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Northern Lights in Alaska. Photo compliments of Wayne Johnson and Visit Alaska.
The mission of the American Institute of Professional Geologists (AIPG) is to be an effective advocate for the profession of geology and to serve its members through activities and programs that support continuing professional development and promote high standards of ethical conduct.

Todd McFarland, 2015 AIPG Vice President, presents the Middle Tennessee State University Student Chapter charter to Brandy Barnes, the student chapter president.

AIPG had an exhibit booth at the AGU conference in San Francisco. Middle Tennessee State University student chapter president Brandy Barnes with 2015 AIPG President Foster Sawyer.
Geological Processes and the Circumstellar Habitable Zone

Jerome Scelza, jrs755@nyu.edu
NYU Polytechnical School of Engineering

Abstract

The circumstellar habitable zone is the distance a planet is required to be from its primary star in order to sustain life. This distance is determined primarily by the ability of the planet to maintain liquid water on its surface (Kasting, 2014). If the planet is too close to its sun, the water will evaporate and the planet will freeze. The current consensus among astrophysicists is that surficial water is related solely to the availability of heat energy that is emitted by the planet’s sequence star, one that is fusing hydrogen to form helium (Kopparapu, 2013). However, Earth’s geologic processes indicate that other factors contribute to or may be even more important to the presence of water than simple stellar distance. Volcanism, atmospheric processes, tectonic plate activity, magnetic field intensity, and surface area play a distinct and well-defined role in the ability of the Earth to preserve and cycle its liquid water. These and other variables contribute to the ability of a planet to host water, and it may be too scientifically confining to suggest that the Habitable Zone is determined solely by the temperature gradient of a planet relative to its star. By taking a closer look at which of these factors contribute to the habitability of Earth (i.e., water and its associated climatic implications), we may develop a more sophisticated and meaningful understanding of the scale and radial distance of the habitable zone of other worlds.

Estimating the Habitable Zone

Liquid water is used as the defining characteristic of the circumstellar habitable zone because it drives biochemical reactions and is crucial to cellular function (Rushby, 2013). The distance from a planet’s primary star (for us, the Sun) is a critical factor affecting temperatures associated with freezing and vaporizing water. This effect can be quantified by measuring the amount of radiant flux or insolation (solar radiation) that is emitted by the host star in the form of electromagnetic energy or instantaneous luminosity. The habitable zone (Figure 1) is determined by three factors: (a) the proportion of the luminosity of a sequence star; (b) the distance between the sequence star and the planet; and (c) the mass of the planet under study.

Mathematically, this relationship has been established efficiently as follows (Dobos, 2013):

\[ r_{inner} = \frac{L}{S_{inner}}, \quad r_{outer} = \frac{L}{S_{outer}} \]

Where: \( L \) = Luminosity of the start in solar units and \( S_{inner} \) and \( S_{outer} \) can be calculated by:

\[ S_{inner} = 1.296 - 2.139 \times 10^{-4} T + 4.19 \times 10^{-9} T^2 \]
\[ S_{outer} = 0.234 - 1.319 \times 10^{-5} T + 6.19 \times 10^{-9} T^2 \]

where \( T \) = Effective Temperature of the star in Kelvin. This equation defines the current Habitable Zone (HZ) of the Sun at 0.99-1.65 Astronomical Units (AU). An AU is the distance between Earth and the Sun, roughly 150 million kilometers. This approach serves as the basis for remote-life detection by most outer space navigating organizations, including NASA (Kasting, 2014).

The first verified exoplanet was not discovered until 1995 and was found orbiting a G-type (yellow) star (Mayor and Queloz, 2009). The search for new exoplanets exploded after this confirmed discovery, as did the race to find the first signs of extraterrestrial life. The Kepler advanced photometer space observatory was launched in 2007. This instrument is capable of monitoring the brightness of more than 145,000 main sequence stars (Dooling, 2014). Kepler allows the direct observation of exoplanets, and by utilizing Kasting’s habitable zone concepts, astrophysicists began to identify planets that potentially could support life.

Volcanism, the Atmosphere, and the Habitable Zone

The solar flux that is received by the Earth from the Sun is too intense for modern or past forms of biological organisms to survive (Guo, 2010). Life began and endures on Earth in large part because of the shielding capabilities of the atmosphere. This thin combination of inert and highly reactive gases protects the Earth’s surface from inhospitable amounts of solar energy while allowing for radiant heat to provide a relatively constant temperature. Carbon dioxide, water vapor, and other greenhouse gases that make up the atmosphere reflect and re-radiate substantial amounts of solar energy that is directed at Earth, while maintaining sufficient energy for biological interaction. It is this interaction, along with various forms of photosynthesis, which recycles these valuable gases and preserves the ongoing, beneficial effects.

While biological contributions to atmospheric gases are sufficient to maintain the greenhouse effect, it certainly was not enough to form the current atmosphere, especially considering the volatility of the early Earth environment and the initial lack of biological activity. There is substantial evidence that suggests a specific geological process – volcanism – played a
major role in the development of the atmosphere (Sekhar and King, 2014).

The Earth and its surface were too hot for water vapor to condense during the early stages of its formation. However, water vapor alone is not a significant enough greenhouse gas to insulate the surface against life-damaging solar flux. The Earth’s primordial, non-protective atmosphere remained in place until large quantities of gases were emitted from the upper mantle via volcanoes. These gases, which include carbon dioxide, methane, nitrogen, and carbon monoxide, were vital to establishing today’s modern atmosphere. Without this fundamental change in the atmosphere caused by intense geodynamic activity, organic life forms would be unprotected from damaging solar radiation.

Volcanism also needs to be considered a modifying factor in HZ calculations. The heat received and retained through solar flux is not directly proportional to a planet’s ability to support life. A planet may be warm enough to contain liquid water and at the same time be absorbing too much radiation. Conversely, it may be receiving less than optimal amounts of solar flux but due to the greenhouse gases (enhanced by volcanic activity), a planet may be fully capable of supporting a thriving ecosystem. It is therefore not prudent to judge the HZ solely based on the distance of a planet from its star and its projected surface temperature.

Plate Tectonics and the Habitable Zone

Plate tectonics is a geological process that plays a crucial role in the maintenance and development of the Earth’s, and perhaps other planets’, habitability (Noak, 2014). Subduction zones are created by the overlapping of tectonic plates caused primarily by compressive forces, and result in the movement of one side of either plate into the mantle (Sekhar and King, 2014). Thermal activity within the mantle melts the subducted rock and it is this relationship that allows recycling of the crust, which maintains the thickness of the lithosphere.

An appropriate lithospheric thickness is important in the ability of a planet to sustain its temperature (Kiefer, 2009). Mars is located in the HZ (1.52 AU from the Sun) but as of the date of this paper, liquid water has not been detected on or below its surface. The Martian environment is substantially colder than Earth’s: -87 to 0°C versus an Earth average temperature of 15°C. This temperature difference may be related primarily to its thin atmosphere and therefore lack of greenhouse effect. However, plate tectonic movement is not apparent on Mars (Sekhar and King, 2014) and its crust appears to be a single sheet of lithospheric material, although similar in composition to the Earth’s. This lack of tectonic activity suggests that Mars lacks the ability to recycle its crust in a significant manner.

Without crustal recycling via subduction, the thickness of the Martian lithosphere continued to grow and this process served as a self-insulating mechanism (Morschhauser, 2011) (Figure 2). The inner core temperatures of the planet suppressed and eventually disabled geothermally-dynamic processes. These processes, in combination with its thin, volcanically-deprived atmosphere, could have contributed to planetary cooling and helped create the below-freezing, apparently lifeless environment currently being explored today, despite the location of Mars well within the Habitable Zone. Used to planetary cooling and helped create the below-freezing, apparently lifeless environment currently being explored today, despite Mars presence well within the Habitable Zone.

Figure 2. An illustration of Mars and its thickening Lithosphere (Calvin J. Hamilton).

Magnetic Flux and the Habitable Zone

Another geological feature that is a necessity in the early formation of a future habitable planet is magnetic flux. An electromagnetic field surrounds the Earth and deflects spikes of solar radiation (solar flares) that would be damaging to life. The field is generated by a collaboration between the solid metallic (nickel-iron) inner core and liquid outer core (Hulot, 2010). Differences in temperatures and pressures between the inner and outer cores, in combination with the Earth’s rotation, generate an electrical current and thus a magnetic field (Figure 3). Because of this geological feature, the Earth is able to sustain life at a substantially closer distance to the Sun than might otherwise be possible. With this protective shield, the Earth could be as close as 0.65 AU to the Sun and still protect developing life forms from excessive solar radiation.

Figure 3. Earth’s protective magnetic field defending it against a massive solar flare (NASA/SDO).

Water to Land Fraction and the HZ

A recently identified geologic concept associated with the Habitable Zone is the water surface to land fraction (Abbot, 2012). An ocean planet or water world (those with very little or no subaerial land masses) is not capable of sustaining life or even its own atmosphere. Such conditions would drastically alter or eliminate the scope of its Habitable Zone. The continental weathering and associated photosynthetic and biological degradation that take place in the basaltic oceanic crust at the seafloor (Abbot, 2012). Therefore, a planet that has a higher fraction of water on its surface would have far greater difficulty recycling CO₂ through its atmosphere. The increased production or build up of carbon dioxide in the atmosphere would result in enhanced greenhouse effects and a considerably warmer climate. The importance of the water surface to land fraction is that a completely or largely water-covered planet would not be

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able to regulate its temperature. Even if it was located within the bounds of the conventionally defined HZ, the planet’s surface temperature would become too hot and would not be amenable to supporting life.

Discussion

The incorporation of geological, planet-specific factors into an evaluation of the HZ provides a broader insight into this concept that can alter and more tightly focus the scope and direction of extraterrestrial investigations into the search for life. Health and Doyle (2014) have suggested an “Ecospheres” approach, for example. Looking holistically at geological and other factors that contribute to the availability of liquid water may identify a wider variety of planets that are capable of supporting life, even where the orbits of those planets lie far outside the inner or outer bounds of the HZ associated with the respective host stars. These planets may contain self-sustaining ecosystems independent of the temperature restrictions associated with the respective distance from a star (Kane, 2014). These specialty ecosystems may have evolved on snowball worlds, densely-atmosphered worlds made from unconventional gases, or even tidally-locked planets (one side in perpetual starlight and another in perpetual darkness) that revolve around M-dwarf (small, cool) stars.

While an important and significant starting point, defining the Habitable Zone goes beyond the traditional analysis of Kasting et al. (2014). It is not sufficient to infer a planet’s ability to sustain liquid water or define its breadth of habitability based solely on its distance from a star. The contributions of complex geological processes are significant in determining whether or not a planet can support not only water but also biological activity. Considering the suggested 17 billion Earth-sized worlds that exist in just our galaxy alone, it seems reasonable for astrophysicists to seek some simple means of isolating the potential for extraterrestrial life (Rushby, 2013). The concept of the Habitable Zone will continue to be a useful starting point, but over time likely will need to evolve into a more sophisticated and broadly encompassing tool that includes geologic and other planet-specific processes. As the HZ tool and our knowledge evolves, our understanding of and efficiency at exploring for life will increase and eventually be determinative.

Acknowledgement

The author wishes to thank Bob Blauvelt (CPG 6508), course instructor for Introduction to Geophysics at NYU Poly, for his review of this paper.

References


Jerome Scelza is currently studying Mechanical Engineering and Nuclear Physics at New York University. He has always aspired to contribute to the physical sciences. With a natural ability for hands on application and a foundation in engineering he hopes to provide an applied component to research in the more pure sciences.
Thirty-four years ago, I was wondering what the “real world” would be like and what my first job might be. Now that I’ve retired from Shell Oil Company, my thirty-four years of geological and environmental experience has produced many lessons I’d like to share with students who are starting a professional career. These are things I’ve learned over the course of my career that will help you enhance your career so you’ll be all you can be.

Lessons Learned

- It takes about nine months to understand a new job and contribute in a meaningful way. Be patient, but work hard. The nine month rule-of-thumb is needed to understand the people, processes, and organization and then you’ll add value.
- Develop your career with a blend of office and field work. In particular understand the operations that you are supporting. As a consultant or employee, what problem are you trying to help your client or customer solve? For example, it might be a company issue or regulatory compliance, but understand the technical requirements and how they are carried out in the field. My early mentor recommended two weeks in the office and one week in the field. A good rule of thumb to apply field learning in the office.
- Be an expert, the “go to person.” Develop a reputation as the person to ask about a particular technical subject. Air, groundwater, reclamation, geotechnical, soils, assessment, restoration, etc. Keep aware of current applications and thinking in your favorite practice area. One way to develop expertise is become a journal editor. You learn from reading technical articles and get feedback from the lead editor.
- Support your team. Most consulting and operations requires you to work with a diversity of disciplines. So reply quickly to email. Give easily understood answers to those outside your field. Don’t try to impress with technical jargon, it is the simple and clearly articulated answers that get you a pay raise or promotion.
- Greatest opportunities are between the disciplines. For example, understand the legal, land, safety, and engineering fields. Those who can apply their trade to other disciplines and help them solve their issues or make better decisions are those who will grow in their profession.
- Learn how to sell an idea. We all sell constantly, even though as geologists we desire decisions based on the scientific approach. But too often I’ve seen good ideas die because the person did not posses the writing and verbal skills to sell their recommended direction. Become involved in groups like Toastmasters to improve your speaking and leadership skills. Learning to convey and sell ideas will pay out, over and over again.
- Information technology has changed dramatically in 34 years. It will continue to change, so invest in yourself and buy quality computers, phones, pads and learn how to use them. Understanding and staying current with technology will make you more efficient and effective.
- Learn personal finance. Your generation will probably not have pension programs. But no generation has had guarantees. So don’t worry about that. Learn about personal investing in mutual funds, IRA, 401K, and all the saving programs. Learn how to take care of yourself financially. I’ve mentored many in my company, several with PhDs from the best schools in the country, and not one had an hour of instruction in personal finance. I know you are broke now and money is not on your radar. But learn about personal finance as your career advances.
- Learn to ride the business waves or cycles. The oil and gas boom we are in will change. I’m not a prophet, and don’t know what the future will bring. So follow the business you are in, the price of the produced product. This also applies to regulators and government workers. I’ve seen regulators laid off, when industries went away. Be aware of your business surroundings.
- Blindsided by a sinking business. Yes, you’ll be impacted by several down cycles in your career, and either be asked to leave or forced out. Don’t let that make you bitter. You decide on how to respond to business cycles. Learn from what happened, start again, and move on.
- Globalization is a reality. My expense statement was processed in India and contractor paid by staff in Malaysia. Don’t complain about this, accept that they work cheaper than us, so you’ll have to do a better job to get higher pay.
- Get certified as a professional. Even if it costs you money and time, do it. You want professional credentials. Plan to take the required tests and when you have the years of experience become a credentialed professional.
- Personal development. Learn how to speak before an audience and write concisely. Practice working with people and leading. There are a wealth of books and podcasts to help you grow. Start now with free podcasts on speaking, writing, and leading.
- Learn how to stand out. I started learning how to play the guitar and sing when I was 37 years old. I changed words to common songs and sang about the team I was on. This made me known—so do something that fits your skills and competency that makes you standout.
- Start your own business. This is one way to learn a tremendous amount about your field and possibly build wealth for your future. Some of you should be geological entrepreneurs. Start learning now about how the real world functions through your early jobs. Your experiences and training will serve you well if you choose to pursue your own business.

Finally, I have a presentation that I’d love to deliver to your geology department based on the above concepts as they related to my career. Please email me at wayne.hamilton1@gmail.com if you are interested in scheduling me to speak.
Getting Prepared for Life and Career – A Brief Memoir

Kernan Davis

How does one prepare for a career as a geologist? When I was at the University of Buffalo in the 1950s, the faculty often told the students, “We do not teach you how to make a living, but how to live.”

Two classes made a major impression on me: Professor Pegrum’s Geology 101, in which he announced that mankind is too puny to affect the global climate, and Professor Sine’s English class, in which we scrutinized the King James Version of the Bible.

Prof. Pegrum knew that the CO₂ levels in our atmosphere had remained nearly constant for millennia. What he did not anticipate was the vast expansion of the human population and its ravenous exploitation of coal and petroleum. He envisioned the extensive use of atomic power as well as water and wind power as substitutes for dwindling fossil fuel resources. The lesson - We must remain wary of projecting present conditions upon the future. Prof. Pegrum often chided us against making unwarranted assumptions.

Prof. Sine led us through a brief review of historical Jewish, Christian and British political structures, and then encouraged us to dig and delve for ourselves to come up with interpretations and understandings of selected readings from the KJV. Those skills served me well in my half-century career and still prompt me to continue questioning, digging, and delving. Moreover was the lesson - We learned to remain calm and be polite while disagreeing (not very easy).

Both science and liberal arts courses provided a firm foundation for my future in a constantly changing world. I graduated with a Bachelor of Arts degree in Geology and Geography, having missed a minor in English by only two credit hours. Even though students may know a great deal about their studied fields, if they cannot effectively convey their knowledge to others, then their education has no teeth. The world passes them by.

My first job out of college was as a Terrain Analyst in the United States Army – yes, I was a GI Geologist. I gathered raw geotechnical information from old maps, air photos and literature from a wide variety of sources, then prepared reports that our military leaders could read, understand, and use in their preparations for battle – or avoidance of battle in untenable places.

Because my studies at college included a broad variety of subjects, I developed a mixture of skills for applying my knowledge of science to the needs of society. That included conducting subsurface site exploration for the Niagara Hydro-Power Project as well as evaluating ground-water impacts caused by that project in the early 1960s.

Later, I found myself at the leading edge of the environmental wave that started to sweep America during the latter part of the twentieth century. I became involved in land and water resources management, and in remediating solid and hazardous waste disposal sites. Both fields required a sound geotechnical basis. In my final years of employment, my duties expanded to include employee training and records management – different from geology, but vital to the success of our efforts.

You cannot rely exclusively on your college education. Technology and society constantly change, so you must keep up to date: continuing education is required. Look for it. Engage in it.

Retiring from the New York State Department of Environmental Conservation in the early years of this century, I adjusted my focus to caring for our children while my wife continued to work as a geologist. Now I apply my scientific knowledge to the family kitchen.

As for English studies, well, I write stories – short ones, like this.

The writer is husband of E. M. Dobson-Davis, CPG. They live in a 19th century farmhouse in the Mohawk Valley of New York. Their daughter studies at Fashion Institute of Technology in New York City, while their son studies accounting at SUNY Buffalo. As a young boy, the writer observed fossils in the rocks, gas bubbling from the Marcellus shale and the apparent drifting of continents.
How to Become a Valued Employee

Jan Horbaczewski, CPG-09369

Some suggestions on how to become a valued employee, based on four decades of observation in the work-place:

- **Become adept at recording and managing information (maintain electronic or hard copy records).**
  - Organize documents – by project, subject, and date.
  - Ensure that all documents, including drafts, are dated for version control.
  - Keep good meeting notes – decisions, action items, assignments, deadlines.
  - Keep good field notes – complete and legible.
  - Take good field photographs – location, date, scale, labels, setting.
  - Collect good samples – clear, complete, accurate labels and chain-of-custody forms.

- **Become a source of reliable information and not just a source of raw data.**
  - Perform a quality analysis of the data – your own data and third party data.
  - Carefully check all final work products for typographical and mathematical errors.
  - Organize and summarize raw data – spreadsheets, graphs.
  - Avoid swamping others (especially supervisors) with data unless they specifically request it.
  - Keep detailed information.
  - If litigation is anticipated or there is the potential, label and keep data confidential using attorney-client and other privileges.

- **Become a good communicator by providing intelligible information to decision-makers.**
  - Provide chronological context for long-term projects – sequence of events.
  - Convey written information concisely – graphs, tables, bullets, short sentences.
  - Ensure that presentation materials are self-explanatory.
  - Keep verbal presentations brief – less than two minutes per major point.
  - Avoid technical jargon and acronyms.
  - Distinguish between facts and opinions.
  - Provide opinions/recommendations with supporting evidence and rationale.
  - Weigh costs/risks against benefits – return on investment, regulatory compliance, liability.
  - Present options, including the option of doing nothing, and the consequences.

- **Become a team player.**
  - Avoid e-mail for resolving disputes – visit other party in person in their office.
  - Gossip – discourage receiving it and never relay it.
  - Keep confidential information confidential.
  - Keep your attitude and comments positive.
  - Commend in public, and identify areas for improvement (criticize constructively) in private.
  - Involve other disciplines and listen to their comments.
  - Always support subordinate team members.

- **Become responsive to requests for information from external and internal “clients.”**
  - External clients – those paying for your services, regulators, auditors, and members of public.
  - Internal clients – other parts of your organization.

- **Become productive through time management.**
  - Keep track of work time in maximum increments of one half-hour or less, preferably.
  - Distinguish equitably between “billable” and “non-billable” time.
  - Billable time is your time that would actually be paid by an external client or is of high value to the organization.
  - Non-billable time is time that would normally be regarded as non-project related “overhead” and that would not be reimbursed by an external client.
  - Keep meetings brief and productive – prepare agendas and stick to them.


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When Teaching Meets Learning: The Role of a TA During the First Year Of Graduate Studies

Steven M. Battaglia, SA-5246
Northern Illinois University

As a first-year graduate student in your geology department, you may be placed into the position of a teaching assistant (TA). The job(s) of a TA can vary greatly from department to department at different colleges and universities. You may work with an instructor in a lecture course by grading exams and homework assignments, answering student questions via email or during office hours, attending lectures to assist in proctoring exams, or finishing other work the instructor may need throughout the semester. This type of TA position is more "behind the scenes" work for which students will not directly see you in front of the classroom lecturing the course material. Perhaps instead you might be required to instruct a weekly physical geology lab; a single credit hour course that introduces the basic concepts of geology to undergraduate students. This position requires you to be "in the spotlight"—directly in front of your students and lecturing.

Now, imagine this situation for a minute: you just started graduate school without an ounce of teaching experience and are immediately placed in front of a small lab filled with undergraduate students whom are expecting to hear your expertise in the subject. It seems you are required to pick up this "how-to-be-a-teacher" thing—and so quickly too! Your first thought is likely to panic. You should NOT panic! You are adept to instruct a group of undergraduates and pass your first semester of graduate coursework at the same time, unscathed, whether you are assisting a professor behind the scenes or in the spotlight instructing your own lab.

I, too, was a first-year TA in graduate school (immediately following undergraduate) and was required to instruct a weekly, one-credit hour physical geology lab. I had to conquer some initial fears right from the start: the pressure of transitioning from undergraduate work to graduate work and teaching undergraduate students at the same time. My supervisors at the time knew that I was capable of succeeding in this position during my first semester. In the end, I survived (and slightly thrived in my personal opinion), and you will too!

Try to remember this: you were selected (over other graduate students who also applied for an assistantship) by your department’s faculty members to be in a TA position for a reason! When you applied to be a teaching assistant, the faculty recognized something in you, beyond just your credentials that made them trust in your competency to instruct an introductory geology laboratory.

I currently have the position of TA Coordinator for the Department of Geology and Environmental Geosciences at NIU. This position requires that I instruct at least one introductory physical geology lab and supervise the remaining TAs who are instructing the other introductory labs in our department. [Disclaimer: I also am under supervision by a designated faculty member from the department!] The TAs that I work with might not have experience teaching a geology lab, or (more likely) may have never taught in their academic career, especially as they enter graduate school for the first time. It is my duty as the TA Coordinator to guide new graduate students in the transition from undergraduate to graduate student with minor, yet significant, teaching responsibilities while simultaneously beginning graduate school.

Here, I will share five pieces of advice which I have found to be extremely helpful, regarding being a first-year graduate TA. I hope at least one of these offers you some perspective on what to expect as you kickoff your new TA position.

(1) Take time to make your own lab presentations. I place this piece of advice first because I found it to be the most valuable in my graduate school career. When you start as an incoming TA, you may be required to formulate PowerPoint presentations for your weekly lab. Do it! At some point during the semester when you are overloaded with coursework, you may be tempted to ask a former TA for their lectures, but this you should not do. Structuring each of your lab lectures yourself and putting thought into how you would like to present the information will allow you to retain the information more efficiently as you instruct your students. By preparing your own presentations, you also will make subsequent semesters instructing the same lab easier since you have already formed your presentations and understand the material.

(2) Be direct with your students about lab structure from Day 1. Students should know exactly how the lab is structured from the first day to the end of the semester. You do not want a student to be lost or to misunderstand logistical information. To prevent mis-haps, provide as much information on your lab syllabus as possible, including week-to-week topics, exam dates, possible field trip dates, office hours, grades and grading criteria, etc. [This information likely will be provided to you by your faculty supervisor from your department.] Undergraduate students make a common misconception that the TA is there to answer questions at any time of the day. This is completely untrue! You are a student too! Inform your students that you also have regularly scheduled courses and homework, and an immense research project to complete. Be clear that they are welcome and you are open to discuss lab-related topics during lab, during your scheduled office hours, or that you will reply to their emails in a timely manner.

(3) Be friendly (to an extent) with your students. You do not want to be
forever friends with one of your classmates. Do not go grab a beer with one of your students! When a student opens up a conversation, be friendly to them as if you were beginning a conversation with an individual you just met or did not know very well. You want to create an open-ended discussion—classroom environment with set boundaries. Subjected discussions should remain in the science realm that relate to a geology topic. By inviting students to have open-ended discussions with you on related topics (during your structured hours), you will appear more approachable and students may want to open up further discussions with you.

(4) Be knowledgeable to the best of your ability. Answer a student question to the best of your knowledge. If you do not know an answer, then it is acceptable and wise to reply, “I do not know.” Being placed in a teaching role does not indicate you now understand every idea and theory known to exist in geology. Remember that you are still a student learning and evolving your knowledge. Instead of attempting to answer a student question with a wishy-washy response, you might reply to the student with, “I am not sure of the answer to that question, but perhaps Professor so-and-so may know the answer. Perhaps you should ask him/her during your next lecture. I am interested too, to know how he/she responds.”

(5) Be excited to be teaching geology! You should be enthusiastic teaching the subject that you have found so intriguing over the past few years. You enjoy geology so much that you are further studying the subject in graduate school! No group of students wants to sit through an instruction by a person who does not exhibit some passion for the subject they are teaching—it will resonate poorly with them. Your excitement for geology will show when you take the time to structure your lab’s presentations and activities, discuss open-ended concepts with your students, and are knowledgeable to the best of your learning experiences (that you have gained) from your undergraduate education. This will improve the classroom environment.

A final thought: if you have never instructed a course or lab in an academic setting before, then do not fret. Teaching can be one of the most fulfilling experiences for a graduate student. It may open up new opportunities for you outside of conducting research. Putting in the hard work during your first year of graduate school to understand the basics of geology and better explain concepts to a student who has never thought of the Earth as a dynamic planet will greatly increase your knowledge of the subject and, perhaps, inspire others from the next group of undergraduates to do the same.

Steven Battaglia is currently a graduate student at NIU and conducts research in planetary geology. He received a B.S. in Atmospheric Sciences and Geology from the University of Illinois at Urbana-Champaign in 2012.

Get the “Frac” Out of Here

Gretchen M. Gillis, CPG-9693

As an ambassador for geoscience and professionalism, I often find that I am the only geoscientist at gatherings. The gathering might be a cocktail party or a town hall meeting, but anyone who learns that I am a geoscientist is likely to react to that fact. The reaction might be, “Isn’t that interesting,” followed by a hasty segue to another topic, but it might also be a lead-in to a discussion where my scientific insights will be important.

The conversation on my mind is about hydraulic fracture stimulation, a procedure performed during the completion of an oil or gas well. Water, sand, and a small amount of chemicals are pumped into the reservoir to initiate and prop open fractures, making production from low-permeability reservoirs economical viable. Most lay people are not familiar with hydraulic fracture stimulation beyond what they are told by the media. The media typically describe it as “a controversial drilling process known as fracking [sic].” This description, like a pickpocket in an elevator, is wrong on many levels.

I will tackle one aspect of what is wrong here. As a petroleum geologist, I insist on using the term “hydraulic fracture stimulation” or “hydraulic fracture” rather than “frac” or other colloquialisms.

The correct technical term is “hydraulic fracturing,” as defined by the Schlumberger Oilfield Glossary (hydraulic fracturing - A stimulation treatment routinely performed on oil and gas wells in low-permeability reservoirs. Specially engineered fluids are pumped at high pressure and rate into the reservoir interval to be treated, causing a vertical fracture to open...). To see the entire definition, visit http://www.glossary.oilfield.slb.com/en/Terms/h/hydraulic_fracturing.aspx (accessed January 20, 2015).

In addition to my affection for proper terminology, I avoid playing into the hands of groups that demonize the oil and gas industry by making a derogatory association between “frac” and an epithet. While I believe that communications should strive to address their audiences with clear and familiar language, this should not come at the expense of the reputation of the entire petroleum industry. Performed properly, hydraulic fracturing is an effective method for enhancing oil and gas production that has been in use for more than 50 years.

I urge my colleagues—students and professionals alike—to appoint themselves ambassadors for the profession and to clear up misconceptions such as this, one person at a time. While I am occasionally frustrated by my lack of progress, I know that petroleum geoscientists and engineers play essential roles in making reliable, affordable supplies of energy accessible to customers wherever, whenever, and in whatever forms are needed. This is the message that opponents of hydraulic fracturing should consider before casting aspersions on our profession, and why I am on a crusade to wipe out the “f word.

Gretchen Gillis, CPG-9693, is a geological consultant at Aramco Services Company in Houston. She served as Editor of the AAPG Bulletin from 2007 to 2010. Gretchen earned a BA in geology from Bryn Mawr College, Pennsylvania, and an MA in geological sciences from the University of Texas at Austin.
For the 2014 National Conference in Prescott, Arizona, President Talkington asked me to present during the Young Professionals technical session. I wasn’t really sure what to discuss; I don’t really conduct any research, and I wasn’t really sure that I could fill 20 minutes with even one of my more exciting projects. But then I got to thinking about my audience: what do I wish I had known when I started working? How did I get to where I was? How could my first 10 years of experience as a professional help others prepare for their own career?

When I graduated college in 2004, I really and truly thought I knew what I wanted to do. I had wanted to be a geologist since high school, and all through college had carefully selected my courses to complement my interests. Of course, as graduation approached, I needed to find a job. With my heart set on natural hazard assessment, I quickly realized that fresh-off-the-stage graduates can’t be too picky in the job search— you kinda take what you can get and hope it somehow relates to your field.

About a week or so before graduation, I applied to an engineering firm’s ad in my hometown paper for a geologist and a geotechnical engineer. Both job descriptions required an understanding of geological processes: check. Both required field time— isn’t that what I had been training for? And both were in the geotechnical engineering department. At the time, I didn’t know what a geotechnical engineer was, but I needed a job and soon, so I applied for both positions.

I received a call back and had my interview the day after I returned home from graduating college. It was an interesting experience and I must have been really nervous, because I don’t remember the interview. I remember stressing over how to dress for a professional job interview, but still maintain the image of a serious field geologist when wearing business casual attire. (I have since learned that geologists can wear wing-tips or heels in the office, but still rock steel toes in the field. We’re versatile that way.)

The interview must have gone well (enough) and I was offered the position as DOWL’s newest geologist! My first two weeks were spent in the soils testing laboratory, shaking sieves and running Atterberg Limits tests. They had me classifying soil using the Unified Soil Classification System (USCS) system (where as I was classically trained on the USDA system) and there was not a single rock to be found. Where were all the rocks?!

Two weeks later, management decided I had enough lab training to start learning the fieldwork – turns out this was just more soil classification, but done outside, in smaller quantities, and with drillers yelling at me to hurry up! The work was tedious and repetitive, but at least my outdoor office had a great view. Still no rocks, though.

About a month into my new job, my manager asked me to join her on a trip for pile load-testing in Akiachak, a small village upriver from Bethel. I was going to get to go to a village and learn something new with my boss, who is a pretty amazing engineer. I was thrilled! We took the jet to Bethel, and then chartered a small plane to a village with a single, 3,300-foot gravel runway. We had to walk a short distance from the airport to the school site, where hundreds of driven steel pipe piles had been installed. My boss Maria may have taught me how to do the static pile load test that day, but what I remember most is the interaction she had with the pile driving contractor, the client, and the inspector.

It was this short day trip to a small village and seemingly simple school site that made me realize just how important the work I do is. The information that I obtain in the field is the basis of the foundation design and ultimate performance of a building, or road, or tower, or whatever development I am working on. Some of the buildings, such as this school, or the airport runway, are essential to a community like Akiachak and serve as more than their named purpose. A village school, for example, is the community center, emergency shelter, and occasional clinic, as well as an education facility. And if their expensive new building doesn’t perform the way it should, the community as a whole suffers.

And it all clicked for me. I then felt like I was part of something important and that the work I was doing meant something. And even though I have (almost) always found my job fun, I like that it is relevant to our daily lives; people depend on this information, and my scientific background and understanding of geological processes is crucial to assisting the engineers.

Since that moment 10 years ago, I have been to more than 60 communities (several of them multiple times for multiple weeks), drilled about 300 projects across Alaska, and been to almost all four “corners” of Alaska (Ketchikan, Barrow, St. Lawrence Island and Cold Bay). And I still want to do it!

I did eventually get to practice some hard rock geology and have had the opportunities to teach engineers about glacial geology, various soil deposition environments, and the importance of geology to the engineering and design of their project. I have also assisted our materials testing laboratory to develop armor rock testing by identifying the rock samples that clients submit.

I started my career as a staff geologist, but I accepted every challenge I could and found my niche. I did my time in the villages by sleeping on an air mattress on the gym floor, pulling 14 to 16 hour days in inclement weather, and working nights and weekends to meet a deadline. I said “yes” and asked questions, and by realizing that I didn’t know everything but could try anything, I have made geotechnical engineering my career. That is all it took for me to grow personally and professionally, and to gain the experience and tenure to earn a chance at working in awesome project locations.

Now, I am a professional geologist with my CPG and I am leading the geotechnical engineering department that I joined 10 years ago. I have surrounded myself with smart, positive, capable people that share the same goals for projects and clients as I. I have advanced in my career, had a family, and participated in professional organizations. How did I do it? I just pressed on and accepted the projects that came to me, regardless of how pleasant or unpleasant the work or
location was. Creating and maintaining a support network in my company, but also with professional organizations like AIPG, helped me find like-minded individuals with similar experiences and challenges, and advice about how to turn those challenges into triumphs.

My company has provided me opportunities and allowed me to create my own. I love Alaska, and DOWL has paid me to visit places in Alaska that others save for their whole lives to visit. I drive around Anchorage and can point out to my kids the buildings I have helped design—buildings in which they might shop, live, and work if they stay here. And the atmosphere at DOWL is open and friendly—I have gotten to know many good people with interesting things to talk about and made some life-long friends.

When it comes down to it, I made the job I got into the job I love. All it took was the right attitude and enthusiasm for even the most mundane task to succeed at any job. I had to realize, and you will too, that it won’t always be 60 degrees and sunny, and to prepare for cold, rain, and snow, both physically and metaphorically. Everyone has to take on some unpleasant projects to earn a shot at the amazing ones. We all have to enter the profession knowing that we need to earn our experience, worth, and place. No one knows it all, especially right out of school—you’re classes prepared you for the technical, but once you start your career, embrace the opportunity to turn the office and field into your classroom to learn the practical aspects of your profession. Don’t be afraid of the uncomfortable and new experiences, because they will lead to more experiences and you will be that much more comfortable accepting the next challenge.

You will make mistakes, and probably at least one big one; if you don’t, you’re not stretching yourself. Learn from your mistakes, and listen to the advice of others. Be polite, respectful, and humble, but remain confident in your abilities. Realize that the opportunities are there and if you can just say yes to at least one, more will follow. If there is one thing that you can start off your career with and carry on through with you, is to just say “yes!”

*Geotechnical engineering is the subdiscipline of civil engineering that involves natural materials found close to the surface of the earth. It includes the application of the principles of soil mechanics and rock mechanics to the design of foundations, retaining structures, and earth structures (Braja M. Das, Principles of Geotechnical Engineering, Third Edition).*

Keri Nutter, CPG-11579, (knutter@dowl.com) is a Certified Professional Geologist in the State of Alaska. Over the past 10 years, she has travelled all over Alaska completing geotechnical investigation for DOWL, a local engineering consulting firm. She is currently serving as the AIPG Alaska Section Vice President and as an Advisory Board Representative of the AIPG National Executive Committee.

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College:

There are those of us who are driven by a passion for geological subjects. College is a place to explore and grow these passions. However, translating these passions into the real world economy can be challenging. The majority of earth science positions will be offered in private industry but there are also opportunities in educational, non-profit, state, and federal sectors. The private sector is driven by methods that maximize profit or generate compliance. Under this model, the minimal amount of data is collected and analyzed. Positions available have been proven to generate high capital, which very well may fall outside your area of interest. In many private sector positions, you may not be challenged as a research scientist or perform the critical analysis typically associated with academic studies. The challenges instead will come from the business aspects of your career and the need to analyze conditions with less data and information. Most of your purely scientific-based projects will be hard to come by unless there is potential to generate profit, but those projects do appear from time to time.

Arizona:

I am most familiar with the economic geology job market. In the four years I have been out of college, I have already experienced a boom and bust cycle in the mining industry. Fresh out of college and through networking I was able to acquire a job as a contract geologist logging exploration core. This job turned into a fulltime position and my responsibility shifted towards mining geology. This included geological mapping, determining rock characteristics, mineral assemblages, alterations and block modeling among other tasks. I was passionate about my job because there was always something new to discover and each day I felt challenged as a geologist. This job spoke to my passion of hard rock geology.

Alaska:

After living and working in Arizona my entire life, I moved to Alaska and began to search for a new job. The market was not so good for geologists in 2011 as grass-roots exploration took a back burner and investors were starting to pull money out of mineral exploration. I was able to land a temporary job that required a schedule of two weeks on and one week off, working 12 hour days and logging core for a mine in Alaska. The job was well suited for my experience but became highly monotonous. Furthermore, the rotational schedule did not suit me. Being in the heart of Interior Alaska in the middle of winter did not help. I fulfilled my contractual duties but did not continue the job. Work as a hard rock geologist in Alaska is scarce to come by, with only a handful of mines in production in the entire state. The mines that are in production are remote, and require rotating shift work.

After being disappointed in the mining industry in Alaska, I looked for other employment based on geological sciences. I found myself unqualified for positions that were available with companies like BP or ConocoPhillips. Unless I was willing to be a field technician, positions required a long duration of experience (10 years+) or a master’s degree. Other possibilities with the state and federal agencies leaned heavily toward engineering. Although I had practiced mining engineering at my previous position, I did not have the formal requirements needed. I was able to get work within the environmental field. The work entailed tasks that were unfamiliar to me, but this proved the challenge I needed and I took it on with full gusto. Environmental consulting includes a variety of field technical tasks including monitoring groundwater and soil sampling throughout the state. The job has been great for visiting parts of Alaska that I would not have been able to see otherwise and has allowed me to meet some interesting characters along the way. Environmental Science is not my true geologic passion and I would love to get back into the hard rock mining industry, but you have to diversify to be gainfully employed. My passion continues in my collecting of rocks and minerals and talking with others about geology in societies and clubs.

Some Helpful Tips to My Comrades:

1) Start networking now and join geological and science societies.
2) Diversify your technical skills.
3) Get out of your comfort zone within the geoscience field and attempt something new.
4) If you end up at a job you don’t desire, keep your passion going in societies or hobbies.
5) Sharpen your knowledge within your field by reading journals, following current news so that you can continue to establish yourself as a professional in the field.

Mr. Johnson has 5 years of experience as a geologist in the mining and environmental industry. His background includes geologic drill core logging and interpretation (both soil and hard rock); mine modeling; mineral exploration; open pit mine operations and surveying. He is an avid mineral collector and vice president of Chugach Gem and Mineral Society. He enjoys hiking, skiing, kayaking, Salmon fishing and tasting Alaska’s local micro-brews.
Snapshots in the Academia-Industry Continuum

Chak-Hau Michael Tso, SA-5582
Department of Hydrology and Water Resources, University of Arizona

In 2012, I was preparing to graduate from the University of Texas with my B.S. in geosystems engineering and hydrogeology, and debating between pursuing graduate studies and taking a job in the industry. One of my greatest fears was becoming disconnected from the industry while in school. I was afraid that the skills I would learn in graduate school would not be desirable for the industry. Also, I was worried that employers would think that I would only be prepared for academia and not for the real-world job. Even if I was fortunate to obtain a research position after I graduated, how would I know whether my research was useful to practitioners?

Two years have passed. I have found more connections than disconnections. I have found myself connecting with the industry in different areas of my graduate student life. The diversity of graduate school life has provided me snapshots of what the academia-industry continuum is. Aside from battling with excessive coursework, I am working on a research project that has a strong industry connection. For instance, the principal investigator (PI) of my project is a practicing environmental consultant. The objective of this project is to demonstrate the hydraulic tomography method in the field, especially in operating environmental sites. In brief, hydraulic tomography is an aquifer characterization method that relies on the differences in subsurface flow fields when pumping/injection locations are changed. A certain pumping/injection configuration can be viewed as a snapshot of the subsurface structure. Since there are many preferential flow paths in the subsurface, analysis using only an individual snapshot will be heavily biased. Therefore, hydraulic tomography emphasizes on switching pumping/injection configurations to generate multiple snapshots of an aquifer system. By recording the changes in head in these “snapshots” at a number of observation wells, and jointly interpreting the data using a robust inverse model, this method can map subsurface structures in detail such that the maps can be reliably used to predict the flow of water and transport of contaminants.

My project needs to show that the hydraulic tomography method works well at a site where a pump-and-treat system has been, and continues to be running. The changes in pumping and injection rates during the daily operation are the mechanism that creates the various snapshots. In other words, numerous snapshots have been generated since the pump-and-treat system at the site started running decades ago. My project site contains more than a hundred monitoring wells, as do many similar sites; therefore, pump-and-treat sites are ideal candidates for hydraulic tomography survey because there is no additional cost involved in drilling wells, or pumping and injecting fluids. We can easily take advantage of the snapshots generated by the existing wells and pumping-injection activities by installing pressure transducers in some of the monitoring wells. Since my first day working on this project, I have found this study to be extremely rewarding. I am learning a lot from reviewing the piles of reports by previous consultants regarding how the site works. I have learned to submit requests to site personnel early so that they can get through the different levels of management in a timely manner. I am working side-by-side with my PI, as well as geologists and engineers at the site. I have learned from first-hand experience about the constraints and considerations of managing and conducting a field investigation at an environmental site. All of the above considerations are not something I would have experienced in a classroom.

Graduate students are always busy with research, homework, and different kinds of funding and internship applications. This has made participating in a local professional organization an unattractive option for my scare supply of spare time. Nonetheless, I did not regret being a part of the organizing committee for the 2013 Arizona Hydrological Society (AHS) meeting in Tucson, AZ. It was an eye-opening experience to spend time with a number of hydrologists volunteering after work, and seeing how they keep track of details in an organized manner and are able to put together a professional conference.

Conferences are not only great places to learn about new ideas, but these events also provide great opportunities to connect with fellow students and colleagues. When I first started graduate school, my narrow definition of conferences only included nationwide academic conferences such as the GSA or AGU meetings. I have had wonderful times at these meetings - many great presentations and conversations have inspired me. However, these conferences are not designed for practitioners from business and industry. Instead, practitioners often choose to attend professional and local meetings. To my surprise, my time at the AIPG/AHS meeting and WM Symposia this year has substantially helped me learn about the environmental industry. I have found that practitioners

1. See the seminal paper: Yeh and Liu (2000), Water Resources Research. tian.hwr.arizona.edu/data/pub/c891af81bc3f-c2bb11c2acfe96dd3c54e.pdf
2. EPA Superfund sites are good examples.
3. Head is a measurement of liquid pressure, expressed in the units of length.
4. Pump-and-treat is the most commonly used groundwater remediation method. It involves injecting clean water to push contaminated water to pumping wells for extraction and treatment. Historically, it has suffered from low clean-up efficiency because the complex variations in structure in the subsurface have often caused the injected water to bypass the contaminants.
are excited to learn about the latest work of graduate students. They are very encouraging and are always ready to share their experiences with the younger generation.

These past two years in graduate school have made me realize that there is not a “flow barrier” between academia and industry. Instead, there exists a broad continuum between them. The more I navigate through it, the more I realize that there is more to explore. But as I am taking different snapshots in my everyday work, like in the hydraulic tomography method, I am sequentially acquiring a more holistic picture of what this continuum is like. This gain in knowledge excites me every day and it motivates me in my research and career. I am mostly “pumping” from the academia-end of the continuum at the present moment. Most certainly, I will not forget to “pump” from the industry-end after I graduate by continuing to serve in different industry liaison projects with colleges. I also encourage every reader to do the same thing and talk to each other about their findings. Remember, one way to increase the efficiency of a hydraulic tomography survey is to take advantage of “pumping sources” that others have put in!

Acknowledgement

Thanks to Jean M. Neubeck of Alpha Geoscience, for inviting me to write this piece at the 2014 AIPG/AHS national conference and editor, Vickie Hill, for following up on it. I would like to acknowledge my research advisor, Tian-Chyi Jim Yeh, my PI, Chin Man “Bill” Mok of GSI Environmental Inc., and co-PI Walter Illman from University of Waterloo for their inspiration and guidance. Thanks to my colleagues and friends, Yuanyuan Zha, Deqiang Mao, Elizabeth Hubbs, and others for making life in graduate school enjoyable. Thanks to generous scholarships from the AHS and the Roy G. Post Foundation, and the many great people who I have met at their award luncheons.

Michael Tso is a third-year hydrology graduate student at the University of Arizona. Michael received a B.S. in geosystems engineering and hydrogeology from the University of Texas at Austin. Michael’s research interest includes hydrogeology, groundwater modeling, inverse problems, hydrogeophysics and aquifer remediation. He is concerned about water issues in underprivileged communities.

The Denver Museum Of Nature & Science Welcomes New Curator

Tyler Lyson – The Denver Museum of Nature & Science, the region’s leading resource for informal science education, announces the addition of Tyler Lyson as curator of vertebrate paleontology.

Lyson studies fossil vertebrates, particularly dinosaurs and turtles. He is especially interested in the evolution of body plans and extinction patterns of different groups across major extinction events. He uses fossils to help determine how ecosystems change through time, what killed the dinosaurs, how long it takes for an ecosystem to normalize after a major extinction event, and the sequence of changes, such as a lizard-like animal becoming the highly modified body plan of turtles.

“Tyler brings exciting new talents to the Museum’s curatorial team,” said Dr. Scott Sampson, vice president of research and collections and chief curator. “He engages colleagues and citizen scientists alike in his research and explains discoveries in ways that intrigue and excite elementary students as much as or even more so than his peers.” Prior to the Museum, Lyson was a Peter Buck Postdoctoral Researcher at the Smithsonian National Museum of Natural History. He is also the founder and director of the Marmarth Research Foundation, dedicated to promoting informal science education and scientific research among citizen scientists in the fossil-rich Hell Creek Formation in southwestern North Dakota.

“I look forward to going on field expeditions to help build the Museum’s collection of vertebrate fossils and to share my excitement about Earth’s rich history with the general public,” said Lyson.

Recent Research Leads to New Understanding of Turtle Evolution

Lyson’s research on the evolution of turtles and their shells, published this month in Nature Communications, has led to new understanding of how turtles developed their unique respiratory anatomy. Unlike other vertebrates that use a combination of musculature and bone to compress and expand the lungs to breathe, turtles rely on musculature alone. Over time, the ribs of turtles have grown fixed into their rigid shells. However, even prior to this, turtles relied solely on trunk muscles for respiration. Lyson’s study sheds light on this unique feature among vertebrates as well as the process and timing of the evolution that occurred to set turtles apart.

By studying thin sections of the fossils, Lyson and colleagues have shown that the modern turtle breathing apparatus was already in place in the earliest fossil turtle, an animal known as Eunotosaurus africanus. This animal lived in South Africa 260 million years ago and shares many unique features with modern turtles, but it lacked a shell. A recognizable turtle shell doesn’t appear for another 50 million years. Lyson says “The body plan of Eunotosaurus tells us what turtles looked like before they had a shell, which provides key insights into the evolution of both the iconic turtle shell as well as the unique breathing mechanism found in modern turtles.”

The study suggests that early in the evolution of the turtle body plan, a gradual increase in body wall rigidity produced a division of function between the ribs and abdominal respiratory muscles. As the ribs broadened and stiffened the torso, they became less effective for breathing, causing the abdominal muscles to become specialized for breathing. This in turn freed up the ribs—approximately 50 million years later—to become fully integrated into the shell. The next phase of Lyson’s research will look into why the ribs of early turtles began to broaden, as this is the first step in the evolution of the ribs becoming integrated into the shell and a reliance on abdominal muscles for respiration.

Lyson received his PhD from Yale University, and is a member of the Society of Vertebrate Paleontology and American Society of Ichthyologists and Herpetologists and is a Honorary Researcher at the University of Witswatersrand in South Africa and Curatorial Affiliate at the Yale Peabody Museum.

About the Denver Museum of Nature & Science- The Denver Museum of Nature & Science is the Rocky Mountain Region’s leading resource for informal science education. Our mission is to be a catalyst and ignite the community’s passion for nature and science. The Museum envisions an empowered community that loves, understands, and protects our natural world. As such, a variety of engaging exhibits, discussions, and activities help Museum visitors celebrate and understand the wonders of Colorado, Earth, and the universe.
Applying of Geologic Theory in Environmental Due Diligence

Aaron Getchell, CPG-11349 and Dennis C. Kenney, CPG-05179

Environmental investigations and cleanups greatly impact the ability for a property to be cleared for development or other productive use in a timely manner. In addition to major delays, the relatively high costs affect local business, industry, and municipalities, as well as the landowners. Environmental Due Diligence is a term to describe the pre-transaction procedures and methods for assessing the potential for a property to contain adverse environmental conditions (Phase I), and for evaluating the extent of identified conditions that represent a potential environmental liability (Phase II).

Recognizing this potential liability, organizations such as ASTM, the USEPA, and some individual states have developed standards during the last 15+ years for conducting environmental due diligence. In effect, these standards and practices translate to “look before you leap” for prospective purchasers, and represent one aspect of providing the purchaser liability relief under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, aka Superfund), per USEPA, 40 CFR, November 2005 and as amended.

Geologic knowledge and applying scientific principles are critical in conducting environmental assessments. Environmental due diligence generally, and most commonly, consists of conducting Phase I and Phase II Environmental Site Assessments (ESAs), defined by ASTM standards E1527-13 and E1903-11. Consulting geologists routinely provide these environmental services to a variety of clients for property transactions and business acquisitions. By education and training, geologists are uniquely qualified to identify and investigate environmental conditions, particularly in the subsurface, to meet the respective ESA requirements.

In summary, a Phase I ESA is a non-intrusive “paper” study that consists of database reviews, interviews, a site visit, and researching historical sources to identify recognized environmental conditions (RECs). Examples of common RECs include underground storage tanks or a former drycleaner. When RECs are identified that warrant investigation, a Phase II ESA is recommended which typically consists of collecting samples to physically evaluate conditions.

Phase I ESAs require geologic knowledge to correctly interpret data and information. In fact, the definition of a qualified Environmental Professional (those meeting specific requirements to conduct a Phase I ESA) includes current Professional Geologist licensure (ASTM E1527-13). Describing the physical site setting includes interpreting the geologic and hydrogeologic characteristics, which aids in evaluating the site-specific geochemistry and potential contaminant transport – a skill set that geologists exercise regularly. Interpreting topographic maps is another Phase I ESA requirement for which geologists are trained. An environmental professional who also is a geologist likely will be familiar with the various types of reports that may be reviewed such as geotechnical investigations, contaminant assessments, or remedial actions. Geologists, who are trained to observe and document information, also will excel at performing the crucial site reconnaissance portion, where the objective is to discern information that might indicate the presence of a REC. The conclusions of a Phase I report require the Environmental Professional to provide an opinion regarding RECs and provide a rationale for those determinations, which is another scientific process familiar to geologists.

Phase II ESAs also require a similar understanding of geology and application of geologic principles. In fact, the definition of a “Phase II ESA Assessor” (ASTM E1903-11) is directly referenced to an “Environmental Professional” (defined in the Phase I standard). The scope of work in a Phase II ESA requires an understanding of the site-specific geology, hydrogeology, geochemistry, and contaminant transport. From this understanding, a conceptual site model is formed and tested by selecting proper drilling methods such as direct push (also referred to as DPT), roto-sonic, hollow stem auger, air rotary, mud rotary, or even hand auger. During the field work, geologic theory and critical scientific thinking continues when the ESA Assessor makes professional judgments on scope changes such as advancing step-out soil borings; constructing multi-level temporary monitoring wells; or adding to a suite of laboratory analyses. When preparing the Phase II ESA Report, the principals of geology are crucial to accurately interpret field data, including geologic boring logs, physical groundwater quality parameters, field screening techniques, laboratory data, and other measurements and observations. By applying scientific principles and geologic interpretations, the Phase II ESA Assessor draws conclusions from the data, validates the conceptual site model (ASTM E1903-11), and makes recommendations regarding site conditions.

It is not required that only professionals with formal geologic training qualify as Environmental Professionals and Phase II ESA Assessors. Engineers, biologists, and environmental scientists who meet the minimum requirements also routinely conduct these ESAs. However, it is clear that formal geologic training and the ability to apply geologic principals and scientific reasoning provides significant benefits in performing environmental due diligence at a high level. Those environmental consultants who understand geologic principles and can apply these specialized skills stand to realize success and high client satisfaction.

Mr. Getchell is a Senior Project Manager in Amec Foster Wheeler’s Tampa, Florida with over seventeen years in the field of environmental consulting. His core competencies include environmental due diligence, contaminated site assessment, health and safety awareness, and project and contract management.

Mr. Kenny is Amec Foster Wheeler’s Central Florida Mining and Geology Practice Lead, and the Tampa, Florida Office Manager. His experience spans nearly 40 years and includes: site development, mineral evaluations, mine planning, environmental permitting and compliance, as well as corporate management in the mining and environmental industry.
Realistic Advice for the New Geologist

Michael J. T. Orobona, CPG-11099

The annual student issue of The Professional Geologist is an opportunity for any experienced AIPG member to write his/her personal vision of a commencement speech. Such advice at graduation may focus on the bright future ahead, the venerable profession we share, or being true to your passion. I will instead list the extracurricular lessons I wish I had learned before embarking on my own journey below the surface of the Earth.

Geology is special...to you.

Every paid occupation celebrates its vital contribution to society, some to nearly mythical status. As a small fraternity, geologists do not have the enormous public advertising capacity of the trades, nor typically the first-person contact and regular, direct demonstration of expertise afforded medical doctors, lawyers, clergy, or other professionals. Building mutually respectful, individual relationships with colleagues from other professions is a key to demonstrating the societal or business value of our profession and navigating a successful career in a world that largely don’t know geologists.

Acquaintances outside the profession sometimes ask me what I do. Not always tongue-in-cheek, I answer that “I write e-mails, make phone calls, and host meetings.” For the management track that is no less “doing geology” than describing a rock or balancing a cross section, but the administrative aspects aren’t for everyone. It’s critical from the start of your career to periodically ask what do I want? Do you love field work? Do you want a family or to sleep in your own bed every night? If you put these questions aside in the excitement of your early career, other values will inevitably come into conflict with your livelihood. It’s ok to want it all, but that means planning for it.

If you’re looking for a stable career in a fluctuating job market, building upon entry-level skills is critical. Twenty-five, one-year experiences is not the same thing as 25 years of experience. Multiple short-term placements under the umbrella of a single temporary employment agency won’t hide that. Five years of increasing responsibility with a single organization is likely worth more to a potential employer than two decades of repeated tasks, even in a variety of geologic terranes. A high-performing geologist quickly learns to apply fundamental skills in any environment. There is room for the journeyman geologist, and for many people it is a rewarding career. But that person may become removed from the decision-making process, deprived of the opportunity to see conceptual ideas through to successful assessment.

Don’t expect to be in management immediately, or even in a senior technical role. Industry boom times may temporarily allow accelerated promotion, but those who prove to be incompetent in their roles are the first to be swept away in the inevitable downturn. There is a time for lateral advancement, but I’ve had once-removed employees leave good learning roles for the promise of a small raise or a flashy-sounding title. Also, be aware of relative terminology: Vice President at some firms or small companies may imply less experience than Project Geologist elsewhere.

But the baton of leadership is in your backpack, if you choose to take it. Authority is given to those who ask for it and are willing to leave the comfortable role of familiar tasks. The wider perspective and extended lead-time of projects mean that job gratification may occur differently and less frequently than for early-career, task-oriented roles, but a managing role potentially can be more deeply satisfying. And, leadership roles have higher earning power due to increased complexity and the inherent instability. However, it may be difficult transitioning back to a field-oriented role. Time (as familiar technologies change) or simple external perception can limit the manager’s options for returning to a technical role. What do you want? Remember to maintain your technical knowledge to maximize your options.

If you do become a boss, you’ll notice subordinates are suddenly attentive to every word you say. Don’t fall into the trap that you are automatically more knowledgeable about the subject matter or a better geologist. Remember, leadership is largely a lifestyle choice and is not always paired with the requisite talent or experience. Good supervisors surround themselves with subject-matter experts. Therefore, your fresh insight is very valuable. Your ideas can influence the decisions of your supervisor, if those ideas are communicated well and backed by good science.

A new geologist isn’t expected to be a Professor of English out of school, but developing a talent for concise, impactful writing is fundamental to disseminating your ideas and to career advancement. Clear writing sometimes is overlooked in the sciences. Geologists particularly love big words, where plain language might broaden their audience.

Throughout your career you will be faced with changing technology, whether applied personally or by the people you manage. Just as you shouldn’t discard the effective methods of the past, don’t stagnate intellectually. Dogged application of the slide rule isn’t what advanced the profession of our colleague the engineer. You don't need to know the intimate details of every new tool that enters your general field of specialization, excluding those that you utilize in your own role, but it’s valuable to understand their potential risks and benefits at a broad level. Continued learning will assist you in choosing best practices among tried methodologies and new technology. Typically, solutions are a combination of the two. Postgraduate courses or seminars also help bridge the recently widening knowledge gap resulting from diluted, nontraditional earth systems degrees.

Technology shouldn’t be a crutch for intellectual laziness and displace critical thinking in the field, so remember to apply your geologic sense. Too often, for example, complexly-embayed or rib-like outcrops are represented...
on factual geologic maps as amoeboid ovals. Downloading GPS waypoints from an easy walk around the outcrop and generating base maps on the office GIS platform will never replace careful field observations. The geologist’s role – in almost any context – is fundamentally building models. These models will always be imperfect. Those done through shortcuts will be more imperfect. Interpretive models are never fully complete and should be challenged at all major decision points. In particular, don’t blindly rely on the previous \((n + 2)\) interpretations of \(n\) project geologists. A geologist who is newly responsible for an established study area should re-evaluate historic factual data and ensure “one voice” in interpretation. A unified interpretation by you or a small, calibrated team may prove to be wrong, but at least it will be consistently wrong, and a batch correction can be applied. Reserves of core or drill chips are like books that should be re-read by a new project geologist, for example. This can be a big job, one which I’ve observed some geologists are averse to, but it’s often more cost effective than collecting new data. However, never discard the previous work of others. Their work may be needed and helpful someday to refine your own.

Consider the economics of your chosen career specialization. For instance, the customer of a process mineralogist doesn’t care about the genetic origins of the rocks or the geologic history, but instead focus on the physical properties and proportions of mineral grains in concentrate or whole-rock that impact a specific process flowsheet or product. Jobs are based on what the world needs, and there are more career opportunities for high-demand niches of the profession, where there is a demand for skills but there isn’t a ready supply of trained geologists. If you’re hoping to be a practicing paleontologist or want a career in geology, you’d better be the best. Social license – beyond the minimum regulatory requirements – for all you do. Social license advocacy may even be a central societal value of the role for geologists in the environmental field. The social and professional licenses intersect at ethics and should never conflict. The dynamic aspects of social license work can outwardly appear tedious and are frequently challenging compared with the relative familiarity and pleasure of geologic practice, but if you aren’t committed to help build a strong relationship between your organization and community, there may be no opportunity to practice geology.

Be willing to utilize the principles of exploration and inquisitiveness you’ve learned to all tasks to which you employ yourself. Geologists can explore data, and not necessarily geological data, as well as rocks. Our ability to apply three-dimensional critical thinking and interpretation in an extra-geological context is a powerful tool that, when exercised, can enhance the value of a geologist to any organization. A summary of what makes a successful career in geology would likely parallel one given by professionals in any other field – it’s largely about developing meaningful relationships of mutual respect as well as core skills. If you have built a working relationship with an experienced mentor geologist, treasure it. If you don’t, AIPG and other industry organizations are good places to find one.

So the future is yours to make. If asked, mentors will help guide you around the pitfalls they’ve had to navigate in their own early careers. And, professional geologists are important contributors to society, even if society doesn’t always recognize it.

Michael Orobona, CPG-11099, graduated from Colorado School of Mines with a B.Sc. in Geological Engineering in 1991, and he completed a M.Sc. in Geological Sciences from Queen’s University in 1996. Between 1991 and 2002, he was employed by Newmont Mining Corporation on gold exploration and mine geology projects in Nevada and the Northwest U.S. He joined Cliffs Natural Resources in 2003, where he currently works as Principal Geologist, following mine-site and corporate roles supporting North American iron ore operations and in management of nickel, copper, and direct-shipping iron exploration projects in British Columbia, Mexico and Western Australia. He is currently on the advisory board of the Mineral Exploration Research Centre (MERC) and a Mentor for the Society of Economic Geologists.

New York State to License Geologists – NYSCPG Past-President John Nadeau (CPG-11181) announced that NY Governor Cuomo signed the bill to establish the profession of geology on November 21, 2014. Visit http://www.op.nysed.gov/prof/geo/
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U.S. Geoscience Enrollments & Degrees Robust in 2014

American Geosciences Institute (AGI), Geoscience Currents No. 96-Adapted from Christopher M. Keane

Enrollments in U.S. geoscience programs remained robust during 2013-2014, with long-term growth of 6% and 4.5% for undergraduates and graduates, respectively. The trend likely reflects the strong employment outlook for the geosciences, and U.S. programs generally are at, or near capacity. Total enrollments in 2014 were 29,219 undergraduates and 11,433 graduate students. Degree production also remained strong for bachelor degrees, while increases in Master’s likely reflects the market and students’ desire to improve employability. The total degrees awarded in 2014: 3700 Bachelors, 1480 Masters, and 638 Doctorates.

Your section needs to start a Student Chapter Today. Contact Vickie Hill at AIPG Headquarters for more details. vlh@aipg.org
Why Internships?

Reflecting on the careers of many students we have seen over several decades, it has become clear to us that many (if not most) of our highly successful students completed a professional internship with some outside agency, field camp, company, school, or organization. In fact, it could be argued that our own positions as Department Chairs had their roots in undergraduate and graduate internship experiences of various types. Informal surveys of colleagues in mid-to-late career stages reveal that almost all count internship experiences as foundational to their success and professional development.

Though some programs of study require internships (for example, field geology camps or student teaching), many degree programs do not require them. However, as time goes on and the competition for good jobs intensifies, the need for undergraduate and graduate students to undertake internship is increasing. There is even a new kind of master’s degree (Professional Science Masters-PSM) that the Council of Graduate Schools started several years ago that requires a professional internship as an integral part of the graduate degree. The University of Northern Colorado plans to offer an Environmental Science Masters-PSM starting in 2015-16. Our interest in starting such a degree was spurred by some of our geology graduates coming back and telling us that it took as long as 25 years to become CEO of their companies simply because they lacked the professional skills and habits of mind that they needed to get there quicker.

The first internship I (WHH) sent a student to in 1984 was the Sea Education Association (SEA), and it completely changed that student’s career trajectory.

I tell you Fred’s story (not his real name) in hopes that you will see some of yourself in it; we certainly see aspects of our own professional development in parts of this story. Academically, Fred was average—he had not exactly “clothed himself in glory,” as one of my mentors put it! Fred’s work suggested he might not even graduate. A certain restlessness characterized his academic career, but underlying it was a passion and a spark for authentic learning. Fred returned a completely changed person from his six weeks of shore training and six weeks at sea. He graduated with a strong record, but what earned him the job as a marine mammal trainer was his SEA training and the confidence it gave him.

Student teaching and other in-school practicum field experiences are types of professional internships with specific titles and many rules. There is truly an art to good teaching; some future teachers who are sitting in college classrooms across the country may not appear to be the most academically astute or outgoing individuals. However, a funny thing happens to many when they get up in front of a group of kids; they transform into perfectly eloquent speakers who engage and nurture. And for many of them, being connected with the right mentoring teacher makes all the difference.

At times, I (MJU) know it can be difficult for students to see the end-goal when sitting in class studying and writing; internships, and in this case, practical field experiences, immerse students in the realm they wish to reside in, and the experience shapes them the rest of the way – into becoming true professionals. One particular student, who I will call Mary, was not a very ambitious student in class; she seemed disengaged and disinterested in coursework. I had nightmares thinking about how she might interact with her students in class once she became a teacher. I half-expected her cooperating (or mentoring) teacher to report Mary as having difficulty relating to students. When I went to her school to observe her student teaching, she was in complete control of the classroom, and she had let her personality show through, by using play-on-words, puns, and humor to engage her students. One could probably just as easily argue that the experience enabled the student teacher to flourish, as the experience molded the student teacher. Either way, the professional “student teaching” internship is a positive experience for future educators.

Tangible Benefits You Can Bank on

Is there something about student internship experiences that universally benefits students in their career development and greatly increases their promise of career success? We contend that there is, and that ALL undergraduate students should actively seek internships. A variety of stakeholders have recently weighed in on the importance and value of internships (Smith, 2014 in Forbes Magazine; McGuire, 2014; Big Future-College Board, 2014; College Parents of America, 2014; and About.com, 2014). Among the valuable outcomes of getting an internship that are documented by these studies are:

- Learning how to apply for a job and representing yourself in an interview (writing a cover letter, making a resume, networking, expressing what kinds of work you are good at, clarifying and expressing your personal values);
- Getting on-the-job experience (many jobs REQUIRE that you have prior experience, and a successful intern-
ship can demonstrate that you are a person with some experience):

- Landing a permanent position with the internship provider itself, or closely-related work;
- Learning how to behave and how to interact in a professional setting—showing up on time, with a positive attitude, and with ideas to improve the outcomes of your work;
- Networking with professional colleagues and in professional societies - finding mentors and learning from them;
- If the internship provides pay, you can get PAID!;
- When you come back to the classroom from an internship, you will typically find new passions to pursue, and newfound motivation to succeed in school;
- Accomplishing a major project from your internship that documents your accomplishments and proves your ability to work with a team; and
- Obtaining a good reference for future job applications from your internship provider.

How to Find an Internship

Though there are lots of resources available to help you find an appropriate internship, typically you will have to take the initiative to get the process started. And plan on many months—even up to a year—to find the right internship for you. Some college advisors, department heads, or college internship offices can be of great help, but you will need to contact various people and try various strategies to research what is available. Many colleges have regularly-scheduled job and internship fairs on campus, and most professional geoscience organizations have formal or informal events at meetings. Use the information and links in Table 1 below to get started. Once you have some ideas, go to your advisor or department head to learn what has worked well for students in the past. Some things that sound good on paper might not be as good as they appear; others might be wonderful, but only one student in the U.S. will win the internship. That one student could be you, but don’t count on it: Be sure to FORMULATE a PLAN B, a PLAN C, etc.

Rules for Internships—Don’t Miss This!!

Colleges and universities have their own rules and requirements that must be met before you do the internship. If you need to have course credit for an internship appear on your college transcript. In order to take an internship for credit at your home college or university, be sure you understand and follow the rules and requirements to allow you to do so and obtain credit. Typically, your school and the agency/company/organization will need to execute an internship agreement, which typically specifies whether or not you will be paid, who the contacts are at the agency and your school, schedules of reporting and feedback on the student intern, and who will be covering your “workers compensation insurance.”

Speaking of pay, some internship providers will insist on paying the student, others can never pay a student, and others haven’t decided whether to pay a particular student. Some organizations charge tuition for the programs they offer and may provide college credit through an accredited college (which might transfer to your school to meet requirements of your degree program). Negotiations for pay are typically between you and the internship provider—your advisor or department head rarely get involved in pay negotiations. Even if you don’t get paid, all is not lost—if you do a good job without pay, internship providers may offer you a job and/or write you a good reference letter. Some departments or colleges have policies that prohibit students from getting BOTH pay and college credit for an internship; others allow both pay and college credit.

Internships We Knew and Loved

One of my (WHH) undergraduate requirements at Middlebury College was to research and write a senior thesis, which we started contemplating at the end of our junior year. I got involved in studying sediment accumulation from paper mills and associated infauna/epifauna in the “Lake Champlain Studies” program started by my advisor, Dave Folger. In addition to learning a bit about diesel engines and the judicious use of ether to start a cold engine in the winter (!), I took a paid internship opportunity to work with the Vermont Attorney General’s Office on lake studies. I worked with engineers and geologists, and was responsible for completing analyses on a set time schedule using precise protocols. When the data from that work and my thesis were used in a U. S. Supreme Court case, I had renewed motivation to go on to graduate school and pursue research. The internship experience and accomplishments allowed me to do both.

For one of us (MJU), a graduate internship fell right into my lap, so to speak. I had just begun my master’s degree in Earth Sciences at the University of Northern Colorado, when the first author of this article forwarded me a solicitation for an intern position at AIPG Headquarters from then Executive Director Bill Siok, CPG-4773. I eagerly expressed interest, and just a few short days later, I was visiting with Bill about the possibility of what turned out to be a paid internship with AIPG. As I was a former earth science teacher, he was interested in having me develop some materials about geology and what geologists do. The end products of the internship were several fact sheets and a brochure. I had taught geology and oceanography as part of the earth science curriculum as a teacher, but researching specifically about petroleum resources, fractionation, climate change, and more, helped me to better understand in detail more practical aspects and applications of geology. The simple act of researching led to a better understanding of how to conduct literature research and paid dividends when it came to completing my final master’s project. As an added benefit, Bill took me to various meetings of the professional geology community, which was extremely valuable to me personally and professionally. I count the AIPG internship as one of the principal cogs in the wheelhouse of my professional success in graduate school, and it was one of only a handful of experiences that spurred me on to future graduate education.

Parting Thoughts

It is not easy to set up an internship—you have to take the lead more often than not. The reason that agencies and companies want student interns is that you may have new ideas, novel ways of approaching problems, and different strategies even in the questions you ask. The companies and agencies are able to approach problems with fresh perspectives because you are there. If the internship provider offers you a job—that’s great! But if not, you often will have made many contacts with associated industries and agencies that have a chance to meet you in a professional setting. Compared to your classmates
<table>
<thead>
<tr>
<th>Type of Internship</th>
<th>Description</th>
<th>Contact Information</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Agency (Various Federal, State, County, and Municipal)</td>
<td>Work for Earth Sciences agency such as geological survey, natural resources office, or GIS technical mapping office; geological hazards or resource assessment work typical</td>
<td>Check with your advisor and your college internship office; Look in your local yellow pages or search online</td>
<td>Federal and State Internships highly competitive; county and municipal internships more available; usually NO pay at government internships—you will often be a “volunteer”; security background check almost always required [See Figure 1 for an example of a publicly-funded internship experience]</td>
</tr>
<tr>
<td>Corporate/Company</td>
<td>Mostly natural resource-extraction companies finding water, hydrocarbons, or minerals; also environmentally-related work</td>
<td>Check with your advisor and your college internship office; check local companies and websites</td>
<td>If getting paid for internship is necessary, companies might be the best place to look</td>
</tr>
<tr>
<td>Consulting Firm</td>
<td>Usually a multi-office environmental engineering firm, or energy sector firm or, water-engineering firm</td>
<td>Check with your advisor and your college internship office; check local companies and websites</td>
<td>Typically large firm with many divisions and offices around the country. Some are multi-national.</td>
</tr>
<tr>
<td>Experiential Organizations (Examples: Geology Field Camps; Sea Education Association; And Student Conservation Association)</td>
<td>Non-profit organizations that focus on groups of people working together to accomplish tasks</td>
<td><a href="http://www.sea.edu/">http://www.sea.edu/</a> <a href="http://www.thescfa.org/gad-landing/?gelid=CMrFgsnJmMECFSyCMgodpSsAFA">http://www.thescfa.org/gad-landing/?gelid=CMrFgsnJmMECFSyCMgodpSsAFA</a></td>
<td>Generally very good for team-building and for overcoming substantial field challenges; travel to site may cost you just to get there [See Figure 2 for an example of an experiential-type internship at sea]</td>
</tr>
<tr>
<td>Individual Proprietor</td>
<td>Typically one person (or a few people) runs things</td>
<td>Look in your local yellow pages or search online</td>
<td>As a single proprietor, there might not be continuous stream of work opportunities; check to see if the proprietor has a good track record working with interns</td>
</tr>
<tr>
<td>Professional Research</td>
<td>Exploratory experiences in your major that place you with experts in the field</td>
<td>Check with your advisor and your college internship office Example: <a href="http://www.orau.gov/netl/research-experiences/index.html">http://www.orau.gov/netl/research-experiences/index.html</a></td>
<td>You may work with a university faculty member on research at your university or in a professional laboratory</td>
</tr>
<tr>
<td>Research Experience For Undergraduates</td>
<td>Funded by National Science Foundation; work on highly-specialized research</td>
<td><a href="http://www.nsf.gov/crssprgm/reu/reu_search.jsp">http://www.nsf.gov/crssprgm/reu/reu_search.jsp</a></td>
<td>Highly competitive and research focused; often in a university or college laboratory for the summer; stipend and travel allowance provided</td>
</tr>
<tr>
<td>Teacher/Educator Licensure Or Certification Programs</td>
<td>Often called “student teaching”; companies want gifted educators for a variety of training programs</td>
<td>Varies by state; departments of education typically run these</td>
<td>There are one- and two-year post-baccalaureate programs designed to prepare degree-holding individuals to become certified teachers for K-12; private schools often do not require teacher licensure or certification</td>
</tr>
</tbody>
</table>

Table 1. Types and Descriptions of Internships.
who did not take the extra effort to get internships, you are way ahead.

What happens if your internship bombs, your supervisor is less than professional in your treatment, or the work does not meet your expectations? Well, aren’t you fortunate to have learned about those things before you land a full-time job or go on to graduate school? Some settings suit you, others might not. In our experience, it is rare that an internship fails to work out well for both the student AND the company. It is to everybody’s advantage that internships work out well. Sure it is a risk to go out and do internships—but not as much of a risk as being ill-prepared for your first job!

THINK IT OVER—AND THEN ACT!

References


William H. Hoyt is Professor of Oceanography and Chair of the Department of Earth and Atmospheric Sciences at the University of Northern Colorado. His first internship was for the Vermont Attorney General’s Office gathering data for the Lake Champlain Studies program, which made its way to the U.S. Supreme Court. Hoyt served on the AIPG National Board of Directors in 2000. A new AIPG student chapter just started at the University of Northern Colorado.

Michael J. Urban is Associate Professor of Education and Chair of the Department of Professional Education (currently on sabbatical) at Bemidji State University, part of the Minnesota State Colleges and Universities System (MnSCU). He interned at the American Institute of Professional Geologists National Headquarters in Colorado. Urban has worked for a private meteorological company, and taught courses in environmental geology, physical geology, and planetary science at several colleges and universities.
Advice for Life From the Flight Crew

Jean M. Neubeck, CPG-11438

No, I am not a former stewardess, but I wanted to become one once — the lure of places far from home, the adventures and all that. Then I wanted to become a pilot; heck, it was the ’70s and women wanted “more.” Alas, there was no pilot license for this girl. But I still recall my first plane ride and peering over the rows of heads to watch the safety spiel. Enough about me, but I’ll get back to the pilot and that flight attendant shortly...

This TPG issue focuses on student geologists. You are the future of our profession. I had chosen solid themes for my column; being open to opportunities and maintaining one’s technical skills. After reading the articles by others I find that they have conveyed similar advice very well; in fact, better than I might have phrased the same thoughts. So I strongly urge all of you - students, new professionals, and seasoned geologists alike, to read their pieces. The authors have put forth much sound and sage advice that we all can apply.

Now that I’m done promoting others’ very practical and realistic advice, let’s get back to the flight crew. Sitting on planes recently got me thinking that airline advice can be pretty philosophical.

Greetings, I’ll be your Captain today...

Respect your boss or supervisor. Bosses will change and you may become the boss someday. That goes for your coworkers, clients, and all others with whom you interact. And you never know, maybe they’ll help you some day - then again, maybe not depending on your attitude.

And don’t be intimidated (for too long). The pilot looks confident and competent in that uniform. Have some confidence (or fake a little). That instrument panel sure is overwhelming if you scan it all at once. A pilot taught me to look at each gauge individually - that one’s the air speed, that one’s for altitude; hey, I can understand it now. It’s a lot easier if you break up a complex task into discreet objectives and steps.

Please notify us if you cannot perform the duties in the emergency exit seat...

Your employer, client, family and others WANT you to succeed. Ask for help, and mentor or help others when you can. Everyone has something to contribute. Sometimes it seems that everything goes wrong. Follow your supervisor’s lead, remain calm and focus so you can function. Don’t let ‘em see you sweat, but don’t be foolish. Seek others’ advice when the situation arises, or well before that point if explosives are involved.

In the unlikely event of a water landing...

Of course, you cannot be prepared for every contingency that life will continuously throw at you. But you can be mentally prepared for the inevitable changes. You bought a ticket to Paris but landed in Brussels? Embrace Plan B, do that “different” job with a smile, accept that transfer, mourn that loss and learn, move on or try another strategy.

Make sure you have all your belongings before you exit...

Always perform quality work, then proof read/check it (again). Learn to accept constructive criticism. Be graceful when compliments come your way, but be sure to share the credit. Use both positive and negative feedback to improve your performance.

Your seat cushion can be used as a floatation device...

Think outside the box, learn new skills especially by helping or watching others. Combine your outside skills with geology; GIS, art, technology, etc. Exercise your brain regularly, and always check technology against your geologic sense and judgment.

Put your own oxygen mask on first...

“Do Your Job!” You cannot help the team or someone else until you understand and complete your job. Even at entry level, your job is important, or I assure you, they would not be paying you. Philosophically, putting on your oxygen also means you must be mentally and sufficiently fit to help others. Take care to be well-rounded, stable, healthy, and engage in activities outside work.

Carry on baggage only...

Only items that fit in the overhead bin or under your seat, please. Everyone makes mistakes, loses a job, has a bad experience(s). Use your critical thinking to evaluate your behavior, attitude and emotions, what went wrong, and how you can do perform better next time. Don’t use someone else’s behavior or words as excuses. You are a GEOLOGIST and want to be accepted for your ability and talent. You will encounter discrimination, adversity, politics, excuses, external fault – don’t fall for it. Assess what you can control or influence; accept and learn. You may stand out from others, but be a geologist first. This is my favorite advice and it has served me well for more than 32 years.

Thank you for choosing our airline...

There are a thousand qualified geologists, consultants, researchers, managers, etc. who could replace you. They are actively applying, marketing, and researching ways to land your job. They’re waiting to hear from an employer, client, or business associate that “the last person didn’t work out,” so don’t let them be referring to you. Be grateful for your opportunities. Remember to thank your clients, co-workers, employer, contractors, suppliers, and even regulators when appropriate.

Now fasten your seat belt and get ready for take-off.
1. This hexagonal mineral [(Ni, Fe, Mg) CO₃] is commonly used as jewelry and has a yellowish apple green color with a hardness of approximately 4.5 to 5:
   a) Malachite
   b) Pyrope
   c) Gaspeite

2. A 50-foot specimen of this Mesozoic marine reptile was found in Svalbard in 2007. The animal is estimated to have weighed nearly 40 to 50 tons with a bite four times more powerful than T-Rex and present-day crocodiles, well in excess of 2 tons per square inch!
   a) Pliosaurus
   b) Dyatrima
   c) Ichthyosaurus

3. This type of “mass movement” or “earthflow” occurs predominantly in regions where the ground freezes to considerable depth. As the permafrost thaws during warm periods, the top portion of the earth starts to move downslope. We know this process as:
   a) “Liquefaction”
   b) “Wetland development”
   c) “Solifluction”

4. In our studies of rock deformation, shear fractures, shear strength and the Coulomb-Mohr fracture criterion, consider the following equations of equilibrium:
   • $P_3 \sin \theta - P \sin \theta + t \cos \theta = 0$
   • $P_1 \cos \theta - P \cos \theta - t \sin \theta = 0$

   For the above, “$P_3$” is the “minimum principal stress”, “$P_1$” is the “maximum principal stress”, “$\theta$” is the “angle between the shear fracture and the minimum principal stress direction”, “$P$” is the “normal stress at failure” and “$t$” is the “shear stress at failure”. Which of the following expressions allows us to calculate the “shear stress at failure ("$t$") from a knowledge of “$P_1$”, “$P_3$” and “$\theta$”?
   a) $t = [(P_1 \times P_3)/2] \times (\cos 2\theta)$
   b) $t = [(P_1 - P_3)/2] \times (\sin 2\theta)$
   c) $t = [(P_1 + P_3)/2] \times (\tan 2\theta)$
   d) Great Scott! Me, do this? Disgusting!
Greetings friends, colleagues, and students in all membership categories of the American Institute of Professional Geologists! It is with great pleasure and anticipation of a successful and productive year for AIPG that I write this initial column as the 2015 President of AIPG. It seems particularly appropriate that this message should coincide with the student issue of The Professional Geologist as I firmly believe that the future of our organization lies within college and university geoscience students and K-12 students who are just beginning to learn about the wonders of our remarkable planet and the incredible importance of natural resources from the Earth.

Given these sentiments, one of my primary goals for 2015 is to build upon the excellent progress made in recent years to engage university students with AIPG. Our student membership numbers have grown dramatically as a result of efforts by the outstanding staff at the AIPG headquarters office, by members across the country, and by actions of the National Executive Committee. Initiating free membership for students in 2011 was an excellent step taken by former President Sam Gowan and the national board that has facilitated recruitment of nearly three thousand student members since its inception. The Foundation of AIPG Board is also working to develop new programs such as the Young Professionals Program, student scholarship and internship programs, and other opportunities for students and young professionals. Another exciting development through the Foundation of AIPG is the recently launched William J. Siok Graduate Scholarship which will increase our engagement with graduate students and honors the tremendous contributions and career of recently retired AIPG Executive Director Bill Siok.

AIPG members also strengthen our student relationships by helping students to better engage with industry through mentoring, networking, resume building, field trips to professional venues, and other industry oriented activities. AIPG members have historically done an outstanding job of supporting these endeavors; however, there is more work to be done. Internships, work co-ops, seminars by professional geoscientists on university campuses, and corporate sponsored scholarships and student competitions all are excellent avenues for engaging students with industry and preparing them to enter the work force upon graduation. I encourage AIPG members to promote these activities through their work environments and to share in these experiences which will greatly enrich the professional lives of students and professionals alike.

In addition to student oriented activities, AIPG members need to engage faculty members of geoscience departments across the nation. A great way to do that is to include them in planning and hosting AIPG conferences, leading field trips, moderating technical sessions, judging poster sessions, and many other activities. Excellent opportunities for interactions with students and faculty are coming up at the next two annual conferences, in Alaska and New Mexico and I cordially invite and encourage your participation and suggestions for increasing our university relations and student interactions at these meetings.

A significant factor associated with engaging students and university faculty with AIPG concerns the way in which they perceive professional certification and licensure. Students and faculty view examinations as the fundamental vehicle for demonstrating competency in a field of study, and many feel that examination-based licensure, registration, or certification is viewed more favorably, if not required, by potential employers. I have personally had students tell me that rather than join AIPG, they chose instead an organization that includes an examination as part of its requirements. There are too many issues associated with this topic to fully explore here; however, if we want to better engage the academic community we should consider a membership category that includes an examination. Such a category could have potential to strengthen AIPG and the geoscience profession at state, national, and international levels.

I’d like to close by thanking everyone in the AIPG community for their past and future support of the organization and for everything they do to make the geosciences a stronger profession. Geoscientists help to provide natural resources and energy supplies that fuel the world, and geoscience research provides fascinating, critical information to better understand our amazing planet. Together we can make a significant impact on elevating our profession to the level that it deserves.

J. Foster Sawyer, CPG-10000
foster.sawyer@sdsmt.edu

Engaging Students

For those who need only an occasional search of the GeoRef database, it is easy to request a GeoRef custom search. A member of the GeoRef staff will conduct the search according to your specifications. The search results will be delivered by email.

To order a Custom Search, contact Jim Mehl at jmp@agiweb.org, (703) 379-2480 ext 236 or Monika Long at ml@agiweb.org.

The cost of a custom search is $225.00 plus $.45 per reference.

Please mention AIPG when ordering your custom search.
Answers:

1. The answer is choice “c” or “gaspeite”, a nickel, iron, magnesium carbonate.

“Malachite” \( \text{[Cu}_2 \text{ (CO}_3 \text{) (OH)}_2 \text{]} \) is a green, monoclinic copper carbonate hydroxide mineral with hardness of 3.5 to 4. Its color is typically darker than that of “gaspeite”.

“Pyrope” \( \text{[Mg}_3\text{Al}_2\text{(SiO}_4\text{)]} \) is a red to purplish-black variety of garnet. The mineral is a cubic “nesosilicate” with a hardness of 7-7.5.

2. The answer is choice “a” or “pliosaurus”.

Diatryma describes an extinct, giant flightless bird of the Eocene Epoch. It grew to a height of about 7 feet. It had massive legs and was probably a strong, fast runner. The head was large and supported a powerful beak.

Ichthyosaurus was a Mesozoic reptilian counterpart of toothed whales. These animals had a fish-like tail, dorsal fin and paddle limbs. The pointed head allowed this carnivore to cut rapidly through the water. They averaged six to eight feet in length, but some probably grew much larger.

3. The answer is choice c” or “solifluction”.

Mudflows through “liquefaction” occur as loosely-packed sediment behaves in fluid fashion in response to ground vibrations or through the sudden addition of water, bringing about the collapse of the sediment’s structure.

“Wetlands” are land areas which becomes saturated with water, either permanently or seasonally. “Wetlands” consist of saturated soils, supporting distinct ecosystems and aquatic vegetation.

4. The answer is choice “b” or \( t = [(P_1 - P_3)/2] \times (\sin 2 \theta) \). The proof follows:

We are given:

\[
P_3 \sin \theta - P \sin \theta + t \cos \theta = 0 \quad (1)
\]

\[
P_1 \cos \theta - P \cos \theta - t \sin \theta = 0 \quad (2)
\]

To obtain the wanted equation for “\( t \)”, we can solve (1) and (2) for “\( P \)” and equate both expressions. Thus:

\[
P \sin \theta = P_3 \sin \theta + t \cos \theta \quad (3)
\]

\[
P \cos \theta = P_1 \cos \theta - t \sin \theta \quad (4)
\]

\[
P = P_3 + t \cot \theta \quad (5)
\]

\[
P = P_1 - t \tan \theta \quad (6)
\]

\[
P_1 - t \tan \theta = P_3 + t \cot \theta \quad (7)
\]

\[
P_1 - P_3 = t (\tan \theta + \cot \theta) \quad (8)
\]

\[
P_1 - P_3 = t \left[ (\sin \theta / \cos \theta) + (\cos \theta / \sin \theta) \right] \quad (9)
\]

\[
P_1 - P_3 = t \left[ (\sin^2 \theta + \cos^2 \theta) / (\sin \theta \cos \theta) \right] \quad (10)
\]

Recalling trigonometric identities:

\[
\sin^2 \theta + \cos^2 \theta = 1 \quad (12)
\]

\[
\sin 2 \theta = 2 \sin \theta \cos \theta \quad (13)
\]

\[
\frac{1}{2} \sin 2 \theta = \sin \theta \cos \theta \quad (14)
\]

Substituting (13) and (14) into (11), we obtain:

\[
P_1 - P_3 = t \left[ 1 / (\frac{1}{2} \sin 2 \theta) \right] \quad (15)
\]

\[
t = [(P_1-P_3) / 2] \times (\sin 2 \theta) \quad (16)
\]

Equation (16) is the answer that we seek and corresponds to our choice “b”. Simple stuff, isn’t it? Oh, well....
On January 12, 2015, a sinkhole opened abruptly on a residential street in Lafayette, Colorado, nearly swallowing a car. Happily, the driver was able to escape without injury, and his car was removed with comparatively little damage. The sinkhole was about eight feet deep, and 20 feet in diameter. Its location and the cause of the sinkhole was no surprise. Underneath was the main shaft of the Simpson coal mine, which operated in Lafayette from 1888 to 1927. The Town of Lafayette owes its name to Lafayette Miller, who owned the land with his wife Mary; they were successful farmers. Lafayette died of heatstroke in 1878. Mary continued the farm, and her business interest shifted to coal, which was discovered on her land in 1884. She then platted the original limits for the town, which she named for her late husband. The coal seam was 14 feet thick, and the mine produced over four million tons before it closed. The shaft, about 200 feet deep, was subsequently sealed at the collar with a concrete slab and buried. The town expanded over the original footprint of the mine, but the shaft remained below East Cleveland Street.

The sinkhole opened when the original slab settled, perhaps due partly to routine traffic vibration in the neighborhood built over the mine. Fortunately for the town, the State of Colorado pays for remediation due to this type of mine subsidence. The initial response was to fill the sinkhole with flowable concrete, sub-base and finally bituminous pavement. At a later time, the plan is to grout the entire shaft to prevent further subsidence. The coal seam was horizontal, and the big question is to what extent the abandoned workings are still open to the shaft, after nearly 100 years. That could mean a lot of grout.

Lafayette is part of the Boulder-Weld Coal Field, and the legacy of mining is extensive. Moreover, the mining records are quite good, enabling municipal planners and developers to avoid areas at risk from subsidence. The various documents are available through the Colorado Geological Survey, or local municipalities, via website or in person.

Sinkholes are dramatic and get good media coverage. In Lafayette, the cause of the sinkhole was anthropogenic; elsewhere, sinkholes due to karst open unpredictably. Eliminating the hazard requires avoidance of karst-prone areas, not always easy in urban and suburban areas.

Less appreciated are risks due to naturally-occurring minerals and elements. Asbestos, radon and lead in paint are perhaps the best examples known to the general population, through routine testing as part of real-estate transactions. More problematic are less-publicized and more subtle geologic hazards due to slow but persistent migration of various metals in vapor and liquid phase through rock and soil. Our ability to understand such hazards reflects the incredible advances in analytical instrumentation since the mid-20th century, enabling geologists to detect and record natural geochemical processes on local and global scales.

I’m presently reading Four Billion Years and Counting – Canada’s Geological Heritage, published in October 2014 by the Canadian Federation of Earth Sciences. This book takes the reader through geologic time from the beginning (the 4,030-million year Acasta Gneiss of the Hadean Eon) to the present (Anthropocene Epoch). The photographs are beautiful, and with colorful maps and explanatory graphics, lead the reader through concepts and places from coast to coast, and the Great Lakes to the Arctic.

Part 3 of Four Billion Years and Counting is Wealth and Health, which contains an interesting chapter, Toxins in the Rocks. One of the central discussion points is how bioconcentration and biomagnification affect the food chain. Cadmium is concentrated by lichens, a staple food of caribou, in which the cadmium collects in certain organs. Mercury vapors naturally emanate from black shales and as a vapor or liquid phase along faults under lakes, biomagnifying in the food chain to apex predators that also happen to be food sources. The latter include humans (“Sick from Sushi” – Consumer Reports, October 2014). Other examples include arsenic and fluoride in well water, and selenium-accumulating plants. The subtle effects of geologic hazards are often difficult to diagnose. Just as the dosage makes the poison, so does knowledge promote avoidance, regardless of the hazard.

Stay tuned for more impressions of Four Billion Years and Counting, a thoroughly enjoyable and engaging read.
Student Interest Topics

As this issue of the TPG is a student issue, I’m sharing some thoughts that students might find useful.

Business cards are a must for networking. Several students attended the Social Licensing conference in Denver and were able to connect with some energy company employees to talk about arranging for an energy expo at their university. The company employees had business cards with their contact information while the students did not. You’ll never know when such cards will be handy. They don’t have to be fancy and so you can either buy them cheaply or join with a friend or two to buy the business card stock you can run through your printer. The point is to have them to hand out to those you meet at meetings, etc. In a related matter, use a personal email address on your cards rather than your student address so that you can be reached outside of school or once you’ve graduated.

Income tax deductions for geoscience equipment: if you earn money from a summer job or by working for a professor, you may be able to deduct the costs of your job-related professional supplies and equipment from your income taxes. Items like hard-toed boots, hard hats, safety vests, hammers, due to professional associations, costs to attend meetings, etc. will qualify. How much you can deduct depends on whether your income is reported to you on Form W-2 or Form 1099. If your income comes via a 1099, you can use Schedule C to deduct the full costs. If your income is reported on a W-2, then you can only deduct the costs exceeding 2% of your adjusted gross income. Every little bit helps.

Professional flexibility is needed to keep working: the cyclical nature of employment for private sector geoscientists is a continuing fact of life. Having a solid geoscience background in a variety of areas will permit you to switch fields as necessary. I know a number of geoscientists who started in the mining business or the oil business who switched to environmental or engineering jobs. In addition to skills you need a good network across the geosciences so that you know what’s going on and have contacts across the geosciences. This is something that being active in AIPG provides.

Field Camp: It’s not Optional for the Professional, this is the title of the lead topic in PE&P column 131 in the Jan/Feb ’11 TPG. If you haven’t taken or made plans to attend a field camp, do so for the reasons set out in that discussion. As a t-shirt I have reads, “The geologist who sees the most rocks wins.” There’s no substitute for seeing geology in the field. Rocks really hang out in the mountain west and if you haven’t visited, do so. Read Stephanie Jarvis’ (then SA-1495) “Notes from the field” Student’s Voice column in the Sep/Oct ’11 TPG and Kristina Pourtabib’s, SA-3410, “A capstone experience” Student’s Voice column in the Sep/Oct ’13 TPG on the value and importance of field camp (back issues of the TPG are available on AIPG’s website).

Volunteer: Jean Neubeck’s, CPG-11438, Editor’s Corner, “Positive Side Effects of Selfishly Volunteering (Yes, I meant Selfish)” in the Oct/Nov/Dec ’14 TPG is an excellent discussion of the benefits of volunteering in professional organizations. Start with the geology club at your school. If it’s not an AIPG Student Chapter, form one. Participate in your local Section’s meetings and field trips and those of other local geoscience organizations. Volunteer to help with these activities and in other ways. Practicing professionals welcome the help and are eager to get to know our younger colleagues. You’ll be surprised at the job counseling and opportunities you’ll be exposed to. This is also known as networking; read Stephanie Jarvis’s, YP-0125, “Transitions” column in the Apr/May/Jun ’14 TPG.

Reflections on a Geologic Career is a free publication from AIPG’s website in which a number of geoscientists from across the geoscience profession reflect on what they wish they’d known when they started their careers. If you don’t have a copy, download one and read it.

Questions for Students and Young Professionals

I prepared Figure 1 showing the age frequency distribution of all AIPG members for whom AIPG has a birth year, a total of 5,554 members. The distribution is not surprising and reflects similar histograms prepared over the years. It is essentially identical to an age frequency histogram I prepared in September 2011. Those over 80 years of age are the remnant of what was a frequency high 35-40 years ago. Those between 51 and 70 years of age were young then and now form the prominent high distribution. Those 30 years of age or less form a new high. These are the students and young professionals who will become the leaders of the geoscience profession and, we hope, of AIPG in the coming years. Currently, 66% of the membership is older than 50 while 20% are 35 and under. The 14% between 35 and 50 are those who managed to stay...
AIPG is very interested in learning what its Student and Young Professional Members would like from the Institute. You are the future of the organization. What can the Institute do to encourage Student Members to become Young Professional Members when they leave school? What are the best methods of communicating with you? How can we help you in your careers?

One suggestion is to make the TPG more web interactive, allowing easy access to individual articles by clicking on links rather than being in its current single PDF file format. If this is something you would like, please let the Editor know. Suggestions or examples of such implementations would be welcomed as well.

I addressed the issues of “Moving from School to Professional Life” in column 146 (Jul/Aug ’13), which included contributions from Dawn Garcia, CPG-8313, Mike Redman, and Rick Powers, CPG-6765. This discussion is worth reviewing.

2015 Proposed AGI Guidelines for Ethical Professional Conduct

I am a member of an American Geoscience Institute (AGI) committee that worked on updating AGI’s Guidelines for Ethical Professional Conduct during this past summer and fall.1 The previous version was published in 1999. These proposed Guidelines are organized differently from many professional codes of ethics, including AIPG’s. The two main areas of focus are the professional geoscientist’s responsibilities in day-to-day activities and as a member of a professional and geoscientific community.

The proposed AGI Guidelines are available for consideration by all AGI member societies, including AIPG. The proposed Guidelines are aspirational and are not the basis for disciplinary activity. Whether discipline is needed is a decision for individual societies. The AIPG Executive Committee will be considering whether AIPG should endorse these proposed Guidelines at the February Executive Committee meeting.

The proposed AGI Guidelines are:

**Preamble:** Geoscientists play a critical role in ethical decision-making about stewardship of the Earth, the use of its resources, and the interactions between humankind and the planet on which we live. The public must trust and have confidence in the work of individual geoscientists and the geosciences as a profession. The American Geosciences Institute (AGI) expects those in the profession to adhere to the highest ethical standards in all professional activities. Geoscientists should engage responsibly in the conduct and reporting of their work, acknowledging the uncertainties and limits of current understanding inherent in studies of natural systems. Geoscientists should respect the work of colleagues and those who use and rely upon the products of their work.

In day-to-day activities geoscientists should:

- Be honest.
- Act responsibly and with integrity, acknowledge limitations to knowledge and understanding, and be accountable for their errors.
- Present professional work and reports without falsification or fabrication of data, misleading statements, or omission of relevant facts.
- Separate facts/observations from interpretations.
- Accurately cite authorship, acknowledge the contributions of others, and not engage in plagiarism.
- Acknowledge and act on real or perceived conflicts of interest.
- Continue professional development and growth.
- Encourage and assist in the development of a diverse and inclusive workforce.
- Treat colleagues, students, employees, and the public with respect.
- Keep privileged information confidential, except when doing so constitutes a threat to public health, safety, or welfare.

As a member of a professional and scientific community, geoscientists should:

- Promote greater understanding of the geosciences by other technical groups, students, the general public, news media, and policy makers through effective communication and education.
- Acknowledge the complexities and uncertainties of Earth systems.
- Use their technical knowledge and skills to protect public health, safety, and welfare, and enhance sustainability of society.
- Inform the public about natural resources, hazards, and other geologic phenomena clearly, accurately, and responsibly.
- Advocate responsible stewardship of the planet through an improved understanding and interpretation of Earth systems, and by communicating real and potential implications of human actions.

The AIPG Code of Ethics has the following headings:

- Preamble
- Canon 1. General Obligations
- Canon 2. Obligations to the Public

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1. Formation of this AGI committee was one result of the AGI Leadership Conference on Ethics described in column 148, Nov/Dec ’13.
That social permission was needed for a mining company to conduct its operations, for example from local communities or indigenous people. Since then, the premise of the SLO has been extended to other geological challenges faced by society, such as fracking for oil and gas development, radioactive waste disposal, carbon capture and storage, geologic hazards, and deep-well injection of wastewater.

“The lay public is frequently uninformed or misinformed about the complex scientific and technical challenges that accompany these issues. This problem is typically coupled with a general lack of knowledge about subsurface geology. The SLO seeks to alleviate this problem through a variety of public participation strategies to engage with citizens, communities, and stakeholder groups. Through this process, geoscientists can develop an understanding of public knowledge and concerns.”

Social licensing involves far more than complying with environmental and other regulatory requirements. The need to obtain general public support is both critical and increasingly covered by statements promulgated by various advocacy and industry groups. NIMBY’s (not in my back yard) are everywhere and not all of them can be convinced that your project should go forward. But you do need majority support for your project. Figure 2 shows the change in emphasis in guidelines from an emphasis solely on regulatory and environmental compliance through growing attention to social issues to an emphasis on sustainable development for natural resource projects of all types. Similar trends affect the oil and gas industry as demonstrated by the recent growth in anti-fracking initiatives in the United States.

Figure 2. The shifting emphasis towards social licensing in mining industry guidelines (after Matt King slide, AIPG Social Licensing Conference, Denver, 11/10/14).

Social Licensing—a New Responsibility for Exploration Geoscientists

As stated in the brochure for the Social Licensing—Achieving Public Support Conference held in Denver on November 10, 2014, “The term “Social License to Operate” (SLO) was originally adopted for use by the Canadian mining industry in the late 1990s, and referred to the concept that social permission was needed for a mining company to address issues that are not currently part of or are not as explicitly stated in the AIPG Code of Ethics:

• Separate facts/observations from interpretations.
• Encourage and assist in the development of a diverse and inclusive workforce.
• Promote greater understanding of the geosciences by other technical groups, students, the general public, news media, and policy makers through effective communication and education.
• Acknowledge the complexities and uncertainties of Earth systems.
• Inform the public about natural resources, hazards, and other geologic phenomena clearly, accurately, and responsibly.
• Advocate responsible stewardship of the planet through an improved understanding and interpretation of Earth systems, and by communicating real and potential implications of human actions.

Revising the AIPG Code of Ethics to incorporate these proposed Guidelines is something AIPG should consider doing. If anyone would like to work with me on this revision to the AIPG Code of Ethics just let me know. I will welcome your thoughts and suggestions.

The Professional Geologist

Geologic Ethics & Professional Practices
is now available on CD

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

AIPG members will be able to update their copy of this CD by regularly downloading the pe&p index.xls file from the www.aipg.org under “Ethics” and by downloading the electronic version of The Professional Geologist from the members only area of the AIPG website. The cost of the CD is $25 for members, $35 for non-members, $15 for student members and $18 for non-member students, plus shipping and handling. To order go to www.aipg.org.
One of the important points made during the Conference was that exploration geoscientists, whether in mining, petroleum, dam siting, highway route investigations or improvements, or whatever the proposed the proposed project is, are generally the first “boots on the ground.” Therefore, their actions affect how the social licensing process, and therefore the project’s success, proceeds. Do they attempt to learn about the local area and population and what their wants, needs, and desires are? Do their activities leave a positive or negative impression of the proposed project? Even where a prospect doesn’t pan out, experience indicates that the prospect will be revisited by others from firms with differing project hurdle rules and/or mineral prices change. The impressions made by the first and subsequent teams are important. This point was made by several of the speakers at the conference and has been made elsewhere (e.g. Andrew T. Swarthout, 2014, Another Important Role for an Economic Geologist: SEG Newsletter, no. 98, July 2014, p. 8).

Debra Struhsacker, CPG-8259, captured this point in Figure 3 in which the professional (mining industry or otherwise) must constantly juggle balls representing community relations, science & technology, media relations, government relations, and regulatory requirements. All the balls are important and dropping any one may cause delays, higher costs, and possible project failure.

Figure 3. Debra Struhsacker, CPG-8259, from “Hard Rock Mining Communications Strategies Case Histories,” AIPG Social Licensing Conference, Denver, 11/10/14; drawn by Peg O’Malley.

2015 Energy Exposition with Technical Sessions Presented by AIPG

CALL FOR ABSTRACTS - submit online
Abstracts due March 9, 2015
June 24 - 25, 2015
Billings, Montana

Transect Across the Beartooth Mountains Front Laramide Triangle Zone: Dean, Montana to The Golf Course

Field Trip June 26, 2015

For more information on Technical Sessions and the Field Trip, visit the AIPG website at www.aipg.org.

Visit the AIPG Booth!

www.aipg.org
ET Measurements Require Care

William J. Stone, MEM-2164

Water budget is an important aspect of water-management studies. Precipitation is the ultimate source of water resources. Upon reaching the ground it is distributed in one of three ways: runoff (RO), evapotranspiration (ET) or recharge (R). Therefore, the water-balance equation is commonly generalized as \( P = RO + ET + R \). If data are available for all but one of these parameters, the value for the unknown one can be backed out, for example, \( ET = P - (RO + R) \). But until recently, solving the equation was made difficult because two of the parameters, \( ET \) and \( R \), were usually unknown. However, technological advances now facilitate the measurement of \( ET \) and a mass-balance method, using soil-water chloride content, gives long-term average recharge rates.

In the case of \( ET \), the rate of passage of a laser beam or sound wave between a transmitter and receiver over a short known distance can be used to determine the water content of the air and ultimately the water loss from plants and soil beneath it. These methods were designed for use on the air over large fields of single agricultural crops. However, the USGS has successfully applied the methods to large, uniform stands of native vegetation as well (for example, greasewood in Nevada).

A failed \( ET \) study I learned about provides some pointers on how not to apply the method. A station was reportedly set up along a stream in a fairly deep, narrow canyon where a single species of pine was the main vegetation type. So far so good. But the instruments were placed a few feet above the ground surface rather than above the vegetation canopy, reportedly to target evaporation from the soil. The original method measures that as well as transpiration since it is the total water loss to the atmosphere that is of interest in water-balance studies. Furthermore, instruments were not left in place for regular monitoring, but deployed only when measurements were to be taken. Finally, power was to be provided by solar panels, but these were inexplicably set up on a north-facing slope where they were in the shade much of the time.

As might be expected, few data were generated and, perhaps mercifully, a flood eventually wiped out the short, poorly anchored instrument platform. Fortunately, the expensive instruments were not present at the time. The tall, heavy towers normally used to properly deploy the equipment would have withstood most runoff events. Tip: if a flood wipes out your \( ET \) study, you’re probably doing it wrong!

Dr. Stone has more than 30 years of experience in hydro-science and is the author of numerous professional papers as well as the book, Hydrogeology in Practice – a Guide to Characterizing Ground-Water Systems (Prentice Hall). Feel free to argue or agree with him by email (wstone04@gmail.com).

Have You Paid Your 2015 Dues?
In accordance with Article 8, Section 8.2.1, of the Bylaws, Annual Membership dues are due and payable January 1, 2015. Those members whose dues are not paid by February 15, 2015, will be suspended. A late fee will be required for dues paid after February 15, 2015. Login to the AIPG website to pay. You will receive a receipt by email when your payment is processed.

Thank You!!
Whether you are new to college, or a returning student, you may want to learn a bit more about how the university you attend functions. You may already have a major and be on track to complete your degree in four or five years, a feat that is becoming more challenging with each passing year it seems. In any case, go ahead and read on for a glimpse into the inner workings of higher education.

There is, of course, a difference between 2-year and 4-year colleges, and the present discussion will be constrained to traditional 4-year undergraduate and graduate institutions of higher learning (referred to, typically, as colleges, universities, schools [e.g., school of mines], institutes [e.g., institute of technology], seminaries, or academies). The broadest classification separates these institutions into public, private, or military. The Carnegie Classification system further describes post-secondary institutions based on size and type; for example, doctorate-granting research universities (extensive, intensive), master’s level colleges and universities (small, medium, large), baccalaureate colleges (e.g., liberal arts), and specialized schools (e.g., Medical Schools, Theological Seminaries), are some of the designations. And, the degree you are able to earn depends on the type of institution you attend: undergraduate (e.g., bachelor’s) or graduate (e.g., master’s or doctorate).

What Are the Kinds of Degrees?

For purposes here, I will assume you may be considering a career in geology or a related field of science. Unless you are seeking a position as some kind of technician, you will likely need to earn at least a bachelor’s degree, but depending on your ultimate career goals, a master’s or doctoral degree may be in your future. The traditional four-year undergraduate degrees are a Bachelor of Science (B.S.), Bachelor of Applied Science (B.A.S or B.A.Sc.), or Bachelor of Arts (B.A.), and each moniker might denote a slight difference in focus; for example, a B.S. degree characteristically recognizes a focus in one of the sciences, engineering, or technology, whereas a B.A. degree may more than likely recognize a focus in the social sciences or humanities. The bachelor’s degree is considered to be the entry-level requirement for most professional careers.

Once an undergraduate degree is in hand, you may opt to pursue graduate studies toward either a master’s degree or doctorate (or both). There are similar types of master’s degrees to bachelor’s degrees, for example both a Master of Science (M.S.) and Master of Arts (M.A.) exist, and these degrees more often than not require about two years of full-time coursework. The pathway to completing a master’s degree routinely ends with a formal research project—or thesis—and a comprehensive exam. A new alternative master’s degree, the Professional Science Masters (PSM), has been authorized by the Council of Graduate Schools. These degrees typically focus on science or technical content (50% of the coursework), professional skills (such as communications, accounting, organizational management and the like), and include an applied internship at a company or agency. Though research might be a part of the degree, a thesis is typically not required. There are over three hundred of these degrees available now (see the references for a web link).

A doctoral program may be entered into directly after earning an undergraduate four-year degree, or after completing a master’s degree, and in most discipline areas, is referred to as a terminal degree or the highest attainable academic degree in a field of study. Finishing a doctorate generally exceeds three years, and almost always entails writing a dissertation—an original research investigation of considerable rigor—and successfully passing a set of comprehensive examinations. The most common type of doctorate earned in academia is the Doctor of Philosophy (Ph.D.), but there are other types as well (e.g., Doctor of Education, Ed.D.). The Ph.D. is so-named not because it focuses on “philosophy” as a discipline—as a few too many people mistakenly believe—but because it accentuates research in a specific discipline.

1. Military academies will be excluded from this discussion.
2. For more details about the Carnegie Classification system, see the references.
3. There are exceptions to this general description. It is possible to earn a B.A. degree in one of the so-called “hard” sciences (i.e., chemistry, physics, geology, etc.), but typically there is more freedom to select elective classes than in a standard B.S. program, which would include more required courses in the major. The word “hard” is used here to contrast with the “soft” (or social) sciences, and is not a reflection, per se, on the complexity of the program of study.
4. The Council of Graduate Schools is a national organization dedicated to leadership and research in graduate education in the United States (it also includes members outside the U.S.). Visit their website: www.cgonet.org
5. Some discipline areas may end at the bachelor’s or master’s level and there would be no equivalent doctorate, in which case, such a degree would be “terminal.”
6. Philosophy heralds from the original Greek “philos” (love) and “sophis” (wisdom), and literally means “love of wisdom” – in the sense that someone studies the knowledge, or wisdom, in a specific discipline area, like maybe geology.
Who and What Are Professors?

The academy, a reference to the “formal academy” of higher learning (i.e., college or university), employs individuals with advanced degrees to teach, conduct research, and serve the academic institution. Most of the individuals teaching your university classes hold terminal degrees, usually doctorates, in their respective fields of study. So, your geology professors likely hold at least a master’s degree, but more often, a doctorate in geology or a related discipline. As I bandy about the word “professor,” it occurs to me that I ought to describe what this means. The nomenclature of the faculty at universities is hierarchical, meaning that there are certain classes of faculty within the academic caste system. In general, regular departmental faculty members are called professors, and depending on the institution, their individual emphasis may be teaching, or at larger institutions, research. The professor’s load, in other words what he or she does each semester at the university, may be primarily teaching, research, or a combination of both. Most professors, even if they are predominately dedicated to research, will teach a couple of classes a year.

Faculty members may be lecturers or professors. A lecturer is often a title reserved for term-specific instructors, full-time non-tenure track instructors, faculty not holding a terminal degree, or part-time instructors. Full-time faculty members at the institution, who are on a tenure-track or on a fixed term, are referred to as professors. Entry level members of the faculty are generally hired as assistant professors. Assistant professors are not tenured and reside at the bottom end (or, is that backside?) of the seniority list at a university. The next rung up on the professional ladder of academic standing is occupied by the associate professor. Associate professors are usually, but not always, tenured, meaning they have continuing contracts for subsequent future employment at the university and are more-or-less “secure” in their jobs. The highest rank held by a member of the faculty is usually that of full professor. These folks are the senior, or most veteran, members of the faculty.

At least colloquially, there is a distinction between staff, faculty, and administration at a university. Staff members are non-faculty employees, such as administrative assistants, counseling providers, recruiters, and other professionals and paraprofessionals. Members of the faculty are the instructors. Administration encompasses the upper tier of leadership, and each department (or college) is under the direct supervision of a dean. A provost is the academic leader at the institution and oversees all aspects related to the functionality of teaching and learning. There will also be one or more vice presidents and a president at the academic institution, who are the political entities at the university, responsible for securing donations, obtaining funding, and managing the community integration of the institution.

What Are Majors and Minors?

A lot of students begin formal academic preparation as undeclared majors at a university. The major is the primary field of emphasis, such as geology, business, accounting, engineering, mathematics, nursing, information technology, computer programming, etc. Most degrees consist of a general coursework (or liberal arts) component plus a major component. In other words, in addition to pursuing classes in your desired field of study (i.e., the major), university students are required to complete a number of liberal arts electives (e.g., philosophy, physical education, health, whatever may be outside the major). The purpose of this requirement is to provide students a rich and diverse background in general subject matter knowledge. Students often must take so many classes or credits in various categories of liberal arts study as a minimum requirement at the university regardless of the intended major.

In addition to the required major and set of elective liberal arts credits, students may select a minor field of emphasis. For example, some students may major in biology and minor in chemistry, or major in physics and minor in mathematics. A minimal number of credits are required in a university minor. The usual total number of credits to earn an undergraduate degree from a university is around 120 (semester credits).

How are Grades Determined?

What has been covered so far is peripheral information, useful for understanding the general functionality of a university. Next, I want to take a brief look at assessment – clearly one of the most essential, and directly relevant, aspects of formal schooling. Be advised that each professor has his or her own way of grading – within the institution’s allotted grade determining scheme – so it is vital to understand just how your performance in each class will be calculated. I include this here because when I first started out as a college student, nobody explained any of this to me, and it is very useful to understand. Whether you agree with the idea of assigning grades based on performance or not, most academic institutions do formally assign letter grades (or numerical equivalents). Let’s quickly delve into this a smidge more.

Grade Point Average

Your grade point average (GPA) is a reflection of your formal academic performance at the institution, and you will likely receive a GPA for each semester’s performance as well as your to-date cumulative record at the institution. Universities determine GPA by assigning a numerical value to each equivalent letter, such as “A = 4.0”, “B = 3.0,” occasionally, an institution will include a +/- for the grades, such as “A = 4.0”, “A- = 3.7,” “B+ = 3.3,” etc. To figure out your GPA, take the numerical value for the grade you have earned and multiply it by the number of credit hours; sum the totals for each class in the semester and divide by the completed number of credits in the term. See Table 1 on next page for an example.

Weighted Percentages

A common practice among instructors at any level is to assign a weighted
percentage relative to each category in a course. So, in a non-laboratory geology class, you may have fifty percent of the course grade based on performance on two examinations (midterm and final), thirty percent determined by assignments, and twenty percent from participation. In order to calculate your final grade percentage in the class, you need to take into account the weighted values. See Table 2 above for an example.

### Grading on a Curve

In many cases, your professors will use a “straight percentage” grading scheme, where an “A” in the class corresponds to performance at the 90% level or above. In some instances, a course professor may choose to “grade on the curve.” This can mean different things to different people, but in general, refers to assigning grades based on the assumption that a typical distribution of grades should be found on a normal curve (hence, use of the word curve in “grading on the curve”). An individual instructor may take a specific approach to “curving” and presume that 10% of the students in his class should earn an “A.” It is important to note that it is the instructor who identifies the percentages he or she will use for each letter grade. In the example below, suppose the average on a test in the class is 85%, and therefore, the center of the normal curve is placed at 85%. In this case, the instructor has arbitrarily elected to adopt a distribution calling for grades as shown in Table 3. Figure 1 shows how the distribution fits on the normal curve. If there are 100 students in the class, then

| Table 1. Calculation of GPA for a semester in which the following grades are earned. |
|---------------------------------|--------|-------|---------|
| Course | Grade | Grade Points | Credits |
| GEO 110 | B | 3.00 | 4 | $(3.00 \times 4) = 12$ |
| ENG 101 | C | 2.00 | 3 | $(2.00 \times 3) = 6$ |
| PSY 100 | A- | 3.67 | 4 | $(3.67 \times 4) = 14.68$ |
| MAT 137 | C+ | 2.33 | 3 | $(2.33 \times 3) = 6.99$ |
| **Total** | | | | 14 |
| **GPA** | | | | 39.67 |
| **GPA = (39.67 ÷ 14) = 2.83** |

| Table 2. Example of hypothetical grading scheme and student scores. |
|---------------------------------|--------|--------|---------|
| Grading Category | Weighted Percent | Points Earned/Points Possible | Total |
| Exams | 50% | Exam 1 = 85, Exam 2 = 70, 155/200 = 78% | $(0.50 \times 0.78) = 0.39$ |
| Assignments | 30% | $A_1 = 20, A_2 = 25, A_3 = 30; 75/80 = 94%$ | $(0.30 \times 0.94) = 0.28$ |
| Participation | 20% | 95/100 = 95% | $(0.20 \times 0.95) = 0.19$ |
| **Total** | 100% | | 0.86 |

*This is assuming the grade in the class is based on straight percentage.

**Figure 1. Illustration of the percentages of students that would fall within 1, 2, and 3 standard deviations of the mean (85). Note: The curve and values are not to scale.**

10. Usually 90-100% = A; 80-89% = B; 70-79% = C; 60-69% = D; < 59% = F. The real difference between grading straight percentage or grading on a curve is choosing to adopt a criterion- or norm-referenced approach (with the former referring specifically to straight percent, where in theory, everybody could earn an “A” in the class; contrast this with the latter, where only a specific percentage of students will earn an “A” even if the lowest percentage earned by a student in the entire class is 90%).

11. Normal curve from statistics, also called a Bell curve. Strictly speaking, a true normalization for grading would base grades on standard deviation within the normal curve; therefore, identification of the exact middle of the curve would be where 50% of the scores fall above and 50% below. One standard deviation from the middle would include 34% of the scores; between one and two standard deviations would contain approximately 14% of the scores; more than three standard deviations would be about 2% of scores. Many, if not most, professors grading on a curve modify the assumed percentages among standard deviations (e.g., 5-10%, rather than 2%, of students should earn A’s). [The description herein is not an endorsement on my part for grading on a curve.]


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5 would receive “A’s,” 20 would receive “B’s,” and so on. For more details about grading on a curve, see the references.

**Cluster Scores**

Another common practice is looking at the natural divisions among clusters of scores on an assignment or test, and then defining the ranges of the clusters as particular grades or percentages. Some of your professors may take an approach like this to defining grades. Figure 2 shows an example of how clusters of scores might be grouped into letter grades.

Whatever mechanism your professor is using to determine your grades in a class, you would do well to understand it (and ask to have it explained, if it is unclear). Like it or not, most prospective employers expect to see at least satisfactory – if not stellar – grades on candidate transcripts.

**What Happens at Graduation?**

The end goal of academic study for most of us is graduating with a degree, certificate, license, or whatever the culmination of our effort may be, so it is worth describing a little more about the literal pomp and circumstance surrounding the ritualistic conclusion of formal academic preparation. Mortar boards (or caps) and gowns aside – as these are permanent, and usually unwavering, staples at graduation commencements – there are other ceremonial aspects worth understanding, at least superficially. What is the difference between graduating *cum laude* versus *summa cum laude*? How are the gowns of graduate students different than for undergraduates and what is a hood? Why do the faculty members have different colors on their gowns and accessories?

As a way to acknowledge exemplary academic scholarship by undergraduate students at the institution, certain honorific designations may be applied at graduation. *Cum laude*, which is Latin for “with honor,” is a formal honor recognizing achievement with a cumulative GPA of typically 3.50-3.69. *Magna cum laude*, or “with great honor,” recognizes achievement for students having a GPA of 3.70-3.89. Finally, *summa cum laude* or “with highest honor,” is the ultimate recognition of achievement bestowed on students with a GPA of 3.90-4.0. A gold stole is often worn by these students at graduation ceremonies in acknowledgement of their accomplishments.

There are a variety of traditional and informal rules governing academic regalia. In general, the higher the earned degree, the more accoutrements are included in the ceremonial attire. The basic shape of the sleeve on the gown worn by awardees varies depending on the degree obtained. Hoods, while not always, usually adorn the master’s and doctor’s garb only, and the colors on it represent two specific aspects of the wearer’s identity: 1) the conferring school’s colors, located inside the hood; and 2) the color associated with the subject area of the earned degree, as a thick velvet trim or border. The subject colors represent a long history of tradition and a few examples follow: science is golden yellow, light blue is education, pink is music, and brown for the fine arts. The dark blue of the general doctor of philosophy degree normally abounds at commencement ceremonies. As the university’s faculty marches into the commencement hall, a diverse collage of abundant gown and hood colors can usually be witnessed, attesting to the wide range of geographic and scholastic variability in the professoriat.

**A Few Tips and Suggestions**

Granted, some of the following recommendations may seem to go without saying, but, it never hurts to be reminded.

1. **Monitor your own academic progress.** It seems to be becoming more difficult to graduate with a bachelor’s degree in four years. Carefully monitoring program and course requirements, the rotating schedule of classes, and your progress can keep you on track for a timely graduation. Note any hidden prerequisites, or those required courses necessary for the classes in your major program of study. Take advantage of the advising services offered to you, and while you should rely on your appointed (or selected) academic advisor, be sure to monitor the program requirements and class schedule yourself too. Students are occasionally poorly advised and their complete trust in an advisor’s word as the final say sets them back a semester (or more).

2. **Get involved.** Take advantage of any and all opportunities to get involved. You hear this all the time, but it really is true. A couple of years ago, I devoted an entire article to the importance of getting involved in activities while attending university (*TPG* Jan/Feb 2012, Career Advise for Graduate and Undergraduate Students). The current issue includes an article on the value of professional internships, which is also worth checking out. Successful future professionals, it appears, do not just show up for classes and then go home. Take advantage of the many opportunities to get involved at your university: undergraduate research activities with professors, internships, student senate, and more. Network; take a leap when opportunity knocks. You never know exactly when or how these efforts will pay off, but they surely will.

3. **Do not procrastinate.** Procrastination on completing homework and preparing for exams is a problem for some, but not all, students. I think most students eventually figure out what works for them, but even though some proclaim that they work “well under the pressure of a looming deadline,” I am skeptical. We all tend to put off work that
we would rather not do, or work that will be time-consuming, but tackling it sooner rather than later is a better option. Even for myself, I find that completing projects in a timely fashion relieves unnecessary stress, and in turn, makes me more productive and do better. Sometimes it seems we forget that the whole reason we are going to school is to learn. Don’t let too many chances to learn or understand something pass you by, you may never have another.

4. **Make good use of your professors.** Whether a professor is likeable or not, personable or not, he or she is the one responsible for teaching you (whether he or she subscribes to this interpretation or not). Contractually, most professors are obligated to hold office hours for students who may have questions or need assistance. Take advantage of your professor’s available time, and seek them out during office hours. Most, not all, professors want to help their students succeed, but all professors agree that if a student is not willing to make the effort to seek assistance when needed, then it is on the student (not the professor). It never ceases to amaze me that students will not ask questions, even when they have questions. Avoid this routine, if possible! While grumbling about “not understanding” something about a topic or lecture makes us feel better in the moment, it doesn’t do us any long-term favors. Take the chance that your professor is professional enough to make time to assist you when you need help.

**Featured Resource**

This issue’s featured resource is the National Center for Education Statistics web page located at: http://nces.ed.gov/

The website is very useful for tracking down data related to colleges, schools, assessment, and more. In fact, one statistic they share is that 50 million students attended 98,000 public schools on the first day of the 2014 academic school year. Particularly applicable to the subject of this article is the Integrated Postsecondary Education Data System (IPEDS) found under the “Survey & Programs” tab and then under the Postsecondary heading. From there, you can use the “College Navigator” to search for schools of interest and find out specific information about accreditation, admission requirements, enrollment, financial aid, programs offered, and more. You can also refine your search in order to identify schools that offer certain programs, such as majors in the geological and earth sciences.

**Acknowledgement:** Thank you to Dr. William Hoyt, Professor of Oceanography, at the University of Northern Colorado for reviewing the document and for the suggestion to include information about Professional Science Masters.

**References**


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**Attention Students**

Are you going to grad school?
Have you graduated?
Please notify AIPG Headquarters so we can keep your contact information updated.

aipg@aipg.org

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**A Message From Liberty Mutual Mutual Insurance**

**Protect Your Family From Radon**

By Becky Karush

Radon is a colorless, odorless gas that can seep into any type of building, including your home. According to the Environmental Protection Agency, it’s the leading cause of lung cancer among nonsmokers. Fortunately, it’s easy to detect radon—and protect your family from it.

Here is important information about dealing with radon.

- **Why is it harmful?** Radioactive particles are released with the natural decay of uranium found in nearly all soil, as well as rock and water. When inhaled, these particles can cause lung cancer. A radon level above 4 picocuries per liter (pCi/L) of air is considered dangerous. About 0.4 pCi/L of radon is typically found outdoors.

- **How does it get inside buildings?** Radon migrates through soil and enters buildings through cracks in the foundation, basement floor, and walls; openings around sump pumps, drains, pipes, and wires; joints in construction materials; and crawl spaces. As radon seeps into your home, it can build up in the enclosed living space, increasing in concentration.

- **Where can you find a radon test?** Low-cost do-it-yourself test kits can be purchased at your local hardware store or online. If you prefer to use a qualified tester, your state radon office can provide you with a list.

- **How do you fix the problem?** If you discover a dangerously high radon level, a qualified contractor can help you find a solution. A mitigation system, which pulls the gas from the house and vents it outside, is an effective solution.

Liberty Mutual is proud to partner with the American Institute of Professional Geologists to provide you with relevant auto and home safety tips for the way you live today.

To learn more about Liberty Mutual Auto and Home Insurance or get a free, no-obligation quote, call 1-800-981-2372 or visit libertymutual.com/AIPG.
Dr. Jonathan W. Harrington, Ph.D., CPG-03528, 73 passed away unexpectedly at Cayuga medical center, Ithaca, NY on November 16, 2014. He was born in Watertown, NY on July 2, 1941. Jonathan earned his B.S. with Honors in Geology from St. Lawrence University in 1964, and a Ph.D in Geology from Cornell University in 1968. He was a faculty member in the newly-established Dept. of Geology, University of Calgary, Alberta, Canada from 1969-1976. He conducted research in the Northern Rocky Mountains, Northwest Territories and Arctic island, as well as research projects throughout the Northeastern U.S. Jonathan and his family returned to the U.S. in 1976 where he established a consulting business, and taught part-time as SUNY Cortland and Mansfield University. Eventually, Jonathan devoted full-time to his professional consulting practice in Alaska, Florida, New York, Pennsylvania, and Wisconsin. He was a member of the Geological Society of America, American Institute of Professional Geologists, Paleontological Research Institute and the Cornell laboratory of Ornithology, and licensed in several states. Jonathan had a particular interest in training young geologists in the practical field methods.

Dr. Kenneth V. Luza, CPG-06363, passed away Wednesday morning, July 23, 2014, in Norman after a brief illness. He was born on Sept. 26, 1945, in Manitowoc, Wisconsin.

Ken received his B.S. in Geological Engineering from the University of Arizona in 1967, and then earned his M.S. in Geological Engineering (1969) and his Ph.D. in Geology (1972) from the South Dakota School of Mines and Technology. In 1969, he was commissioned as a second lieutenant in the U.S. Army Corps of Engineers.

In 1972, he joined the Nevada Bureau of Mines and Geology, where he worked on engineering and environmental problems in the Reno and Las Vegas areas. In 1975, he took a position as Engineering Geologist with the Oklahoma Geological Survey.

In addition to his work for the Survey, Ken also served on the graduate faculty at The University of Oklahoma, supervising graduate students in the fields of Geology and Geophysics, Civil Engineering, and Geological Engineering. His professional service included membership in the following organizations: Geological Society of America, American Institute of Professional Geologists, Association of Engineering Geologists (AEG), American Institute of Professional Geologists (AIPG), Shallow Exploration Drillers Clinic, and Oklahoma Board of Geographic Names (OBGI); he served as Chair of the OBGI and as an officer in the Oklahoma Sections of both the AEG and the AIPG. He gave many lectures to technical and public interest groups, mainly summarizing his research on earth quakes, seismicity, and tectonics, and on problems in the Picher lead/zinc mining district and the Tar Creek Superfund Site.

Ken Luza will be missed by all who knew him, not only for his important contributions to Oklahoma as a geologist, but also for his sly wit and humor. A longtime Survey staff member noted “If Ken Luza told you something, you could take that to the bank. He didn’t say things he wasn’t sure about. And he was sure of, and right about, so much in this state.”

George Edwards Moore, CPG-02471, passed away March 31, 2014. He was born in Bryan, Texas. He received his bachelor and master degree in geology from Texas A&M University where he was a member of the Corp of Cadets and Tau Beta Pi.

For thirty-one years, George was employed as a senior consulting geologist by Union Oil Company in California. After retirement he spend summers in Ouray, Colorado where he enjoyed producing field guides and leading field trips in the San Juan Mountains. Hew wrote a guide for exploring the geology of the area entitled Mines, Mountain Roads, and Rocks which is now in its second publication. He was heavily involved in the Ouray County Historical Society as a board member and fundraiser. He was instrumental in cataloging a large book collection, at the Ross Moore Library, containing information on mining techniques, mining equipment, geology and the history of the area. George loved the San Juan Mountains but sometimes felt the need to see the horizon of his beloved West Texas.

He was a member of the American Institute of Professional Geologists, Society of Independent Professional Earth Scientists, Geological Society of America, American Association of Petroleum Geologists, Society for Sedimentary Geology, Rocky Mountain Association of Geologists, New Mexico Geological Society and West Texas Geological Society. Hew was presented the Pioneer Award by the West Texas Geological Society.
Lessons Learned

Stephanie Jarvis, YP-0125, stephaniekjarvis@gmail.com

I nearly laughed out loud when I read the first sentence of Kristina Pourtabib’s column in the July/August/September issue of TPG (“Expect the Unexpected”): “Before beginning a graduate program... it is generally expected that you will be conducting the research that you discussed with your prospective advisor prior to beginning your program.” Yes, indeed, that is the expectation—ironic because it so rarely seems to happen that way. She goes on to explain her change of topics and obstacles that she has faced in her graduate work, maintaining that dealing with setbacks is a valuable life skill and inherent to conducting research. I could not agree more.

The statement struck me as funny because at the time I was reading it I was also working on my thesis defense presentation—a year after leaving campus. What I like to call my “Master’s Saga” lasted 3.5 years and, now that it is over (yippee!!!!!), I am just starting to work the self-confidence back up to be able to look at it with the kind of positivity Kristina has. I am also parsing out the life lessons I learned, or relearned, during the Master’s Saga. In the spirit of the student issue, I will share my thoughts thus far.

The Master’s Saga

A year into my program, I realized that if I did not switch advisors and projects I was not going to finish my degree. Life lesson #1: Do not be so stubborn that it takes you a year to do what you realized needed to be done after a month. Then, though I had much simpler options, I decided to take on a whim of a side-project idea of a professor I had hardly met—who was about to leave for a few months for a research cruise and who had not worked with the fossils I would be collecting—on a topic I knew absolutely nothing about. Life lesson #2: You do not always have to choose the hardest route.

Thankfully, my new advisor turned out to be pretty awesome. However, a year of self-doubt does not just end. Life lesson #3: You are your harshest critic (at least, I am mine). I then spent what was supposed to be my final year trying to wrap my head around this new topic, working out sampling logistics, and making a lot of lab mistakes. All while taking too many classes and teaching. Life lesson #4: There is a critical limit to how much you can stuff in your brain and actually retain, no matter how interesting you find the material. Life lesson #5: If you are going to take it upon yourself to completely rewrite sed/strat labs, make them easy to grade. It was summer before I really got into my lab work. A serendipitously timed temporary consulting gig gave me some great experience and much needed funding that fall. Life lesson #6: There will always be a learning curve from classwork to real work, no matter how good your classes were. Events in my personal life unexpectedly took me across the country for most of that October. Life lesson #7: It is ok to put loved ones above deadlines. And it is ok if you need someone to reassure you that it is ok to do that. By November, I was done with lab work and anxious to get some time in at home before I moved on to wherever I happened to be going. I temporarily moved in with my parents and figured I would take a month or two to write and job search. The only thing I really accomplished was banging my head against the statistics wall, which led to the realization that I needed to go back to campus and rerun my stats. In January I swung through campus to redo the stats on my way to Denver for my new job. Again, I thought it would take me a couple months, at the most, to finish writing. Life lesson #8: Big transitions, particularly when several are happening concurrently, are hard. They are not conducive to writing a thesis. I ended up taking a few breaks of varying lengths, only one intentional. Life lesson #9: Emotional/Mental wellbeing is a prerequisite to being productive, you can only push a work/relax imbalance so long, and stressing about something does not get it done. What finally got me in gear was the decision to pair my first half-marathon with my “thesesing”. I signed up for a matathon a month out (yes, I knew that was stupid), found a 4 week training plan, and made my goals—of finishing the race, spending twice as much time thesising as training, and getting my thesis to my committee by race-day—Facebook-official. I have always avoided setting goals and I once swore that I would never train again. The training part did not work out too well—I got shin splints after a week, took two weeks off, and ran a couple short runs the week before the race. Turning my thesis in to my committee by race day did not happen either. However, having that time goal and a daily schedule for something other than work did wonders for getting me past my mental block and I made quite a bit of headway on writing. As for the race, I could not have asked for more perfect weather or a nicer course. I won the poker draw and my age group. Total beginners luck! Life lesson #10: Goals are not necessarily bad, even when you do not meet them. Life lesson #11: Sometimes, the less thought and preparation, the better. Though you may hurt afterward. I eventually got a draft to my advisor and then to my committee, pulled my presentation together, and went back to southern Illinois for Halloween weekend to defend. After a few edits and a lot of formatting stress, I got it submitted the day before the deadline.

Moving On

I have been doing a lot of thinking about what post-thesis life means, and these thoughts seem to be taking the
New Research Offers First Glimpse at ‘Neglected’ Dinosaur Skull

Rapid City, S.D. (Nov. 13, 2014) – New research published by a South Dakota School of Mines & Technology paleontologist has opened the door for future discoveries about one of the last non-avian dinosaurs to roam the planet 67 million years ago.

The Thescelosaurus neglectus was discovered more than a century ago, but little has been known about its life or relationships with other creatures of its time during the Cretaceous period in Western North America.

Clint Boyd, Ph.D., who has studied the skull of the T. neglectus since 2005, is the first to fully describe the dinosaur’s head. Knowing more about the skull will allow future research on the life of the ornithischian dinosaur, one of the last non-bird dinosaurs. Boyd’s paper, “The cranial anatomy of the ornithischian dinosaur Thescelosaurus neglectus,” was published today by the online scientific journal PeerJ.

Named after being neglected for nearly 20 years, T. neglectus roughly translates to “marvelous, neglected lizard.” The original specimen was found in 1891 but wasn’t studied or named until 1913.

Although the average 12-foot-long body of this herbivorous dinosaur was originally described in 1913, little was known about the structure of its head until now.

The skulls of these animals give us the most insight into their relationships with other dinosaurs. Having the entire skull described provides insight not only into the broader relationships of this species, but also new insights into the early evolution of all ornithischian dinosaurs,” said Boyd, a post-doctoral fellow and assistant professor in the Department of Geology & Geological Engineering at SD Mines. The full description of the skull also allows researchers to study the diet and brain structure of this species in greater detail.

Bones from the T. neglectus are known from Wyoming, South Dakota, North Dakota and Western Canada. There are also possible fossils from California and Alaska.

The two specimens studied by Boyd were found by private individuals in Harding and Dewey Counties in South Dakota.

Boyd, who is now working on a complete revision of the relationships of ornithischian dinosaurs using data from this study, identified a possible relationship between this species and similar dinosaurs known from Asia and Canada, suggesting a dispersal between these continents during the Cretaceous period.

The skull found in Harding County is roughly 99 percent complete and now resides at the North Carolina Museum of Natural Sciences in Raleigh, N.C. The other skull, roughly 68 percent complete, remains in South Dakota at the Timber Lake and Area Museum.

Read Boyd’s full paper online at https://peerj.com/articles/669/.

This information was provided by the South Dakota School of Mines News.
Writing Essentials

Kristina Pourtabib, SA-3410
pour1824@vandals.uidaho.edu

For this issue of TPG I am going to try and keep my overarching idea simple. Grant writing (whether necessary or not) is an essential part to asserting your success as a researcher. For most new graduate students, the amount of continuous writing done outside of their thesis/dissertation can be overwhelming. The truth is that most graduate students, postdocs and professors, in order to follow their research goals, must write to receive funding. Frequently improving upon your writing skills even after undergrad is key to your success as a graduate student. Applying for funding not only provides vital feedback on how your research ideas are effectively (or ineffectively) being broadcast to people both outside and inside of your major field of study, but helps force you into learning about other researchers and professionals in your research area. Even if you are one of the few who does not have to apply for funding in order for your research to continue, it is still very important to at least go through the grant writing process to show to any future employer that you can successfully bring in outside funding to your project.

Many graduate students and professors spend their first few year(s) in any program or position devoted to just writing grants and getting their research started. Grant writing can be a very arduous and stressful process that at times can get very frustrating. Being able to write a successful grant is a multi-step procedure that starts with first looking up what type of grants you are eligible to apply for, deadline, and what the grant is for (i.e. travel, research funds, university grants, state/national grants, etc.). Next, it is a good idea to get familiar with your panel of reviewers, and if possible connect with individual members of the panel, for instance, send them an email or make an effort to bump into them at a conference. This type of outside interaction can really help to improve your chances of receiving the grant, and even if you don’t get a response the panel might appreciate your extra efforts, just make sure to keep the communication to a minimum (you don’t want to annoy your panel before they get a chance to read your proposal). Another point is to look carefully at your budget and timeline. The budget and timeline can make or break your application, be sure to keep it realistic. For instance, if you request a large amount of funding for your proposal, then possibly recommend an alternate budget and timeline in case you only were to receive partial funding from the committee (any bit of funding can help). Then, it is important to look at the individual requirements for completing the grant itself, and to start writing.

After the initial draft is complete, always check and double-check your grammar and page formatting. The easier you make your proposal to follow (including things such as separate paragraphs, section titles, and italicizing the main points), the easier it will be for your panel to decide if your proposal hit all of the requirements that they were looking for. Along these same lines, you don’t want to be writing a proposal wanting for. After these lines, you don’t want to be writing a proposal wanting to get a large sum of money and make frequent spelling or punctuation mistakes. It’s seemingly small errors like this that can make your proposal look unprofessional and can mean the difference between being considered for funding or not. Remember, your panel will most likely have hundreds of proposals to review, and the more clear and concise you make your proposal, the more your panel will appreciate not having to pick out the main points themselves. The easier you make their job the better.

Although I’ve only skimmed the surface of what goes into grant writing, it is still a very subjective process that ultimately depends on your panel of reviewers. Even if you don’t get funded, the comments your panel makes on your proposal will only help you to revise and be better prepared for the next proposal deadline.
In an effort to engage the sections of AIPG, Vice President Brent Huntsman tasked the four advisory board representatives with an assignment: to become section liaisons. Over the course of 2014, the four advisors, Christine Lilek, CPG (WI), Todd McFarland, CPG (TN), Keri Nutter, CPG (AK), and David Pyles, CPG (IN/IL) began conversations with sections in an effort to open the lines of communication and better understand how National can serve them.

In our discussions with the section leaders, the four advisory board representatives became familiar with each Section’s typical activities, achievements, struggles, and general goings-on. Several sections are quite active and host regular meetings, provide newsletter or email updates to the memberships, sponsor student chapters at the local universities, and engage in educating the public or supporting local scientific political policies.

However, it also quickly became apparent that many of our Sections struggle with people, time, and monetary resources, and feel that they are not able to sponsor events and activities with their limited resources. Many Sections have only one or two incredibly dedicated people who are holding the Section together and find it difficult to engage the membership for a variety of reasons, be it geography, interest, or time. The normal tendency would be to hold on to the last of their resources and wait for better times. Yet, the opposite action of sharing these remaining resources appears to be creating opportunities for not only the Section, but for those they serve.

If you are a member of a Section struggling with limited resources, consider sharing your limited time and resources with another Section, professional organization, university, or business in a joint effort. Some examples of these shared efforts are listed herein, and if you have a new idea and want us to help find your partners, please contact us!

Student Events

Florida has discovered that students have a lot of energy. They have been visiting more schools, especially universities, to encourage participation in field trips, establishing student chapters, and making presentations on items of interest such as international projects, resume and interview strategies, and an overview of careers & networking opportunities.

The Northeast Section has volunteered some of their members and monetary resources to help with university geology short courses and continue to engage over 70 universities with their annual scholarship – the Angelo Tagliocozzo memorial. They will be asking scholarship awardees to present their research at meetings and in the Section newsletter.

Michigan holds their meetings at Michigan Universities to allow increased participation of students and professors.

The Kentucky Section held a networking event and invited students, consultants, government employees, and academics. This allowed for students to network with practicing geologists to discuss potential career opportunities. The Kentucky Section also hosts an ASBOG review class twice per year for students preparing to take the Fundamentals of Geology Exam.

The Tennessee Section provided lunch for the GeoConclave event that brings together geology programs throughout the state for a weekend of geology themed activities. This resulted in several new student memberships as well as interest in starting new student chapters. They have also begun incorporating student presentations at the spring quarterly meetings to allow graduating students to present senior research.

Colorado section has provided a fantastic number of resources to student members and chapters by providing scholarships, encouragement of student chapters, and a lot of support from the professional members.

Multi-Section Efforts

Wisconsin and Minnesota Sections recently got together with three other professional groups (Wisconsin Groundwater Association, Society for Mining, Metallurgy & Exploration and the American Planning Association – Wisconsin Chapter) to hold a Frac Sand Mining Research Webinar. Approximately 200 participating sites with some sites hosting multiple people participated in the webinar. Webinar participants have indicated future participation in similar Section activities in the future.

Florida and Kentucky Sections will be working to develop Geologist – In-Training (GIT) examination study workshops in 2015 to support the recently emplaced GIT certification in those states.

Inter-Society Joint Efforts

If there is not a sister AIPG section nearby, then consider partnering with another local geological or scientific organization. Some sections, such as Oregon and Arizona have found this to be an effective way to bolster meeting attendance through increased resources and communication avenues. A central meeting location and guest speaker of a shared topic of interest tend to draw the troops, and it makes for a great networking opportunity!

Illinois Section and Illinois EPA sponsored a joint vapor seminar for remediation managers.

Social Networking

AIPG National is using LinkedIn and Facebook. Tennessee is also on LinkedIn. To reach the masses, email is a great base, but also consider reaching more folks through social networks to create a section Facebook or LinkedIn
account for posting events and section updates.

Environmental Organizations & Geology Clubs

Holding joint meetings with local geologist groups have been very successful for the Northeast Region Section.

The Northeast Section and the Virginias Section has made a practice of attending and participating in local Geological Society Association (GSA) meetings and giving out free AIPG memberships to students who attend these events; while the South Dakota Section scheduled their annual meeting in conjunction with the Department of Environmental and Natural Resources annual Environmental and Groundwater Quality Conference.

Getting involved in local environmental events is working for Florida and Wisconsin Sections. Florida has been coordinating with other geological associations on events and fieldtrips. Wisconsin Section will be a sponsor of a Student Presentation Day event at a local nature center this fall. Both Sections will have an AIPG booth at the environmental events.

Government Entities

This year, the Environmental Directorate of the Air Force Civil Engineer Center, headquartered in San Antonio, requested that the Texas Section give a presentation about AIPG and our certification requirements. They were one of several professional organizations giving presentations to their employees about certification/registration.

In Illinois the Professional Geological Licensing Act is about to sun-set. Many regulations have been developed with the support of AIPG and to the benefit of all geologists who practice in the state. Getting involved with this rule making process provides leadership among the profession and attracts members. It allows the section membership to be aware what is being developed and provides a collective voice.

Website Redesigns

The Northeast Section recently redesigned their website and hired hosting firm, both of which were huge improvements to their members and visitors. This hosted website is also being used to announce meetings, registration for meetings, and to manage our mailing lists. Florida Section also finds that an active, up to date website brings more folks to shared meetings and events.

Consultant Demonstration Days

The Georgia Section has been working with several remediation consulting firms to sponsor field demonstration days for AIPG members, students and interested parties. These demonstration days have been very popular and well attended.

Newsletters

Can’t get the resources together to put out your own newsletter? Before sending out their own newsletter, the Wisconsin Section provided their event calendar and information in the Wisconsin Groundwater Association’s newsletter. Or give quick email announcements to membership lists a try. Colorado and Oklahoma Sections have been sending email blasts out to their members; including geology news, job announcements and event details. They have gotten good feedback from that simple effort.

Save the Date

To simplify organizing meetings, the Colorado and Illinois/Indiana Sections have a tried and true tactic: hold meetings at the same location on the same date(s) every year. By holding a consistent meeting time and place, it makes it easier for members with busy calendars to remember when and where meetings are and to better accommodate their schedules.

Close the Geographic Gap - Meetings via Teleconference

The Texas Section has started to meet via teleconference calls, since they are spread out over the entire state. Other states like Wisconsin, Colorado and Alaska have found teleconference/video conference calls to be an effective way to bring spread out sections together. While this may cost a fee, sections that are implementing this technology are finding it easier to gather more section members, more regularly.

Professional Development

Jeffery Frederick, member of the Northeast Region Section and President of Louis Berger Consulting stated “At the very bottom of this issue is the increasing difficulty professionals have balancing work/life. Senior people in the industry need to prioritize professional involvement at the most basic level. I intend to build “contribute to the profession” into the pro development plans of all of my employees, and to back it with a set amount of hours of participation each year. If we don’t expect (and facilitate) more involvement from young professionals, we have no excuses.

The Illinois/Indiana Section held a Vapor Intrusion Training program during their Fall section meeting. The program included a field demonstration for sample collection techniques, a comprehensive review and discussion of the equations and a regulatory question and answer session. This attracted many geologists who are section members to participate and who in turn brought other geologists/colleagues into our meeting. This short-course was very valuable and engaging to our membership and attracted interest to many other geologists whom are currently non-AIPG members. Continuing education credits were offered.

Ask for Assistance

For those sections that want to do more but are either struggling to engage the section membership or are considering changing up the activities in an already active section, consider contacting your fellow section leaders. Conversations between the advisory board representatives and section leaders were easy, casual, and although we are all busy professionals, everyone was willing to take the time to offer their insight and suggestions for success. The advisory board representatives, as well as executive committee and AIPG members and leaders are willing and ready to take any questions or suggestions to share.

Note from AIPG National-Sections, we are here to help you. Please contact the national office, if you need anything. Remember to look at the AIPG website for Section Resources, http://aipg.org/Sections/resources.htm. The staff and Executive Director Bob Stewart are here to help the sections. Email aipg@aipg.org or call (303) 412-6205.
UIC UMIAQ
Environmental Hires
Dr. Keith Torrance as Associate Environmental Geologist

Expanding their professional services to better meet client needs, UIC UMIAQ, LLC has established an Environmental Division that is uniquely organized into two key components; environmental consulting services and field compliance services. UIC UMIAQ is able to provide key services for Alaska-based operations from project planning, to construction through production.

Dr. Keith Torrance, CPG-11647, has joined UIC UMIAQ as an Associate Environmental Geologist within the newly formed Environmental Division. Dr. Torrance is a Certified Professional Geologist (CPG), a Chartered Geologist (CGeol), a European Geologist (EurGeol) and an Environmental Professional for environmental site assessment. He has a diverse background that includes work on mining and remediation projects throughout Alaska, North America and Europe over a career spanning twenty five years. Keith will be working to increase the scope of UIC UMIAQ’s Environmental project portfolio and support the expanding Environmental team.

A native of Scotland, Dr. Torrance has worked in the United States since 1989 and has been an Alaska resident since 2010. Keith has a Bachelor’s degree in Geology from the University of Glasgow, a Master’s degree in Environmental Engineering and was awarded a PhD in 2012 for research on the mobility of arsenic and other toxic metals in surface water impacted by mine sites in Alaska. He has specific expertise in regulatory compliance, site assessment, environmental geochemistry, analytical chemistry, surface and groundwater hydrology, mine permitting, minerals exploration, mercury mobility and the evaluation and remediation of contaminated sites. He has presented at numerous international conferences and has published in peer-reviewed journals on environmental science.

Dr. Torrance is also a part-time Adjunct Professor within the geology department at the University of Alaska, Anchorage where he teaches environmental geology. He also serves as a member of the department’s industrial advisory committee. He is active in many professional societies, including the Alaska Geological Society (President 2014/15), the Alaska Miners Association and the Association of Environmental and Engineering Geologists – Alaska Chapter (Vice Chair 2014). He was elected a fellow of the Geological Society in 2009.

GSA Announces New Executive Director

GSA is pleased to announce that Vicki S. McConnell, MEM-0649, will become its new Executive Director, effective 1 April 2015. Judy Totman Parrish, a former GSA President, will serve as Interim Executive Director from 3 January through 31 March 2015.

Vicki is presently the State Geologist of Oregon and Executive Director of the Department of Geology and Mineral Industries, appointments by the Governor that she has held for the past decade. She was President of the Association of American State Geologists in 2011-2012. Under her direction, Oregon has been a leader in earthquake-risk reduction in schools and emergency facilities, tsunami-hazard mitigations and preparedness, and acquisition of LIDAR for applications in land-use planning, ecosystem restoration, and geologic and hazard mapping.

Vicki received her Ph.D. in geology/volcanology from the University of Alaska Fairbanks in 1985. She has also been a Research Associate at the University of Wisconsin-Madison and an Adjunct Professor of Geology at Eastern Oregon University. Her scholarly work has focused on understanding volcanic eruptive histories and their impact on magma-generated hydrothermal systems. She applies geologic field mapping and geochemical research to volcanic hazards and renewable geothermal energy systems.

She is a GSA fellow, and was chair of the local planning committee for the 2009 GSA Annual Meeting in Portland. She is also a member of the American Geophysical Union, Association for Women Geoscientists, National Center for Science Education, Association of American State Geologists, and American Institute of Professional Geologists. She has served on numerous boards and councils, including the USGS Scientific Earthquake Studies Advisory Committee, and the Federal Advisory Committees for the National Cooperative Geology Map Program and the National Geological and Geophysical Data Preservation Program.

Alliance Environmental Group Welcomes Felix A. Perriello as Principal Scientist

Felix is a Certified Professional Geologist, CPG-10240, a Certified Hazardous Materials Manager (CHMM), a Massachusetts Licensed Site Professional (LSP), a Connecticut Licensed Environmental Professional (LEP), and a registered Soil Scientist. He has close to 50 issued U.S. and foreign patents. Felix brings a wealth of experience managing environmental
investigation and remediation projects to Alliance with over 23 years in the field. He has completed hundreds of projects across the United States, Brazil, and Azerbaijan for clients ranging from small commercial facilities to major international firms. Felix replaces Jacob Butterworth, who is no longer with Alliance.

With Mr. Perriello on staff, Alliance will have a stronger presence in assessment and remediation of environmental releases in both Connecticut and Massachusetts. In addition, Felix adds his technical capabilities in determining the most appropriate methods of both assessment and remediation of releases in a wide range of environmental situations.

Charles Dimmick Recognized for 40 Years of Service on Wetlands Panel

AIPG’s Charles Dimmick, CPG-3886, was recently recognized by The Cheshire Citizen (December 1, 2104) for his 40 years’ work as a volunteer for the Cheshire Inland Wetlands and Watercourses Commission. Through Charles’ efforts the town first established its IWWC in 1974, and Charles has been an active member ever since. Charles received a certificate of appreciation from the Cheshire Town Council in October 2014.

Charles is also an emeritus professor of geology at Central Connecticut State University, retiring after a 40-year academic career in 2005. He has been a professional wetlands consultant for 38 years, representing developers and citizens’ groups. Charles regularly volunteers at AIPG’s annual meetings as the teller during matters involving formal votes at the executive committee meetings.

Photo by Dave Zajac/Cheshir Citizen.

Outstanding Earth Science Teacher Program

The Award

Outstanding Earth Science Teacher (OEST) awards are given for “exceptional contributions to the stimulation of interest in the Earth Sciences at the pre-college level.” Any teacher or other K-12 educator who covers a significant amount of earth science content with their students is eligible. Ten national finalists are selected, one from each NAGT regional section. Some sections also recognize state winners. Individuals may apply themselves or nominate a colleague for the award.

The Outstanding Earth Science Teacher Awards program was adopted by NAGT in 1971. Devised to honor pre-college teachers of earth science, the program has the following specific objectives:
• Identify excellence in teaching
• Appropriately recognize and reward excellence in teaching
• Stimulate higher levels of teaching performance
• Establish NAGT as a strong support organization for pre-college education, and
• Via active statewide and sectional programs, build a solid state, regional, and national liaison with administrators of pre-college earth science education.

Section Winners
• Central Section: Ella Bowling
• Eastern Section: Victoria Gorman
• New England Section: Rita Chang
• Pacific Northwest Section: Dale Lehman
• Southeastern Section: Lisha Hylton
• Texas Section: Lawrence Witt

State Winners
• Alabama: Wendy Bramlett
• Alaska: Darren Kellerby
• Georgia: Donna Governor
• Illinois: Keni Rienks
• Indiana: Martha Hoyt
• New Jersey: James Miller
• New York: Mark Percy
• North Carolina: Mark Townley
• Ohio: Paul Genzman
• Oregon: Laura Orr
• Pennsylvania: Michael Baer
• South Carolina: Lisha Hylton
• Washington: Randy Taylor
• Wisconsin: Beth Spear

The American Institute of Professional Geologists provides a one-year subscription to The Professional Geologist to the OEST winners. The following list are the winners for 2014. For information on the winners bios, refer to http://nagt.org/nagt/awards/oest.html#recipients

Is Your Profile Correct?
It is important to keep your address, phone numbers, and e-mail information up to date in our records. Please take the time to go to the AIPG National Website, www.aipg.org, login to the member portion of the site and make sure your information is correct. You can edit your record online. If you do not know your login and password you can e-mail National Headquarters at aipg@aipg.org or call (303) 412-6205.
In today’s world, with modern equipment and technology, things can be done and accomplished that couldn’t have even been imagined only a few tens of years ago.

Let’s take a brief look back at satellites, for example. In your great-grandparent’s generation, the earth had one natural satellite – the moon. It was a literary favorite for poetry and prose – love, insanity, mystery, and never ending speculation about its composition. During the 1957-58 International Geophysical Year, the first artificial earth satellite, Sputnik 1, was launched by the Soviet Union. In May 1961, with the space-race and the cold-war going full tilt, President Kennedy challenged American ingenuity to put a human on the moon before the end of the decade. Apollo 11 rose to the challenge and safely transported three astronauts to-the-moon-and-back in July 1969. Just for fun, ask your mature relatives if they remember where they were when Neil Armstrong first climbed off the Eagle Lander and stepped onto the lunar surface. Eugene Cernan and geologist Harrison Schmitt were the last humans to walk on the moon in December 1972. We have learned much since then, including that the moon is composed of basic/mafic rocks.

Things we take for granted (not granite) today were transferred from someone’s fuzzy ideas to napkins or the back of envelopes, and then refined on wooden drafting boards. Think about it. Space travel in the middle of the last century was engineered with pencil-paper-eraser, logarithmic tables, and – of all things – slide rules (Figure 1). Our infrastructure of the 19th and 20th century also was engineered with these same primitive tools. Examples include the Erie Canal (1825), Brooklyn Bridge (1883), Empire State Building (1931), Hoover Dam (1936), and Golden Gate Bridge (1937), to name only a few.

During the 20th century, geologic mapping was done wearing field-boots, snake leggings, and wide brimmed hats with chin straps to keep from being blown away by unexpected gusts of wind. The basic tools for a typical field geologist included a map board, paper topographic maps, printed black and white stereographic aerial photographs, a portable stereoscope, paper notebooks, marker pens, lead pencils, colored pencils, Brunton compass, rock hammer, tape measure, hand lens attached to a rawhide neck lanyard, steel WWII canteen of water, and a backpack filled with lunch, first aid kit, and a few cloth sample bags (with a thick paper ID tag stitched into each bag’s seam).

Fast forward to the early 21st century. Now-a-days, with Global Positioning Satellites, the Internet, handheld tablet computers, and an “app” for just about everything, a day in the field, if you choose, can be about as challenging as walking around pushing buttons on one or more handheld electronic devices. At the end of the day, a final button push can present you and your home-office with a geologic map and structure sections documenting the day’s activities. Equally, your supervisor will have been able to direct your every move via your satellite connection to the internet.

So, catch 22, you are damned if you do rely on technology and you are damned if you don’t.

The advantage of using modern-day technology includes: accuracy of location and altitude, computer-generated graphics, and a false sense of security and accomplishment. All that is left for you to do is to record attitudes by laying your smartphone compass/inclinometer on planar surfaces, photograph outcrops, fill sample bags, and make preliminary assessments of rock/soil types, color, texture, porosity, and other project-specific data. Done! Not a lot of critical, multi-dimensional thinking required. Then, off to the diner, a couple of brewskies and bed – all to be repeated the next day, and the next. Boring, but your boss loves it!

But technology alone cannot duplicate the thinking geologist, who can continually process and incorporate data as it is collected. The advantage of doing field work the old fashioned way, using your brain to check the geologic reality and the internal consistency of your technological gadgets, is that at the end of the day you will have had to stretch the muscle between your ears to think in 6 dimensions (X, Y, Z, Time, Geologic Processes, and Interaction-with /Changes-in Geologic Processes over Time). And most importantly, you will have developed a mental model of what the geologic map and structure sections should look like after you’ve completed them in camp or in your motel room. You will intuitively know where you want to go the next day to look for contacts, faults and missing strata – an energizing and fulfilling feeling that can only come from applying your geologic sense and skills to make those critical decisions. With each day in the field, the geologic puzzle will become clearer and your self-esteem will grow. Then, at the end of the project, the exhilaration of presenting your hand-drawn results (that improves or corrects the technological version) to your boss will provide an emotional achievement that cannot be taken away from you!

So, it may or may not be up to you – how you want to do field work. But, if you have a say in the decision, do it with your brain engaged in the process and experience the feelings of self-esteem and self-worth that come with good old fash-
ione hard work. You will understand what you have done and you will have made a contribution to science, hopefully appreciated by your stressed boss. Real paper geologic maps (Figure 2-see page 60), structure sections and stratigraphic columns, fleshed out with colored pencils, are still appreciated as an awesome geologic treasure.

Mr. Elliott graduated in 1966, from San Diego State University with an M.S. in geology. After spending five years as an Exploration Geologist with Standard Oil Company of California, he moved on to the world of Engineering Geology. Retirement wouldn’t come until forty-four years later. Following eight years of experience with geotechnical firms in Southern California, he hung out his own shingle to begin a thirty-six year career as an independent Consulting Engineering Geologist. Being on his own was scary, usually terrifying. But in the end, long hours, good, hard, honest work done on-time and within-budget led to that sometimes elusive intangible gift -- good feelings of self-worth and self-esteem. Would he do it all over again? Yes! There is, however, one caveat -- I would play more between the endless cycles of crises that define the life of a consultant.

University of Tennessee-Chattanooga Student Chapter presented with the student chapter charter. From Left to Right: Vince Phothisene, SA-5727, (Treasurer), Rusty Sewell, MEM-2487, (Sponsor), Macy Howell, SA-5769, (Secretary), Jeb Barrett, MEM-1978 (2014 TN Section President), Zach Dearmin, SA-5711, (President), Kyle Nicol, SA-5704, (Vice President).

Members of the University of Tennessee-Chattanooga.

Attention Student Chapters

How would you like to attend the AIPG Annual meeting in Alaska???

The deadline for the Student Chapter of the Year award is June 1, 2015.

Coming in the next issue of TPG!!!

AIPG Annual Meeting Information

Mark your Calendars- September 19-22, 2015

Anchorage, Alaska

Field Trips

Technical Sessions
This service is open to AIPG Members as well as non-members. The Professional Services Directory is a one year listing offering experience and expertise in all phases of geology. Prepayment required. Advertising rates are based on a 3 3/8" x 1 3/4" space

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Abstract

A new approach to road and landslide stabilization using small inclusions, and lots of them, not only proved to be an effective permanent fix, it was also delivered quickly and on budget that was 50% less than traditional methods. The approach combined design/build project delivery, soil/rock anchor technology and geosynthetic reinforced soil (GRS) with micropiles. This combination repeatedly produced efficient, high quality, long-term solutions that were previously unattainable.

This paper highlights a pilot project on Vancouver Island, British Columbia that embraced these concepts. It proved to be so versatile in a variety of terrains that it was used on other highways and gained the attention of the BC Premier who granted it the 2013 Premiers Innovation Award.

The pilot project involved 7 Ministry of Transportation and Infrastructure sites on Vancouver Island. There was a common theme for the locations: remote, steep, and each were along critical access routes to the towns or communities they served with no easy solution for repair.

Road closures were not an option, and traditional methods proved to be too expensive to entertain. Due to these constrains the necessary repairs could not be completed in a traditional fashion and over years and decades caused maintenance work to be more frequent at an ever increasing cost.

Through extensive research and a collaborative effort, the above-mentioned techniques successfully mitigated every site with minimal traffic disruption and at a fraction of the time and cost associated to traditional approaches.

Introduction

Fill slope failures along roads, rail, pipeline, and trails are common and frequently extremely challenging issues. Excavating the failed material out and either replacing it with higher quality soil and construction or retaining structures are the common or “traditional” methods of mitigation. Unfortunately these techniques are laborious, take time, and due to the excavation component are challenging to construct while maintaining traffic.

These types of failures are small but frequent; they also repeatedly prove to be technical but are generally under funded for traditional repair methods. This paper describes recent innovations that not only proved to be very efficient, they successfully mitigated multiple sites in a twelve month period and caught the attention of the BC Premier Awards committee who granted Peter Bullock, P.Eng., M.Eng. and his team the 2013 Innovation Award.

The 7 sites across Vancouver Island, BC. each had some, or all, of the following attributes: steep ground, limited access, environmental constraints and/or limited right of way.

Design/build delivery with small inclusions, and lots of them, were the theme of this work. Soil and rock anchors, closely spaced micropiles and geosynthetic reinforced soil (GRS) were the tools. Small footprint, few resources, shortened construction timeline and reduced cost with a wide applicability was the result.

The Challenge

Unlike large jobs, the small, non-emergency, maintenance type work on secondary or rural roads have limited political pull, few resources, but all the technical challenges. Every site was unique and every site had challenges. This resulted in the need for specialized engineering and/or expensive investigations and logistical considerations.

The following few examples were all long standing challenges that the BC Ministry of Transportation and Infrastructure had been repairing, studying and routinely maintaining for years, even decades at an ever increasing cost to the taxpayer.

The Test

After years of watching traditional methods either consume budgets or simply prove to be too expensive to proceed, a test project was entertained. In 2011 the South Coast Region took on a new venture that captured multiple projects under one design/build contract on Vancouver Island.

The Vancouver Island District was canvased and suitable projects were highlighted for cost and priority. The list identified 12 challenges with a combined construction cost estimated at over $10 million using traditional methods.

The Region allocated $500,000 for the preliminary work. The intent was to mitigate 5 sites: Ford Cove Hill on Hornby Island, and 4 sites on Highway 4: Kennedy Canyon, Kennedy Lake East and West Slides and Kennedy Lake Pinch point. Highway 4 travels across mid Vancouver Island between Qualicum Beach and Tofino.

These projects proved so successful that additional work was completed under a different contract on Highway 14. Highway 14 travels up the southwest coast of Vancouver Island from Victoria to Port Renfrew.
Design Methodology

The design/build process is best completed when there are synergies between the designers and construction crews. The flexibility of a system and process are critical to allow for field alteration as required.

The preliminary design was based on basic site measurements, observations, experience, and past studies (when available). The assumptions made in the initial design work were verified through the construction process and alterations were made as warranted.

Design methods for the soil anchors, micopiles and GRS followed the following publications:

- FHWA0-IF-03-017, “Geotechnical Engineering Circular No.7”

Project Overviews

The following case studies are highlights from the initial design build contract and the additional work completed on Highway 14.

Both Highway 4 and Highway 14 traverse extremely steep and rugged coastal terrain. The routes were initially pioneered in the 1950’s as forestry and mining roads carved out of the slopes and wilderness as single lane dirt tracks. Much of the road length was cut fill construction with frequent rock cuts and log cribbing to cross the steeper ground and gully systems.

The routes were further challenged with high rainfall, up to 4m/year, and limited width due to cliff bands, streams and lakes.

Highway 4, Kennedy Hill West Slide

Kennedy Hill West Slide was a shoulder fill area that was impacting the westbound lane for decades. During wet weather events it was not uncommon for the slide to move several cm’s/day and 100-300mm annually causing frequent need for asphalt patch repairs. The road width as also very narrow constrained by large boulder (5-8m diameter) colluvium on a steep slope above and Kennedy Lake below.

In 2008 the Ministry made some improvements through the area with a road widening project using concrete blocks and geogrid. The project was initially successful at gaining the desired width, however the additional loading only exacerbated the slope movement (Figure 1).

The work involved soil anchors varying in length from 6 to 18m through every concrete block and a third row above on an offset pattern. The anchors were all grouted into the boulder colluvium and bedrock was not intercepted (Figure 3). Torsional stiffness and corrosion protection was gained with a shotcrete shell (Figure 4).
The work was completed late 2011 and the site has performed exceptionally well ever since. The MoTI Road Area Managers comment when the work was completed “It is interesting, driving across it now “feels” solid.”. The last inspection in March 2014 found no reflective cracking or settlement.

**Highway 4, Kennedy Hill East Slide**

Kennedy Hill East Slide was only 40m east of the West Slide (Figure 5), but the morphology of the slide was completely different.

The site crossed a rock cut and fill section that was also widened using similar techniques of concrete block and geogrid in 2008. Unfortunately the additional width was unknowingly placed over the edge of a subsurface rock cliff and over the next 3 years the work progressively slid down the slope approximately 7m and reduced the road width back to pre construction widths (Figure 6).

This site was also investigated and the mitigation cost was prohibitive and the gaining the desired road width was not guaranteed. Using tie back anchors, micro piles and GRS fill, an additional 3m of width was constructed at a quarter of the traditional cost estimate.

The site was excavated to competent material, the road was shored up and the micro piles constructed to gain global stability for the GRS fill (Figure 7).

**Highway 4, Kennedy Lake Pinch Point**

The “Pinch Point” was a trafficability challenge for decades that became more of an issue with 2008 road improvements just to the west that widened the road and effectively increased the hourglass effect that pushed vehicles toward the inside cliff.

Eastbound, the highway closely followed the shores of Kennedy Lake and then steeply climbed to an upper bench across a steep cliff face. The “pinch” was created at the base of this hill with the construction of cast in place gravity wall from the 1950’s.

Additional width was needed but infilling into the lake was not an option and deconstruction of the wall would render the highway impassable during construction (Figure 8).

Due to numerous factors, the engineering and delivery was undertaken by the author, Peter Bullock, P.Eng., M.Eng. The design involved tie back support for the marginally stable gravity wall into bedrock, GRS fill supported by micropiles and a tie back anchor system to gain the additional width (Figure 9).
The final product gained the necessary road width allowing for enhanced road geometrics and additional shoulder width (Figure 10).

Hornby Island Ford Cove Hill
Hornby Island is a remote Northern Gulf Island just south of Comox, BC. Travelling there requires two ferries from Vancouver Island, via Denman Island. This trip takes time and logistical challenges for not only the locals but construction intent too.

The Island has one main access road from which the secondary roads connect to. Near the end of this road is a large cliff escarpment of conglomerate and sedimentary rock sequences. The road traverses down across the cliff face to the harbour below.

Near the top of the hill was a section that was built out onto a rudimentary log crib and a poorly constructed road side barrier “wall”. The challenge was the logs were rotten and no longer able to support the shoulder fills above. The consequential settlement was impacting the road surface, the cross culvert system, and increased the maintenance needs.

Unlike the other sites highlighted in this paper, bottom up construction was an option. The preliminary design to remove the shoulder fills and reconstruct with GRS founded on bedrock was completed, however the construction cost estimate was more than anticipated and the need to remove the protected Gerry Oaks from the work zone was not desirable so alternatives were investigated.

The result of the second phase investigation found that a “beam” of soil anchors across the top of the slope would adequately support the failing shoulder fills and off-load the soil below stabilize them as well. The overall construction cost was less than half of the original design and no trees were lost in the process.

Highway 14, Lost Creek Culvert
On August 30, 2012, the author sat in a pre construction meeting for a paving project along Highway 14 near Sombiro Bridge. During the meeting it became apparent that the cantilevered log section in Lost Creek had not been identified or highlighted to the contractor, nor had construction plans been investigated due to the technical challenges of the site. This was a problem as it would not address the maintenance issue of the site and the contractor was reluctant to cross the area with the heavy asphalt equipment.

The 15m wide segment crossed a natural steep gully system where the bedrock quickly fell away. The cliff below was approximately 40m high above Lost Creek with an overall slope angle of nearly 60 degrees. Shoulder loss was mitigated with the addition of several logs in the fill effectively bridging the gully and twin culvert system (Figure 14).
Timeline and budget were critical for this job. The pavers were scheduled passing through this segment within 3 weeks of the pre construction meeting. In that time a design had to be developed, a contractor secured and construction complete to allow for asphalt.

Through the successes of the previous work on Highway 4 enough experience was gained to develop a GRS fill supported by rock anchors and micropiles into bedrock (Figure 15).

The system worked and the paving schedule was unaltered.

Conclusions

Within a 12 month period 7 significant sites within the MoTI inventory had been mitigated with long term solutions and are now no longer maintenance issues. These repairs were extraordinarily efficient as the construction costs in terms of both time and money were repeatedly less than 50% of traditional approaches.

Much of the savings were due to the compressed investigation, design and construction sequence afforded by the design/build approach. The technical requirements were attained with the philosophy that “many hands make light work”. The close spacing of smaller anchors provides a more uniform loading and redundancy, while the close spacing of the geosynthetic fabric completely alters the soil mechanics of the retained fill.

Acknowledgements

The writers would like to acknowledge the contribution of a number of individuals to this project.

Bob Barrett GSI Founder, Colby Barrett GSI President, Nate Beard GSI Eastern Regional Director, Matt Birchmier, GSI Chief Engineer, John MacKay MoTI District Technician (retired), Cal Fradin MoTI Assistant District Technician (retired), Wayne Jentsch, MoTI Project Manager (retired), Sue Powells – MoTI Road Area Manager, Vince Trozzo MoTI Paving, Manager, Jonathan Tillie MoTI Operations Manager, Grant Lachmuth GeoStabilization International.

References


Permission to reprint was granted. This article was originally part of the 2014 GeoRegina Conference proceedings.

Peter Bullock, Principal Engineer. Peter is a native of British Columbia, holds a Geological Engineering degree from the University of British Columbia, and has 20 years of experience within the earth science and engineering fields. His early days were spent primarily in the forestry and mining sectors both within the corporations and as a consultant. In 2006, Peter moved into the Public Sector as a Regional Geotechnical Engineer for the Ministry of Transportation in BC. Through the years Peter has been involved with hundreds of projects that ranged from routine maintenance to multi million-dollar legacy and capital works projects. Many of these projects were scattered across the globe and ranged from the African deserts to the ice of Antarctica. His earlier years focused on the natural hazard side of geotechnical engineering. These hazards included landslides, slope stability and rock fall challenges. As his career progressed he became more interested in the structural side of engineering, which led him to complete his Masters of Engineering at the University of Saskatchewan, gained him a nomination for the BC Premiers Award for Innovation and ultimately GSI.
The California Section AIPG and UC Davis Student Section are active, with monthly meetings from October to May, as well as two weekend field trips. The UC Davis student section was founded in 2010 and is quite active. Photo of the California Section AIPG Meeting on January 8th, 2015 at UC Davis with the Student Section. Stephen Testa, CPG-6464, a former president of AIPG and AGI, is the Executive Officer of the State Mining and Geology Board in California. He was the guest speaker. His talk focused on famous California geologists, including the two related, but often opposing William Blake and Josiah Whitney. Stephen concluded the presentation with his comments on what makes a successful professional geologist. The talk was well received. AIPG National provided a plaque shown in the photo that will be permanently mounted in the Moores Conference room at UC Davis. The current AIPG UC Davis Student Section president is Timothy Nelson, SA-4789. The past student president is Richie Winn, SA-5346. Student mentors are Steve Baker, MEM-2553, and Rob Sydnor, CPG-4496. The student section advisor and sponsor are Robert Zierenberg, MEM-2106, and Jim Jacobs, CPG-7760 respectively.

Figure 2 from William Elliott’s article on page 48.
Comparison of STEM and Geoscience Occupation Growth Over the Next Decade

Recent discussions have focused on the current and future job market for science, technology, engineering, and mathematics (STEM) graduates, and AGI has received multiple requests for comparisons between the geoscience workforce and the STEM workforce.

According to the Bureau of Labor Statistics (BLS), there are approximately 300,000 geoscientists and 8.7 million STEM workers employed in the United States with average median salaries of $83,811 and $81,413 respectively. Both annual median salaries are well over the overall annual median salary of $35,080 in the U.S. workforce.

Over the next decade, the BLS projects a 14% increase in geoscience jobs and a 13% increase in STEM jobs. This predicted growth is a bit higher than the overall average growth of 11% for all occupations in the United States. Within the geosciences, environmental scientists and environmental engineers are predicted to have the most workers, increasing to 103,200 and 61,400 jobs respectively, and the occupations with the greatest increase in jobs will be petroleum engineers (26%) and geographers (29%). Within STEM, computer occupations and engineers are predicted to have the most workers, increasing to 4.3 million and 1.7 million jobs respectively, and the occupations with the greatest increase in jobs will be within the mathematical sciences (26%) and computer occupations (18%).

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