained through AAPG's insurer. However, as Ladd noted, the "insurance company started getting nervous, and beginning this year they were requiring that each trip would need to have a trip leader who not only was an AAPG member but also had so many health and safety certifications that they might as well be an EMT. They even required certification in small marine craft safety! For a trip to South Park?" About a month before I was to lead a field trip for this fall's GSA Annual Meeting in Denver, I learned that I needed an up-to-date Red Cross basic first aid certificate. I've taken many first aid courses over the years but it has been a while since I'd taken one. There are new things in the course: dealing with seizures, drug overdoses, diabetic commas, and the use of an AED along with refreshers on the usual things including CPR. The point being that keeping up to date with current first aid practices is, or should be, a part of basic safety, particularly field safety, programs.[8] The time spent at such training should be counted as part of one's Continuing Professional Development hours.

7. This was long before cell phones and most of the places I worked are probably still out of cell coverage.
8. The more senior members may remember the arm-lift-back-compression form of artificial respiration that preceded the Cardio-Pulmonary Respiration method used now.

Professional Memberships: How involved are you?

Michael J. Urban, MEM-1910

As you are reading this student issue of *The Professional Geologist* (TPG), the quarterly publication of the American Institute of Professional Geologists (AIPG), *you may or may not* be familiar with AIPG as a professional organization. In fact, you may or may not be a member of AIPG. For those of you, particularly students, who may not be familiar with AIPG, welcome to what could be your first of many issues of TPG! I encourage you to check us out at http://www.aipg.org/. For those who are already members, welcome back. The article before you considers what it may mean to be an active, or involved, member of a **professional organization**, which could include anything from a *society* to a *council* to a *student chapter* (and more) in business, education, or even geology (e.g., AIPG). Professional organizations exist for their members, but also *because* of their members. Are you interested in becoming more involved? If so, now is the perfect time.

With the onset of this new year, you may be pondering your choices from last year in order to take stock and gear up for your upcoming initiatives in 2017. I know I am. All of those failed 2016 resolutions (does anybody make those anymore?) and best intentions about diet, exercise, and finances are almost a distant memory now, *thankfully*. In their place, dwells the promise of a new year and the clean slate that accompanies it. After recently establishing a few new personal goals for this year, I turned my attention to some potential new professional goals, one of which being whether or not to heighten my commitment and involvement in the professional organizations and associations, like AIPG, to which I belong.

A significant factor determining my involvement in any organization is the quantity of them relative to my available time. As I reevaluated the number of professional organizations for which I hold membership, and the cost associated with each, I realized that it may be time to cut ties with a few or redouble my efforts as a way to justify the expenditure. Neither decision is an easy one to make. On the one hand, I believe in supporting all of these organizations; on the other hand, do I really need to be a card-carrying member of six or seven, each routinely sending me yet another journal contributing to an already towering heap of infrequently read, inevitably forgotten, and ultimately recycled paper? [To be honest, I do read quite a few of these journals, but writing as much in the previous sentence only serves to soften the point.] Would it not, perhaps, be better for me to lessen my total number of affiliations, opting instead to devote more effort to the chosen few? After a bit of personal deliberation, I believe the answer for me is a resounding yes.

I have been contemplating just exactly what it might mean to increase involvement in these professional organizations. The word *involvement*, to me, conjures images of intentional action. These actions may be demonstrated in a variety of ways, including, but certainly not limited to, activities consistent with a mindset of *dedication* and *support* for the organization. Dedication to an organization's mission may mean a member consciously upholds the values of the organization and works to further the positive perception of the organization in the community at large. Support surely consists of the more obvious actions like donating (time or money), volunteering (time or expertise), and serving (on a board, committee, etc.), but also may encompass the less apparent activities: attending or presenting at sponsored conferences; authoring articles in newsletters, blogs, or journals; mentoring students or early career professionals; and providing free advertisement by purchasing and wearing the hat or jacket, or hoisting the coffee mug, emblazoned with the association's logo. There are unquestionably many more ways to demonstrate involvement than those presented here. I invite you to consider drafting your own list.

For my part, I am involved more heavily in some organizations than others. This is an important determinant for me in deciding which affiliations to maintain: I am noticeably more involved where my passions are stronger, in the realms of geology and science education. Currently, I am a peer reviewer of submitted manuscripts for several professional journals; volunteer at organizational booths at conferences; present at conferences; write articles; donate money and time; purchase adorned clothing and cups; and a few others. As I reflect on my immediate future, this new year, I know there is more I *can* do to be involved. Make that more I *will* do. What more might you do?

Featured Resource

This issue's featured resource is AIPG's own website: http://www.aipg.org/

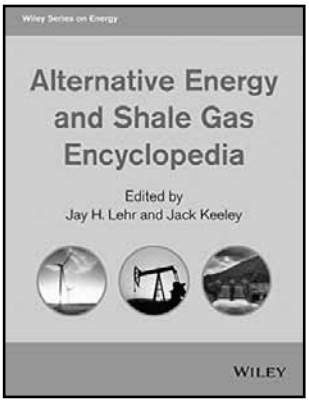
If you have not visited our site, or not recently, you should check it out again to see what's new. The benefits of membership are detailed at the **Membership** tab, then **Why Join?**. For students, check out the **Students** tab, then **Why become a student member?**. Are you an educator looking for teaching materials, professional development opportunities, or other resources? Click the **Educator** tab. Also, check out our **Career Center** and **Resources** tabs, or any of the others to further explore the site.

AIPG is seeking Associate Editor

Articles submitted for The Professional Geologist are reviewed by at least two associated editors before printed. AIPG Members that are interested in becoming an Associate Editor can fill out the required questionnaire. The questionnaire is in pdf format and can be filled out using the Adobe Reader hand tool. After you have filled out the questionnaire save it and email it to aipg@aipg.org.

THE READING GEOLOGIST – BOOK REVIEW

Alternate Energy and Shale Gas Encyclopedia, edited by Jay H. Lehr and Jack Keely (Wiley, 2016)



As Howard C. Hayden noted in the introduction of the *Encyclopedia of Alternative Energy and Shale Gas*, "energy drives everything." Alternative energy is loosely defined as being that source which is different from the conventional energy source at that time. Coal initially became an alternate energy source to wood after large scale deforestation occurred about 1500 AD in Europe. Coal eventually became the conventional energy source, driving the industrial revolution. Whale oil became commonly used as an energy source in the early 19th century for indoor lighting and it later competed with the new alternate energy source, petroleum hydrocarbons, discovered by Colonel Edwin Drake in commercial quantities in Titusville, Pennsylvania in 1859. Petroleum hydrocarbons were commonly used after the U.S. Civil War, and thus no longer an alternative energy source.

Known collectively as "fossil fuels," petroleum hydrocarbons and coal have been the primary sources of conventionally supplied energy in the U.S. and in most developed nations for more than 120 years. A variety of alternate energy sources have been developed since then. Many of the alternate energy sources are renewable, such as wind, solar, biogas, geothermal, wave, tidal and several others featured in this book. Another alternate energy source that is a petroleum hydrocarbon and described in this book, is petroleum hydrocarbons found in unconventional reservoirs and which require a variety of newly grouped technologies to extract such as horizontal drilling, sophisticated geochemistry, and hydraulic fracture stimulation.

Regardless of the power source, there are five main phases to commonly implement the use of most alternate energy systems: Phase 1 Business Development; Phase 2 Feasibility Assessment; Phase 3 Engineering and Design; Phase 4 Construction; and, Phase 5 Operations and Ongoing Maintenance.

The critical and limiting factor for rapid and safe implementation of a variety of these capital intensive energy projects remains human resources. In Phases 1 through 3, high-level economists, design engineers and environmental impact scientists are required to create and investigate the business opportunities, test the concepts and demonstrate and modify as needed, the specific project details. By Phase 4, project managers, equipment operators and numerous technicians assemble the energy systems on a site and develop and connect to an energy network to distribute the energy. Later in Phase 5, operations of the energy system require robust continued training and health and safety programs for the technicians maintaining the systems.

The needs for large numbers of well-trained engineers and scientists as well as technicians capable of sophisticated real-time assessment, measurement and safety knowledge require a layered infrastructure of community colleges and universities to provide graduates with high level of science, technology, engineering, and math (STEM) skills, as well as the social infrastructure to build, develop and deploy this training system. Indeed, the STEM trained workforce could end up being one of the primary limiting factors in the alternate energy revolution that is currently underway.

For those interested in a career in alternate energy systems, the Encyclopedia of Alternative Energy and Shale Gas provides an overview that can be quickly read on various of the seven energy systems. The seven systems are covered in sections, as follows: wind, solar, geothermal, hydropower, energy storage (battery and fuel cell), renewable energy concepts (biomass, tidal power, municipal solid waste energy systems, and ethanol), and shale gas.

WIND

One can't talk definitively about alternate energy sources without speaking about wind-harnessed energy. According to the most recent statistics from the Wind Energy Foundation, wind energy is the fastest-growing source of electricity in the world, with a global installed capacity of 35,467 megawatts (MW) in 2013. In the United States at the end of September 2014, there were 62,300 MW of wind capacity installed and operational, with more than 13,600 MW of new generating capacity under construction. U.S. Energy Department data agree with these trends.

The wind power topics include 18 articles about the acceptance of wind power, the general concept of alternative wind energy sources, as well as the technical issue of fatigue failure in wind turbine blades. Challenges with wind power include the great variability in wind speed, timing and duration of gusts, and direction of flow. These variables have both technical and economic implications for wind generation system performance and output of energy into the power grid. Wind power prediction research and mathematical modeling is a growth area, and often involves the use of artificial intelligence techniques such as artificial neural networks (ANN) and adaptive neuro fuzzy interference systems (ANFIS). The article on wind power forecasting techniques, by Michael Negnevitsky, provides various persistence models as well as statistical and neural network methods for very short term forecasting. An interesting case study provided in the article features a data set from a wind energy site in Tasmania (Australia) that includes wind energy parameters from a 21-month time series

in steps of 2.5 minute intervals. Other aspects to the design of wind energy discussed in this section include visual impacts, spatial relationships, and offshore wind farms.

GEOTHERMAL

The geothermal energy section has eleven articles and starts with the history and development of geothermal resources. Geothermal energy has been enjoyed by humans for millennia. Early humans used geothermal water from natural pools and hot springs for cooking, bathing, for heat and for performing some religious activities. A variety of people used geothermal energy in early recorded history, including the Romans, Japanese, Turks, Icelanders, Central Europeans, New Zealanders, as well as the Chinese. As the authors Mathew Aneke and Matthew Menkiti noted, "like many areas in life, the practical application of geothermal energy precedes scientific research." Geothermal topics which are covered include thermodynamic analysis of geothermal power plants, dry cooling towers for geothermal power plants and thermal energy storage.

HYDROPOWER

Hydropower, which was quite popular in the 1950s and 1960s, has been a viable energy source for hundreds of years. The state of California, as well as other states in the western U.S., has been revisiting hydropower over the past few decades. The result has been the removal of selected dams to allow for environmental restoration. Nationwide, more than 1,300 dams have been removed as of 2015. Four hydroelectric dams will be removed on the Klamath River, which flows from Oregon through northern California. These facts prove that the primary constraints to hydropower as an energy source are not technical or even economic, but rather environmental and social. The section on hydropower includes twelve articles on topics of safety in hydropower development and operations, pumped hydroelectric storage systems, and large cavern design for underground powerhouses.

Energy regulators require and customers also demand a high degree of reliability in the energy grid. Geothermal and hydroelectric power systems do not require backup systems because the power is renewable as well as continuous as long as the power plant and distribution system are working properly. Solar thermal, photovoltaic solar, wind and tidal energy output, all are highly intermittent and variable and are not necessarily in synch with the demands of the energy consumer. Due to these constraints, energy storage using batteries and fuel cells are an important part of renewable energy systems. The energy storage options are presented in a section containing six articles. An article on treatment, recycling and disposal of spent batteries contains lists of over a dozen compounds used to create the battery components.

TIDAL

The topic of renewable energy concepts includes the interesting concept of tidal energy power harnessing. An article by Roger H. Charlier starts with tide mills and the history of tidal energy power. Two forms of tidal energy power have been used for centuries; both the current power as the tide moves laterally, as well as the rise and fall in the elevation of the water bodies which occurs between low and high tides.

OTHER

Biomass, municipal solid wastes, and ethanol production are described in this section which features twelve articles, including one on bottled gas as household energy. And in stark contrast to the use of alternate energies in developed countries, nearly three billion people in the developing world rely on the energy predating the Renaissance, solid fuels; these include firewood, charcoal, agricultural residues, dung, and coal. These solid fuels are handled extensively to the extent that children are taken out of school in some areas for family fuel collection. There is a large economic, environmental and social cost of using solid fuels, including the destruction of forestlands. The fuels also produce fine particulate matter and harmful emissions. An article by Masami Kojima describes solid fuel use and the improvements in the quality of life which are enjoyed as a result of switching to natural gas or liquefied petroleum gas (LPG) for cooking and heating.

SHALE OIL/GAS

The United States has made significant carbon dioxide and greenhouse gas emissions reductions over the past few decades by replacing coal-fired power generation with natural gas-fired electricity generation. The changes at power generating stations relate to a shift in energy source from coal to a feedstock provided by the natural gas produced from the energy revolution derived from the production of unconventional petroleum hydrocarbon resources such as shale gas from the Marcellus Formation in Pennsylvania and tight oil from the Bakken Formation in North Dakota. The section on shale gas includes ten articles describing directional and horizontal drilling of oil and gas wells, hydraulic fracturing, and topics like shale gas versus ethanol, and shale oil.

As a reliable and current reference book, the 912-page *Encyclopedia of Alternative Energy and Shale Gas* contains a total of 76 articles covers multiple important alternate energy and renewable energy sources and shale gas topics. Absent from the presentation is Nuclear Energy, which is not discussed in the book. Articles range in length from a few pages to about twenty pages. Engineering calculations are provided for some energy system evaluations and other practical information is included. All articles are accompanied by figures, charts and graphs, and are fully notated with scientific references for further reading and research. The book was published by Wiley in 2016, and has great value as a current energy reference book in public and university libraries, as well as on the bookshelves of those interested in getting a quick overview of alternate energy sources and shale gas.

Dr. Jay H. Lehr is the Editor-in-Chief and is an author of more than 1,000 magazine and journal articles and more than 30 books. Jack Keeley, Senior Editor, is the former Chief of Groundwater Research at the USEPA Kerr Water Resource Research Laboratory in Ada, Oklahoma.

Reviewer: James Jacobs CPG#7760 is a consulting geologist with Clearwater Group.

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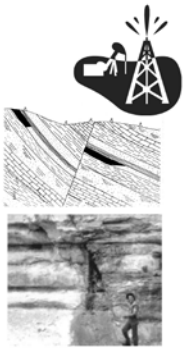

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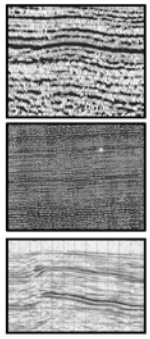

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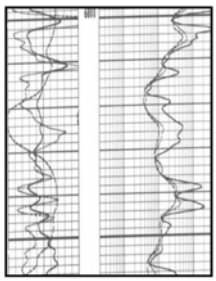

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Comments on proposed rule: Modernization of Property Disclosures for Mining Registrants

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

The Appalachian Mountains

Cortney Cameron, SA-5313

STUDENT ARTICLE

When o'er the earth I see them rise,
By meters, bluegreen, through the skies,
With their flanks, my spirits climb
By ten million years at a time—
Back to the churning of great continents,
Which joining, birthed—the earth was bent—
These gentle gods, which wrinkled, stand,
As watchful guardians of this land,
Who from their bodies, bleeding, built,
The East Coast, from the sea, by silt,
Across three thousand thousand centuries
Which link a trilobite and me—
My chest grows tight, my vision blurs,
And in my soul, an eon stirs.

"Dedicated to Tracy Cameron, 7/18/1968 - 2/5/2017"

The Blue Ridge of North Carolina seen from the Grayson Highlands State Park, Virginia. Photograph by C. Cameron, SA5313

Update on Foundation of AIPG

The Foundation of the American Institute of Professional Geologists supports a variety of programs of the American Institute of Professional Geologists (AIPG) that include student scholarships, educational programs aimed at practitioners, the public, and policy makers and, on occasion, some special needs requested by AIPG. The Foundation is engaged in exclusively educational, scholarship, and research programs. The Foundation may also support public information forums, public education meetings, teacher seminars and geological seminars for other professionals such as engineers, architects, planners and others; thus coordinating the expertise of several professions for a better understanding of the geosciences and global issues. The Foundation is proud to be able to serve AIPG and the geosciences by providing financial support for these programs.

The Foundation received many donations as part of the end-of-year appeal. We are very appreciative of these donations and the interest in the Foundation. We anticipate funding several undergraduate scholarships as well as the Siok Graduate Student Scholarship to be announced later this year. The Foundation also looks forward to supporting other programs and endeavors as possible in response to requests from the AIPG membership and executive board. The Foundation looks forward to hearing from you.

We ask that you continue supporting the Foundation with monetary contributions that would be used primarily to fund our scholarship and young professional initiatives, and other Foundation programs as well. The Foundation relies on the support of generous donors. Your donation will be acknowledged by name in future editions of The Professional Geologist magazine and on the Foundation web page.

Information about donations is on the Foundation web page of the AIPG web site http://aipg.org/foundation. You may donate on-line or send your donation check by mail to:

Foundation of AIPG
12000 N. Washington St., Suite 285
Thornton, CO 80241-3134.

If you have any questions or comments about the Foundation, please contact me for additional information.

Thank you for your support of the Foundation so the Foundation may support AIPG and the geosciences. Your continued interest and support is greatly appreciated.

Barbara Murphy, CPG
Chairperson, Foundation of AIPG
480-659-7131 office phone
bmurphy@clearcreekassociates.com

Geoscience Online Learning Initiative (GOLI) - AGI/AIPG

You, as an AIPG Member, are invited and encouraged to submit a presentation to be given online for the Geoscience Online Learning Initiative (GOLI). AGI and AIPG have teamed up to build a portfolio of online learning opportunities to help support the professional development of prospective and early-career geoscientists as well as addressing topics of interest to the broader geoscience profession. GOLI courses support both synchronous and asynchronous online learning, and count toward continuing education units (CEUs).

A $200 stipend and 10% share of registration fees are provided to the presenters (details on presenters guide).

If you are interested please read the GOLI - AGI/AIPG Presenters Guide and Guidelines and Suggestions for Webinar Presentations on the AIPG National website (*www.aipg.org*).

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Microfacies and Diagenetic Analysis of Lockhart Limestone, Shah Alla Ditta Area, Islamabad, Pakistan

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shaneekhattak@gmail.com
Bahira Univeristy Islamabad, Pakistan

STUDENT ARTICLE

Abstract

The Larger Foraminifera made a major contribution to Paleocene and Eocene biota. The microfacies and diagenetic setting of the Paleocene Lockhart Formation were analyzed in Shah Alla Ditta area, Islamabad. The Lockhart Formation is highly fossiliferous, comprising of thin nodular limestone with interbedded shale/marl. The lower contact is unconformable with Jurassic Samansuk formation while the upper contact is conformable with Margalla Hill Limestone.

Rock samples were collected from the field and thin sections were prepared. Measured thin sections were analyzed under the microscope and on the basis of detailed petrographic study three types of microfacies were identified and interpreted based on Dunham's textural classification, allochem type, fossil content and sedimentary structures. The microfacies include: LH-MF 1: Foraminiferal Wackestone/Biomicrite Microfacies LH-MF 2: Algal Foraminiferal Wackestone Microfacies, LH-MF 3: Mixed Bioclastic Mudstone Microfacies. A number of larger benthic foraminifera, and the lack of Planktonic foraminifera in the Lockhart Limestone indicate shallow to deep water of restricted inner to middle shelf environment of deposition. Larger foraminifera and dasycladacean algae are the two major fossil contents present in the Lockhart Formation. Larger foraminiferal species like Lockhartia hameii and Lockhartia conditi present in the formation confirm the age of Lockhart Limestone as Paleocene.

The main diagenetic fabric recognized in the limestone reveals mechanical and chemical compaction, deep burial water pressure, pressure solution and tectonics-related fracturing. The nodularity in the limestone is credited to pressure solution.

Introduction

The Shah Alla Ditta area is located in the foothills of the Margalla hill ranges which are part of the NW Himalayan foreland fold and thrust belts of Pakistan and are related to the main zone of Himalayan convergence (Jadoon, 1992). A major thrust fault, the Panjal-Khairabad fault, divides the NW Himalayan sequence into a deformed southern zone often referred to as the external or Foreland zone, and a deformed and metamorphosed zone also known as the Hinterland zone (DiPietro et al., 1996; Pivinik et al., 1996) (Figure 1). The Paleocene stratigraphic succession is well exposed throughout the area.

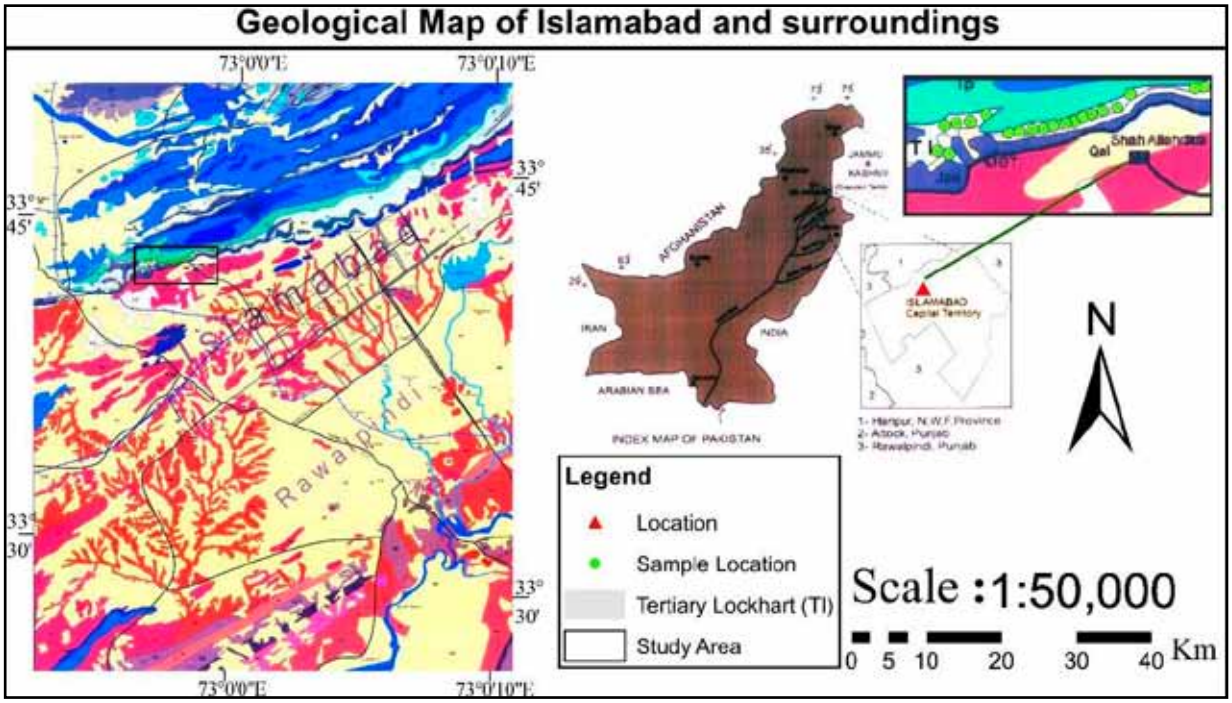

Figure 1. Accessibility map of the study area, field section is shown by black square (Google generated map)

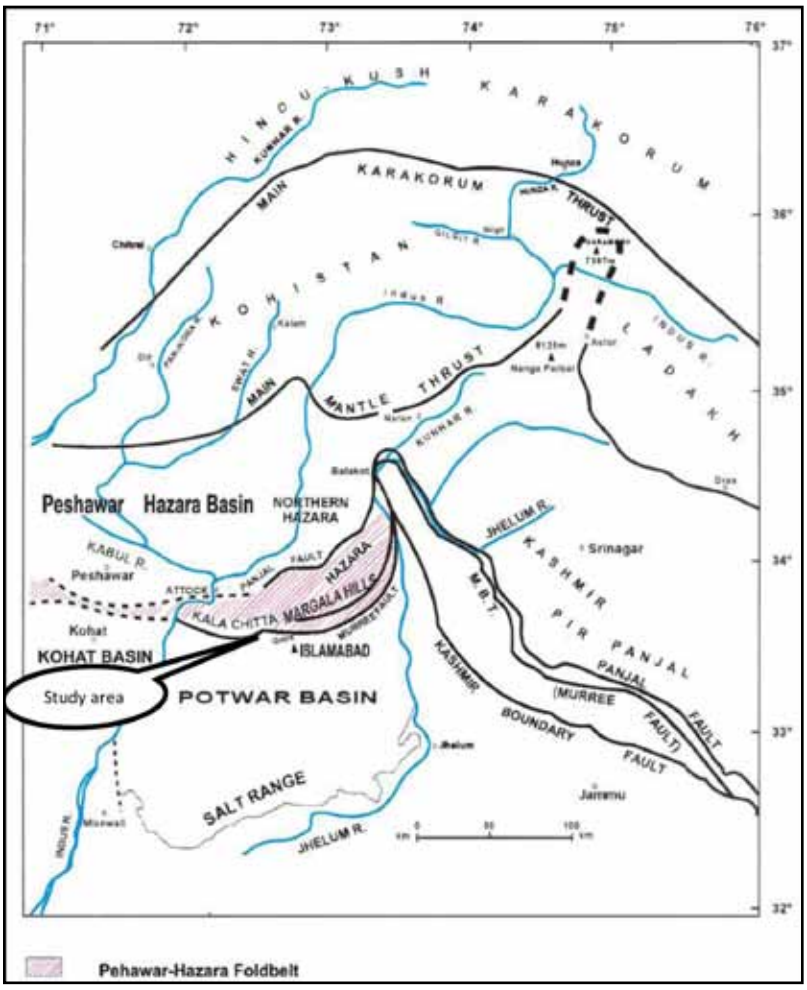

Figure 2. Geological map of northern Pakistan showing major structure boundaries, the study area is indicated by diagonal ruling. (modified after Ghazanfar et al., 1990)

Era	Epoch	Period	Formation	Lithology	Symbols
Cenozoic	Tertiary	Eocene	Margalla Formation	Limestone,Marl and Shale	
		Paleocene	Patala Formation	Shale and Limestone	
		Paleocene	Lockhart Formation	Limestone and Shale	
Mesozoic	Jurassic		Samanasuk Formation	Limestone,Sandstone	
Cenozoic	Tertiary	Miocene	Muree Formation	Sandstone and clay	

Figure 3. A brief description of the stratigraphy involved in the Shah Alla Ditta area.

The emphasis of the present study is on microfacies analysis and the diagenetic history of the Lockhart limestone. Dunham (1962) is used for classification of rocks and Flügel (2004) is used for the identification of microfacies and interpretations. The standard microfacies scheme of Wilson (1975) is also used for the comparison of identified microfacies.

Geological Setting

Geologically the study area is situated in the fault zone of the Main Boundary Thrust (MBT) and the Panjal thrust, (Figure 2). The overall structural grain of the area is NE-SW. The Main Boundary Thrust (MBT) is well exposed in this area and is located in the southern part of the study area, in Islamabad. It carries Jurassic Samanasuk Formation over Miocene Muree Formation at the surface. The strike of the fault is ENE to WSW. The average dip of the fault is 35 degrees to 40 degrees towards the north. The lithologies present in the area have a strong influence on the style of faulting. In the study area the exposed stratigraphy ranges from the Mesozoic to the Cenozoic era. The oldest formation is the Samanasuk Formation of Jurassic age. The Lockhart and Patala Formations are of Paleocene age. The Margalla Hill limestone is of Eocene age, and the Muree Formation of Miocene age is present in the area. The Lockhart Limestone has an unconformable contact with the underlying Jurassic Samanasuk while its upper contact is conformable with the Eocene Margalla Hill Limestone. The youngest formation exposed in the area is the Muree Formation (Figure 3).

Methodology and Data

Twenty samples were collected from the Shah Alla Ditta area. Detailed measured sections in the field were used to describe the facies and determine sample locations (Figure 5). Thin sections of all samples were prepared. The Dunham (1962) and Embry and Klovan (1971) classifications were used for the microfacies identification and interpretation.

Microfacies Analysis

On the basis of detailed petrographic and micropalaeontological studies three types of microfacies were recognized with distinct texture, allochem types, fossil contents and sedimentary structures. The Lockhart limestone microfacies are, from the base of the formation upwards:

Lockhart-Microfacies 1: Foraminiferal Wackestone/ Biomicrite Microfacies.

This microfacies is mainly characterized by skeletal allochems, which are the only allochemical constituents marked by moderate diversity of organisms. These skeletal allochems include: larg-

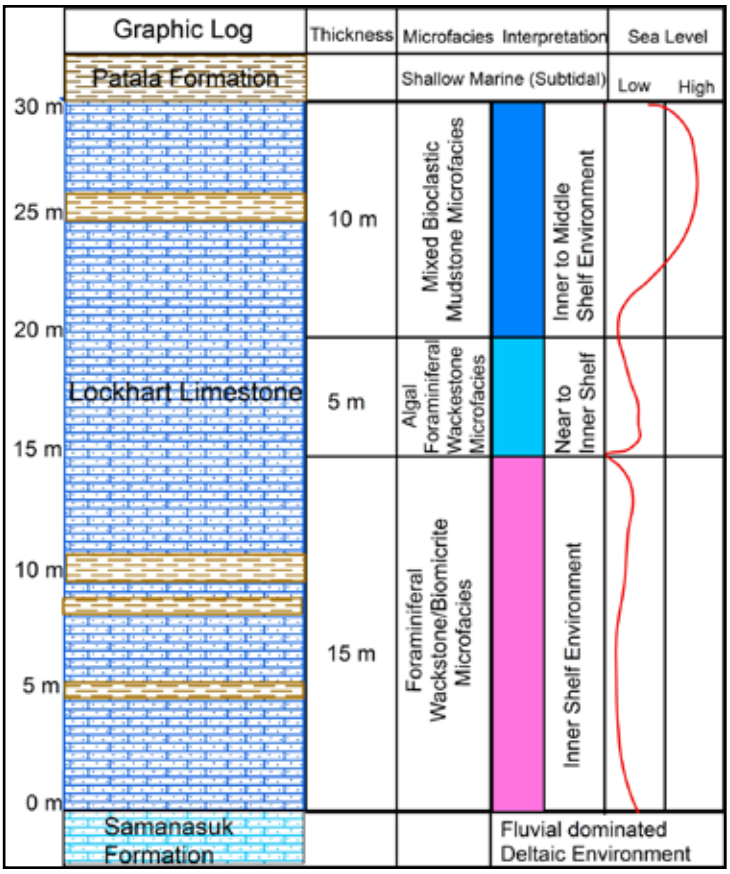

Figure 5. Showing the depositional environment of microfacies with respect to sea level rise and fall

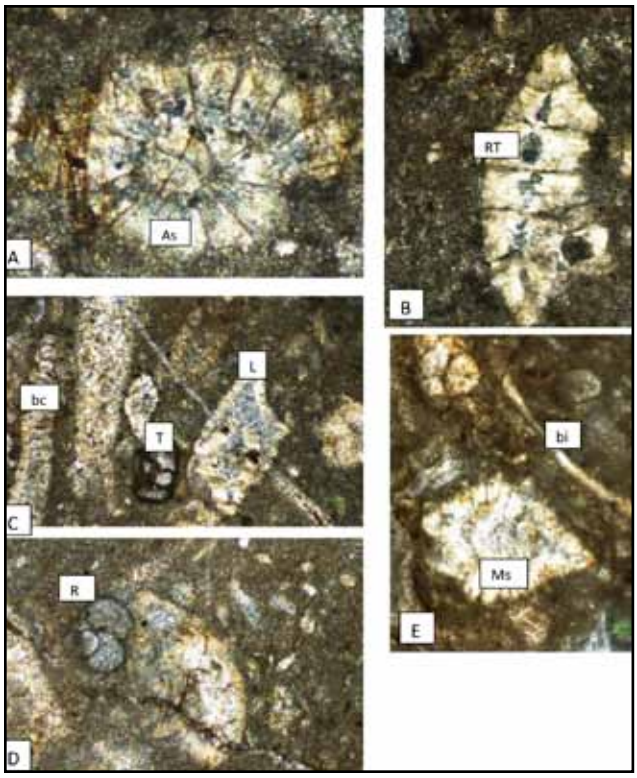

Figure 4a. Photomicrograph displaying (A) *Assilina*, (B) *Rotalia trochidiformis* (Lamarck) (RT), (C) Bioclast (bc), *Textularia* (T) and (L) *Lockhartia* sp. (D) *Rotalia* sp(E) *Miscellanea sp.*(Ms) and Bivalve (bi) in lime mud matrix in Foraminiferal Wackestone

er benthic foraminifers, gastropods, pelecypods, ostracods and rare dasycladacean algae. The benthic foraminifers, constituting 20-45% of the skeletal constituents include, *Miscellinae miscella, Lockhartia haimei, Lockhartia conditti, Ranikotalia trochodiformis, Quenquloclina sp., Idalina sinjarica sp., and Cibicide* (*Figure 4a*). Dunham(1962) recognizes wackestone as a textural type in this microfacies, while Folk calls the same material poorly-washed biomicrite(1959).

Lockhart-Microfacies 2: Algal Foraminiferal Wackestone Microfacies.

The Algal-Foram Wackestone Microfacies is comprised of dark grey, thin bedded, nodular limestone with minor clay/marl interbeds. It is characterized by larger and smaller benthic foraminifera mixed with dasycladacean algae, mollusks, gastropods and ostracods with rare echinoderms and planktic foraminifera. The dasycladacean algae vary from 10-15%. The benthic foraminifera constitute 20-25% of the skeletal constituents and include milliolids, *Lockhartia sp., Rotalia sp., Textularia and Assilina* sp. (*Figure 4b*)

Lockhart-Microfacies 3: Mixed Bioclastic Mudstone Microfacies.

The allochem constituents are exclusively skeletal fragments displaying mudstone depositional fabrics according to Dunham (1962), or biomicrite according to Folk (1959). Algae, *Miscellanea miscella*, and a very few smaller benthics are also

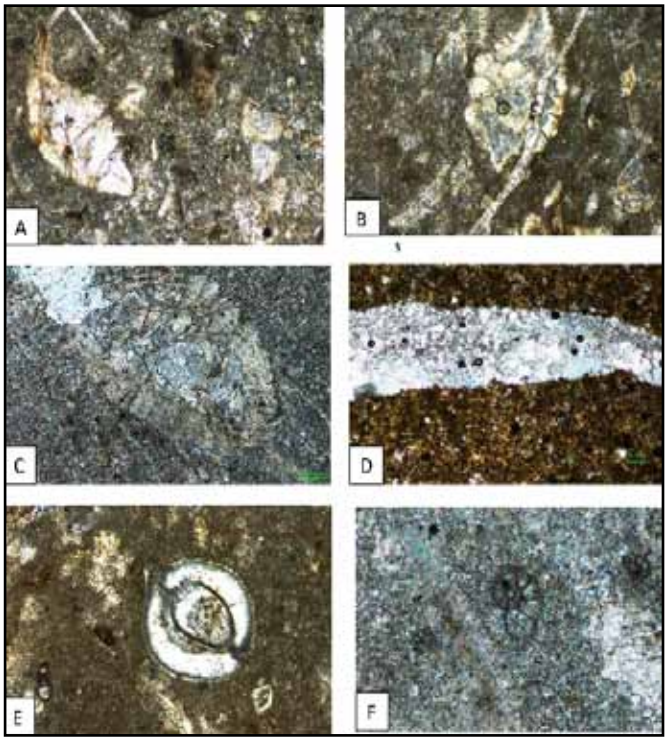

Figure 4b. Photomicrograph displaying Lockhartia sp (A, B), Fossil replacement by calcite (C), Calcite vein (D), Quenquolocolina (E) , Assilina (F) in Algal Foraminiferal Wackstone.s

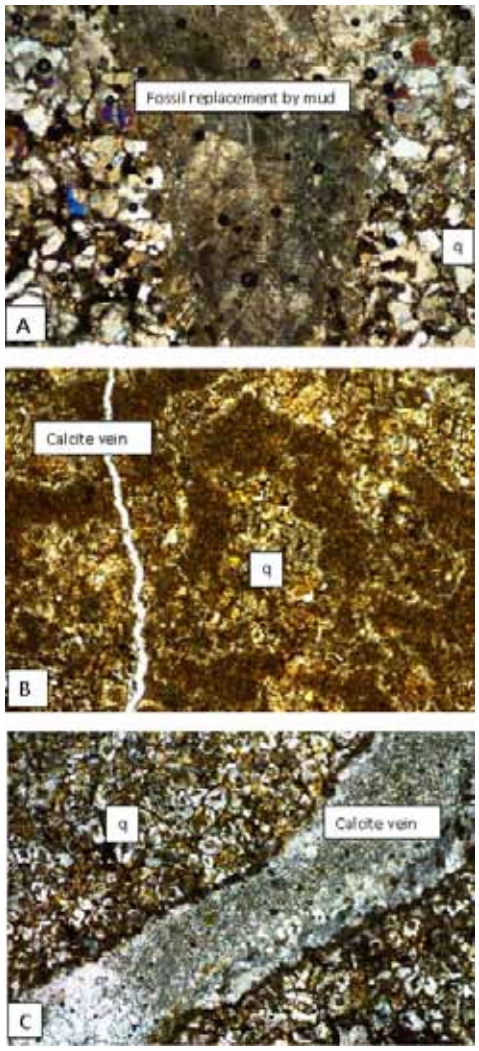

Figure 4c. Photomicrograph displaying (A) fossil replacement by mud and (B) &(C)calcite vein and (q) quartz crystal in mixed bioclast mud stone facies.

observed in these sections. Mostly the calcite veins found in this mocrofacies replace bioclasts. Veins are parallel to subparallel, and also cross-cut each other. This type of cross-cutting is evidence of a tectonically highly fractured zone. (*Figure 4c*).

Discussion

The microfacies identification and interpretation shows that the Lockhart Limestone represents deposition in near-shore, inner to middle shelf environments, (*Figure 5*).

Sea level changes control the distribution of microfacies, which reveal the onset of shallow marine conditions. During sea level still-stand the Foraminiferal Wackestone/Biomicrite Microfacies was deposited. Times of gradual sea level rise are associated with the deposition of Mixed Bioclastic Mudstone Microfacies. The Algal Foram Wackestone in the middle of the Lockhart Limestone indicates sea level fall and inner shelf subtidal settings.

Diagenesis

Diagenesis encompasses all the processes affecting carbonate rocks until the realm of incipient metamorphism at elevated temperature and pressure (Tucker and Wright, 1990). The diagenetic processes characteristic of the Lockhart Limestone are responsible for the development of typical features diagnostic of those regimes. These processes include compaction, transformation of aragonite to more stable low-Mg sparry calcite, and pressure solution.

Conclusions

Three microfacies are recognized in outcrops of Shah Alla Ditta area:

i. Foraminiferal Wackestone/Biomicrite Microfacies, deposited during sea level stillstand.

ii. Algal Foraminiferal Wackestone Microfacies. Laid down during sea level fall.

iii. Mixed Bioclastic Mudstone Microfacies representing sea level rise.

These three microfacies represent inner shelf, near shore to inner-shelf and inner to middle shelf environments of deposition.

Acknowledegments

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Field Trips and Scientific Debut

STUDENT ARTICLE

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On Field Trips

This year I had the pleasure of attending the Carolina Geological Society field trip, led by USGS Research Geologist Arthur Merschat and others, to the Grayson Highlands area in the southern Appalachians. I shared a self-aware sense of amusement with passersby at seeing over a hundred adults (myself among them) huddled on the roadside, inspecting and gathering rocks with childlike wonder. These treasures, stored in those bottom compartments typically reserved for luggage, slid and clanged beneath us as the tour buses hugged the mountain curves. Without belaboring the specifics the trip taught me, two broad themes stand out. First, although oftentimes hidden by age and vegetation, the East Coast boasts an amazing record of geology for those curious enough to look. By rock and mile, the trip transported me back to an era where glaciers and volcanoes raged in the now-docile mountains of Virginia; in western North Carolina, hundreds of miles inland, I found myself standing beneath an ancient ocean and watching as ultramafic intrusions snaked their way through fresh crust. Few other fields offer such an exhilarating time-machine ride--a sobering, tangible testament to the meaning of a half-billion years, to the power of the great earth engine churning beneath our feet. Second, the trip showed me the importance of staying active in local geological groups as a means to maintain connections--with other professionals and with the geology around you.

The Scientific Debut

This October, I conquered the seemingly monumental (to me) task of at once attending and presenting at my first scientific conference. Approaching the podium, my presumptuousness could not escape me—that is, for a fledgling like me to stand before a room filled with some of the greatest minds in the field, whose publication histories exceeded my age twofold, and present my nascent work. At the same time, my exact particular grain, picked from among the mountains of science, had remained heretofore unexplored except by me, and a certain thrill lay in sharing my exclusive knowledge with these greats, who, unlike most of my acquaintances, showed genuine interest in my work. Later, I found myself thinking the trial reminiscent of an aristocratic debut, with an advisor officially presenting a blushing protégé as ready to engage with the community—the obvious difference and advantage, compared to a traditional debut, is that the scientific debut leans more meritocratic. I, of course, survived the experience better for the wear, and despite the tortures the darker side of my imagination had predicted, the responses were constructive and helpful. Presenting at the conference forged a dimension of realness into my work, and indeed, as if I had synergistically absorbed some of the passion and knowledge of the scientific betters there, my inner geoscientist left the event feeling refreshed and reconnected.

Carolina Geological Society members at a stop on Whitetop Road in Virginia (36.70806°N 81.61692°W) during a Society field trip on Oct. 29th, 2016. The author is at center holding an orange field book. Society members are examining an amygdaloidal metabasalt flow in the lower Unicoi Formation (dark color) which is overlain in the upper part of the picture by marine quartzites of the upper Unicoi Formation. (Photo by C. Cameron)

Cortney Cameron holds a B.A. in earth science from Duke University and is an NSF Graduate Research Fellow and M.S. candidate at North Carolina Central University. Raised in the foothills of the Appalachians, these mountains fostered her initial interest in geoscience.

Wisconsin AIPG Sponsors Best Geology Project Vote

Christine Lilek, CPG #10195

Three companies competed in Wisconsin AIPG's GoFundMe "Best 2016 Wisconsin Geoscience Project" scholarship fundraiser: Project A – CBI: Geothermal Energy Project on Remediation Site, Project B – Natural Resource Technology: Groundwater Relief System, and Project C - Marek Landscaping LLC: Bluff Stabilization. gofundme.com/2p22yy4. The votes raised $275 for Wisconsin AIPG's Student Scholarship Fund!

The final votes were cast on October 31. While each of the 3 projects received many votes of appreciation, the winner was Project B – Natural Resource Technology: Groundwater Relief System!

Photo Credit: Courtesy of NRT
Restored Shoreline along the West Twin River

Project B was located at the Wisconsin Public Service Corporation's (WPSC) former manufactured gas plant (MGP) site in Two Rivers, Wisconsin. In 2015, WPSC completed a Time Critical Removal Action (Removal Action) at their former Two Rivers MGP site (Site) in Two Rivers, Wisconsin to address MGP contaminated materials through the United States Environmental Protection Agency's (USEPA) Superfund Alternative Site (SAS) program.

Located in a residential and industrial neighborhood, the Site covers approximately 4 acres. The Two Rivers MGP operated from 1925 to 1946 and produced waste by-products such as coal tar. Handling of the waste resulted in contaminated soil and groundwater at this Site. To address the source area of MGP waste, approximately 80,000 cubic yards of coal tar-impacted soil were treated utilizing in situ solidification/stabilization (ISS) and approximately 26,000 cubic yards (47,000 tons) of material were disposed at a licensed landfill. To accomplish the ISS treatment a complex groundwater relief system was designed and installed.

NRT's design team evaluated how the addition of the impermeable solidified soils underground would affect groundwater flow and potential for flooding adjacent properties.

Pre- and post-groundwater conditions were modeled and indicated a groundwater relief system would be required to prevent flooding. To address this, an innovative design was developed in which the groundwater relief system required the main excavation area to be backfilled with clear stone.

Groundwater relief trenches with clean, rounded 2-inch stone were installed underground from the relief system and around the solidified soils to direct the groundwater via gravity from the relief system to an area on site where wetland soils remained.

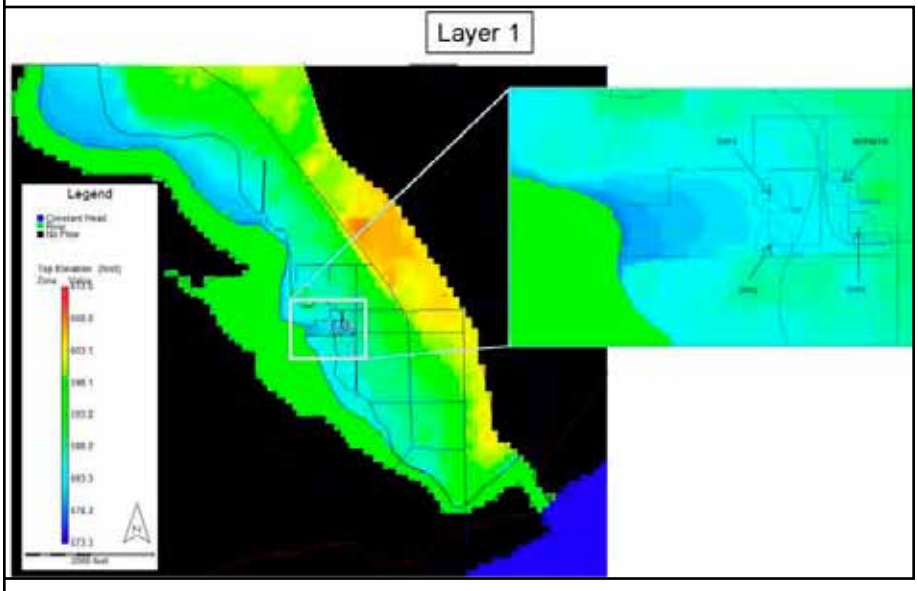

Photo Credit: Courtesy of NRT
Computer model used to design the groundwater relief system

Additional project details can be found at: http://www.naturalrt.com/sites/default/files/wire-pdfs/AIPG%20Best%20Geoscience%20Proj%20Submittal.pdf

The Wisconsin AIPG congratulates NRT on their award-winning project and looks forward to the submittal of other geoscience projects for our 2017 "Vote for the Best Wisconsin Geoscience Project" scholarship fundraiser!

Invitation from AIPG to Submit Articles!

Author instructions are available on the AIPG website at *http://aipg.org/gettingpublished.*

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