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ON THE COVER - Mills Glacier at the foot of Long's Peak east face, Rocky Mountain National Park, Colorado. Long's Peak at 14,255 ft is the only fourteener in Rocky Mountain National Park. It's distinctive summit rises a full 9,000 ft above the plains of northeastern Colorado. The east face of Long's Peak forms part of a magnificent cirque, with granite walls that soar. Photograph by Daniel R. Heidenreich, CPG-10085.
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American Institute of Professional Geologists (AIPG) is the only national organization that certifies the competence and ethical conduct of geological scientists in all branches of the science. It adheres to the principles of professional responsibility and public service, and is the ombudsman for the geological profession. It was founded in 1963 to promote the profession of geology and to provide certification for geologists to establish a standard of excellence for the profession. Since then, more than 10,000 individuals have demonstrated their commitment to the highest levels of competence and ethical conduct and been certified by AIPG.

The mission of the American Institute of Professional Geologists (AIPG) is to be the superior advocate for geology and geologists, to promote high standards of ethical conduct, and to support geologists in their continuing professional development.

For AIPG news and activities go to www.aipg.org.
CALL FOR ABSTRACTS
Rocky Mountains and the Colorado Plateau
Canyons, Resources & Hazards
American Institute of Professional Geologists
Hosted by AIPG Colorado Section
Grand Junction Geological Society
Mesa State College

October 3 - 7, 2009
Grand Junction, Colorado

Join us
in beautiful western Colorado's mountains, canyons, and incredible geology for a diverse program of scenic field trips, technical presentations, and social events. The formal sessions will begin on Monday, October 5th and will end Wednesday, October 7th. There will also be field trips on October 3rd, 4th, and 8th.

Our technical program covers diverse geoscience topics including road construction through mountains and landslides, the impacts of energy development (petroleum, coal, and uranium), resource and reserve classification (it's been 100 years since H.H. Hoover defined proved ore), permitting issues, and geoscience software, its use and misuse.

Field trips, many of which are very scenic—bring your guest along—will include a loop through the Colorado National Monument and a look at places where eastern museums stole Colorado dinosaur bones; a trip over Grand Mesa, an incredible bit of reverse topography, landslides, and scenic views; a trip to the Lake City area with the active Slumgullion Slide, along with a lot of smaller ones; a trip over the Million Dollar Highway between Ouray and Silverton that will see very diverse geology, the ultimate in angular unconformities, a laclolith, an avalanche shed, and consideration of the impacts of naturally occurring hydrothermal alteration's acid drainage and its modification by mining; a trip to an underground uranium mine; a trip to an active oil rig; a float trip down the Colorado River; an examination of stream capture in the Unaweep Canyon; and everywhere, scenery that can't be matched elsewhere.

We're planning short courses and workshops on GIS and GPS use, various types of geoscience software, reserve and resource definitions, and permitting (regulations, legislation, and community relationships).

Social events will include tours of the local wineries and site seeing through the Colorado National Monument and Grand Mesa. You're invited to join friends on less formal tours, like a trip to Ouray's fabulous natural hot spring swimming pool, which is great in snow storms.

www.aipg.org

CALL FOR ABSTRACTS
Important Dates
May 1, 2009..........Abstracts due
May 15, 2009.........Authors notified
July 1, 2009..........Final abstracts/papers due

Abstract Subject Areas
(suggested topics welcome)
FOC Future of Coal
GEO Geohazards: landslides, engineering geology, etc.
GIS GIS Applications
IMD Industrial Minerals Geology
IRD Impact of Resource Development on Local Communities
MTH Mountain Highways
MIN Trends in Mineral Development: oil shale, coal-bed methane, etc.
PLI Planetary Impact Geology
PMT Permitting
REG Regulatory Issues
RRD Resource/Reserve Definition
URG Uranium Geology
WTR Water Issues: acid rain, etc.

How to Submit Abstracts
To have your abstract considered for a presentation or poster, please submit a one-page abstract and the Abstract Submittal Form by May 1, 2009. Abstracts must be in Word format, single spaced, 12 point Times Roman, and should not exceed one page. You will be notified by May 15, 2009 if your abstract has been accepted.
SCHOLARSHIP PROGRAM

Purpose
To assist students with college education costs and to promote student participation in the American Institute of Professional Geologists (AIPG). Up to four scholarships will be awarded to declared undergraduate geological sciences majors who are at least sophomores.

Scholarship Awards
Scholarship awards in the amount of $1,000.00 each will be made to eligible students attending a college or university in the U.S. Scholarships are to be used to support tuition and/or room and board.

Eligibility Requirements
Any student who is majoring in geology (or earth science), is at least a sophomore, and is attending a four-year accredited college or university in the U.S. can apply. Also, the student must be either a student member of AIPG or must have applied for student membership at the time the application for the scholarship is submitted.

Each student who is awarded a scholarship agrees, by accepting the scholarship, to prepare a 600 to 800 word article for publication in The Professional Geologist. The subject of the article must be related to a timely professional issue.

Application Process
Applicants must submit: a letter of interest with name, mail and e-mail addresses, and telephone number; proof of enrollment in an eligible geological sciences program, transcripts; an original one-page essay on why the applicant wants to become a geologist; and a letter of support from a faculty member familiar with the applicant’s academic work. The application packet should be submitted to:

American Institute of Professional Geologists
Attn: Education Committee Chr.
1400 W. 122nd Ave., Suite 250
Westminster, CO 80234

For questions regarding the application process call (303) 412-6205 or e-mail: aipg@aipg.org.

Applications must be received by FEBRUARY 15th
Awarded the month of SEPTEMBER

Basis of Awards
Awards will be based on the content and creativity of the essays as judged by the Education Committee. The decisions of the Education Committee are final.
Colorado Section

Special awards for Colorado Section Members

Two members of the Colorado section received awards from the American Association of Petroleum Geologists (AAPG) recently. Stephen Sonnenberg, CPG-06201, was granted honorary membership in the AAPG for his “distinguished service and commitment to the AAPG and the petroleum industry.”

The AAPG Distinguished Service Award was presented to Douglas Peters, CPG-08274, for his distinguished and long-term service to the AAPG and its Divisions and his “unflagging enthusiasm for the geological and planetary sciences.”

Congratulations go out to these outstanding representatives of our organization and of the field of geology.

Georgia Section

Last Meeting.

We had our last field trip on August 9, 2008, to Amicalola Falls. The weather turned out great early in the morning and we had a nice hike up to the top of the falls and lunched together. Afterwards the kids played and some of us talked shop. It was fun just to get out to a state park and enjoy the day.

The famous hanging flume above the Dolores River in Colorado. Photo by Jim Burnell.

Illinois-Indiana Section

Record Attendance at Spring Meeting

The Spring 2008 Illinois and Indiana Section meeting at The Morton Arboretum in Lisle, Illinois on April 9th garnered a record turnout – over 60 geologists, scientists and engineers! We were close to standing room only, and next time we will book a larger room.

Our keynote speaker was Mr. Gregory W. Dunn, Program Manager of Illinois EPA Voluntary Site Remediation. He gave a presentation on regulatory updates 740/742, vapor intrusion, community right-to-know, and Site Remediation Program (SRP) status. The regulatory update – and especially the vapor intrusion review – generated intense interest and a lively question and answer period.

The second guest speaker was Mr. James Adamson, Hydrogeologist at V3 Companies of Illinois. Mr. Adamson’s presentation, Haiti: Finding Water Where There Was None, dealt with his team’s efforts to provide drinking water to an impoverished area of Haiti. Adamson described some first class geologic and hydrogeologic work employed to uncover much needed water resources.

The AIPG Illinois-Indiana Section officers at the Spring Meeting.

Fall Colors Morton Arboretum in Lisle, Illinois.

Michigan Section

Michigan Section Field Trip

On August 8 and 9, 2008, nearly 50 Michigan Section members and their families attended a two-day field trip in northeast Lower Michigan. The field trip kicked off at 10 am on Friday morning at the LaFarge Stoneport Quarry. Quarry Engineer Allan Idalski met the trip participants and led the busses into the quarry where quarry personnel were ready to blast a section of a bench in the actively mined area.

Following the blasting, Allan gave an overview of quarry operations, providing an opportunity to view portions of the quarry. Participants then had the chance to search “waste piles” for various fossils. The Stoneport Quarry workings extend through the middle Devonian Dundee Limestone, Bell Shale, and Rockport Limestone.

After fossil collecting in the quarry, the trip participants broke for lunch, and then met in the early afternoon at the Thunder Bay National Marine Sanctuary in Alpena. There, the group was given a tour of the facility with explanations of the area the sanctuary covers and the number and age of various shipwrecks found within the sanctuary boundaries.

Saturday morning saw the trip participants assemble at the Rockport Quarry north of Alpena. MDEQ geologist Jeff Spruit gave a short presentation on the history of the quarry, its role in the construction of the Mackinac Bridge, and the fossils that could be found before everyone headed into the quarry. In spite of a torrential downpour, everyone had a good time. And yes, Larry Austin recovered nicely from his trip-and-fall incident.

Field trip participants Seraphine and Emma Heft and their two-day haul of horn corals, brachiopods, bryozoans, and Hexagonaria corals from the Stoneport and Rockport quarries.
South Dakota Section

Members of the AIPG South Dakota section at the entrance of the Kirk adit of the former Homestake Mine near Lead, South Dakota.

Missouri Section

Missouri State Geologist and Land Survey Director Mimi R. Garstang, CPG-10185 Retires - Honored with Section Achievement Award By Kerry L. Nikolaisen, CPG-10454

At the close of July 2008, Ms. Mimi R. Garstang, CPG-10185, Missouri State Geologist and Land Survey Director retired after a long tenure with the State of Missouri. A retirement banquet was held on July 25, 2008 to honor Mimi and recognize her accomplishments. Numerous colleagues, friends and organizations gathered to celebrate her career achievements with many awards and accolades. Mimi was a long-time contributor and active in the AIPG Missouri Section, Association of Missouri Geologists (AMG) as well as the Association of American State Geologists (AASG). AIPG Missouri Section recognized Ms. Garstang’s contributions to the Institute, Section and geologic profession by honoring her with the James Hadley Williams Outstanding Career Achievement Award. The award was handed out by AIPG Missouri Section member Kerry L. Nikolaisen, CPG-10454, during the ceremony. It was only the second time the award had been given out, after being awarded to its namesake and Ms. Garstang’s predecessor, longtime State Geologist James Williams, CPG-00374.

The following is a snapshot of Mimi’s career, as highlighted on the retirement program (courtesy Hylan Beydler).

A Career Spanning More Than 27 years

A Missouri native, Mimi Garstang began her career with the Missouri Department of Natural Resources’ Division of Geology and Land Survey (MDNR – DGLS) in 1979.

Prior to her employment with the department, Mimi earned a comprehensive Bachelor of Science Degree in Geology in 1972, from Southwest Missouri State University. Her first job in her chosen career field was as an environmental geologist with White Consulting Engineering Company in Memphis, Tennessee, where she conducted many water shed studies, assisted with numerous drainage projects, subdivision design, and stormwater layout.

When Mimi accepted employment with the Department, as a geologic technician, some of her first duties included crushing and preparing rock core in the division’s lab. As an individual with a very practical nature, her career goal was to work in the division’s Environmental Geology Section where basic geologic principals were applied to solve real world problems. Thus, much of Mimi’s early career with the Division involved work in the Environmental Geology Section of the Geological Survey Program. Mimi conducted water tracing and site suitability studies for siting waste disposal facilities.

Unit Chief

As Unit Chief of the group of geologists that evaluated the geology and hydrology of hazardous waste sites in Missouri, she faced some of the most rewarding challenges of her career.

Mimi was the lead geologist involved in characterizing the dioxin contamination at the infamous Times Beach and multiple sites in the state where both groundwater and soils were contaminated with radium, thorium, and uranium from the processing of ore for the Manhattan Project for the development of the atomic bomb.

In the Forefront

Mimi’s career touches some of Missouri’s biggest environmental challenges. In addition to the work at the Times Beach dioxin site, Mimi worked on other critical remediation projects including the Weldon Spring chemical plant site in St. Charles County, the St. Louis Airport Radioactive Waste site and numerous other hazardous waste cleanup sites in Missouri.

Deputy Division Director

For six years, beginning in 1994, Mimi served as the Division’s Deputy Director and for two years, she served as interim lead for the Water Resources Program. In this capacity, Mimi was the Governor’s representative regarding interstate river issues. She was also a delegate to both the Upper Mississippi River Basin Association and the Missouri River Basin Association where water politics has greatly influenced the management of these two great river systems.

Division Director

In June 2000, Mimi was appointed by the Governor as State Geologist and Division Director, the position from which she retired August 1, 2008.

Issues Affecting Missourians

As State Geologist and Division of Geology and Land Survey Director, Mimi has served on numerous national and state geologic and environmental-related committees and task forces regarding issues that have significant impact on the health, safety and welfare of Missourians.

She has represented the state regarding issues such as the development of new energy resources including coalbed methane and tar sands, the investigation of potential underground reservoirs for longterm storage of carbon dioxide and the evaluation of earthquake risk in the New Madrid Seismic Zone in southeast Missouri.

State’s Industrial Minerals

Mimi’s work lead to the creation of the Geologic Resources Fund and the Industrial Minerals Advisory Council by the Missouri legislature. The Industrial Minerals Advisory Council will provide the department director with advice and counsel on the administration of the Geologic Resources Fund, work products to support the industrial mineral operators, and all other matters brought before the council by the MDNR Director.

Variety of Assignments

Mimi had a wide variety of challenging work assignments that prepared her for her job as State Geologist and Division Director. She focused division goals on assisting Missouri’s residents with a better understanding of Missouri geology and land surveying. She has been an advocate for the application of
geologic knowledge and principles to real world problems, allowing us to make better environmental and economic decisions in Missouri. The importance of the application of geologic data cannot be understated in the protection and development of our natural resources and in making sound engineering and economic decisions. Mimi has often stated that she sincerely appreciates the honor of serving as Missouri’s State Geologist, and that she feels very fortunate her hobby and personal interests both lie in her profession.

**Major Milestones and Accomplishments**

- Missouri’s 18th State Geologist, Mimi is the first female to hold the position since the agency was created in 1853.
- In 2003, the Division marked its 150th birthday with an open house. Visitors and dignitaries came from across the state. The Missouri Geologic Map was updated that year. It was Missouri’s first digital version.
- Mimi served on the Missouri Well Installation Board, the Missouri Land Reclamation Commission, the Missouri Geologist Registration Board, the Oil and Gas Council, the Industrial Minerals Council and represented Missouri as a member of the Central United States Earthquake Consortium.
- At their 100th Anniversary meeting in June 2008 Mimi was voted into honorary membership of the American Association of State Geologists.
- Mimi was recently honored by Missouri First Lady Melanie Blunt during the inaugural First Lady Awards ceremony in the Business and Innovation category.

**Members in the News**

**Congratulations to Larry Fellows!!** Former Arizona Geological Survey director and state geologist Larry Fellows, CPG-04447, accepts the Distinguished Service Award from the Association of American State Geologists from Lee Allison, AIPG MEM-0328, our current Arizona Geological Survey director and state geologist. Lee accepted the award on Larry’s behalf at the AASG Centennial meeting in West Virginia.

Larry is a past AIPG Arizona Section President and currently our Treasurer. Again, congratulations to Larry on a well-deserved honor.

**Shannon & Wilson Geologist Earns Stormwater Certification**

Christopher B. Darrah, CPG-09877, Principal Geologist for Shannon & Wilson, Inc., Fairbanks, is now a Certified Professional in Erosion and Sediment Control (CPESC), qualifying him to prepare stormwater pollution prevention plans (SWPPPs), required for construction projects under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Construction General Permit. Darrah can now prepare SWPPPs for projects regulated by the City of Fairbanks and the Fairbanks North Star Borough, as well as construction projects under the auspices of the State of Alaska and the U.S. Army Corps of Engineers.

Darrah is also recognized as a Certified Erosion and Sediment Control Lead (CESCL), which qualifies him to conduct site inspections required by state and federal stormwater regulations.

Darrah joined Shannon & Wilson as a geologist in 1987; he came to the Fairbanks office in 1992. He has extensive experience in environmental field investigations and regulatory compliance. In addition to his stormwater expertise, Darrah is an EPA Asbestos Hazard Emergency Response Act (AHERA)-certified asbestos inspector, accredited to perform inspections for asbestos-containing materials in schools, or public and commercial buildings. He can also serve as the owner’s representative to monitor asbestos abatement projects.

Shannon & Wilson, Inc., has been offering geotechnical and environmental consulting services in Alaska, since 1974. The company is recognized as a leader in geotechnical and environmental engineering in Alaska. Our environmental professional staff includes geologists, chemists, engineers, and a microbiologist. We have developed particular expertise in the investigation and assessment of contaminant releases and the design and operation of site-cleanup measures in arctic and subarctic conditions. Our geotechnical professionals specialize in permafrost engineering. They are supported by an in-house American Association of State Highway and Transportation Officials (AASHTO)-certified and U.S. Army Corps of Engineers (USACE)-validated materials testing laboratory, which performs soil test procedures, asphalt and concrete mix design, and earthwork compaction quality control testing.
Innovative Remediation Technology Conference

Eric Lowe, MEM-0385, Ronald Wallace, CPG-08153

In early January of this year five members of the Georgia Section got together to consider sponsoring a technical conference. Two of the section officers, Ron and Eric, met with Ken Summerour, Yo Sumartojo, and Past student chapter president Beth Lavoie. The original idea was to have a one-day conference on a Saturday, anticipating that more consultants should be available to attend the conference. This idea was quickly voted against and the decision was made that the conference should be popular enough that consultants could attend during working hours. It was also decided that the conference would need to be more than a one-day conference in order to draw an appropriate amount of exhibitors. Since we had never attempted anything like this before, we decided that a one and one-half day conference should be our format. Although a number of different subject matters were discussed, we quickly decided to have an innovative remediation conference because a number of new technologies were currently being implemented in Georgia.

The next issue was a proper venue. The section had used Georgia State University’s continuing education facility for groundwater modeling classes in the past, but the facility was too small. Eric Lowe was familiar with the Kennesaw State University’s continuing education facility and it seemed large enough to accommodate the conference and exhibitors in the same room. We wanted to schedule the conference in the spring but before June to avoid vacation conflicts. The university was very flexible and allowed us to pick our own caterers for lunch. We decided that our section could provide breakfasts and breaks each day in order to keep the costs of catering to a minimum.

At our first meeting we identified a number of the speakers we wanted to personally invite to speak. We also sent email announcements to other environmental professionals in an attempt to solicit speakers. We also identified two additional speakers through a contact with EPA Region 4 in Atlanta. We had a total of 15 speaker slots to fill and most of the slots were committed by mid-March. We told all speakers that we had no travel funds but, we would not charge them a registration fee. We had five speakers from out of state including professionals from Florida, South Carolina, Pennsylvania, Illinois, and Oklahoma.

The next issue was obtaining enough sponsors and exhibitors to fund the event. We sent over 60 letters to environmental consulting firms asking for sponsorship. The price was only $50.00 more than the non-AIPG registration fee. In exchange for their sponsorship, the company would be able to send one attendee at no additional cost. We informed the sponsors that we would highlight their company information during the conference in both the course notebooks and on our website. A number of our speakers also chose to become sponsors for the conference. After a slow start, we anticipated and budgeted for 10 sponsors, but ended with a total of 23 sponsors. The exhibitors were very hard to attract because this was a new conference. We initially sent letters out to local companies and companies that sponsored conferences in the southeast that we had previously attended. However, through personal telephone calls and a few meetings with potential exhibitors, we slowly attracted enough exhibitors to fill the area of the venue dedicated to exhibitors. We were very careful in our selection process because we wanted to attract a wide variety of exhibitors and to avoid focusing on one segment of the industry. We had originally anticipated and budgeted for 10 exhibitors but ended with 12 total exhibitors. Each exhibitor was allowed one attendee and a space for their company booth. Exhibitors were also highlighted during the conference, both in the course notebooks and on our web site.

The last major issue was soliciting enough professionals to attend. Through AIPG national we sent out a number of emails to our members in Georgia and reminders in our monthly newsletter. We also sent emails to the surrounding sections and it was also advertised in the TPG. We also worked with other professional organizations in the area including Georgia Ground Water Association, Atlanta Geological Society, and Air & Waste Management Association to advertise our conference to their members. We sent out over 200 letters to registered Georgia PG’s in the surrounding counties asking them to attend. Our budget projected a total number of participants at 135 but a total of 130 attended the conference.

We also requested additional help as the conference date approached. Caryl Alfaro coordinated with all our speakers in getting their presentations into the notebooks. She also designed our cover for the notebook and worked the registration area. Yo Sumartojo coordinated with all our sponsors and exhibitors to include them in the notebook and also worked the registration area. Beth Lavoie was in charge of our caterers for lunch, coordinated the breakfasts and breaks, and helped with registration. Elise Blesi assisted Beth with catering. Eric Lowe was our master of ceremony and introduced each speaker. Ron Wallace made the welcoming announcement and gave a short presentation on AIPG during lunch. After the first day Leggette, Brashers & Graham, Inc. volunteered to sponsor a post meeting social at a nearby Taco Mac restaurant.

Prior to the conference, we notified the six universities in Georgia that offer geology degrees about the conference and encouraged students to submit their resumes. Only five resumes were received, but one student did receive a job through this conference.

The conference was a complete success! Comments received in our post-conference questionnaire indicated that the conference was well received.

We set a few goals for this conference, which included raising money for future student scholarships, AIPG name recognition, and a source of continuing education credits for our members and other professionals.

There are always lessons learned during the first time any event is held. One of the more important lessons was passed on from our current National President, Dan St. Germain. Dan told us that an event should always give the impression of success. The room we selected was large, but placement of the exhibitors in the same room as the presentations helped fill the room and allowed the exhibitors to be close to the attendees. We also had the option to move the exhibitors outside to the registration area if needed.

We plan to sponsor another technical conference again in the fall of 2009 and hope to attract an even larger crowd. The conference helped increase the budget for the Georgia AIPG Section which will allow us to sponsor more students and provide as a means to reach more geological professionals in the state.
By the time you read this, the run-up to the November 2008 presidential election will be history, and has cost tens of millions of dollars. For this price tag we have been forced to endure months of campaign rhetoric, commercial spots, debates (a term I use with reservation), interpretations of what was really said, etc., where candidates have deluged us with innuendos, misrepresentations, partial truths, and out-and-out lies that we are supposed to accept at face value and not question. And I, for one, am glad that this campaign season has come to a close, but am also saddened, discouraged, and disappointed. Now, this is where what I had initially written was discarded, and replaced with the following.

Last evening, as I was heading out to teach my Physical Geology class, there was a typical Florida downpour, so I grabbed my AIPG ball cap – you know the one with Competence, Integrity, and Ethics stitched above the bill and under AIPG – to keep the rain off my glasses. After arriving in the classroom with two buckets of samples for show-and-tell, I failed to remove my cap (poor manners, I know).

As usual our class discussion began with items related to current politics and recent news stories, because many of my students are interested in how what we talk about in class applies to the “real world”. So, discussion of topics like energy dependence, “clean” coal, alternative fuel sources, offshore drilling, inequitable distribution of mineral and other natural resources, and climate change begins nearly every class.

Last evening was no exception. A comment by one of my more mature students was directed toward petroleum. He had heard the oft repeated comments by politicians that: the US has about 3% of the world’s known petroleum reserves, yet uses more than 25% of the world’s annual production; the US imports more that 60% of its daily petroleum needs, and; additional offshore (also ANWAR) drilling is necessary to alleviate this dependence on imported petroleum. He also wanted to know just how big the impact petroleum from ANWAR would have and how long it would take to ‘get to the pumps’. This was not the first time that such questions have come up. However, in the intervening time, several students had searched the internet for information, and began sharing what they had learned. One had gotten interested in the numbers of hectares currently under lease by oil companies that are being actively produced in continental US. Another had discovered data that illustrated known reserves versus production. Another asked the question about how long it takes to actually get production from offshore sites. Then a question came up about why so much oil is left in the ground, and why haven’t the oil companies done the research to get more out.

Early in this discussion, a potential math major raised his hand and asked about production rates of petroleum wells, and then busily punched keys on his laptop, later sharing with the class estimates of the number of new wells producing at three production rates it would take to eliminate petroleum imports. This was followed by a question from the other side of the room about how long would our 3% petroleum reserves last.

After that question, the room got real quiet. Then one of the students commented, “Dr. Gibson, you are not being very polite tonight. You still have your hat on.” Then, she wanted to know what AIPG meant and what the other writing was. I responded, and she commented that politicians could use more of that, which makes me proud and humble to be part of AIPG.

One last item. If any of you who read this still beat on rocks, my wife and I both could use mineral and rock samples for our introductory classes. Contact me via ggibson@fcj.edu. Thanks.

THANK YOU NANCY!

As those of you who have read TPG faithfully over the past four years know, Nancy Price has written some very insightful pieces from the student perspective. The Nov/Dec 2008 issue of TPG will contain her final official contribution to TPG, as a student, but I hope not her last contribution. Nancy, as you pursue the Ph.D. work, we all wish you the best and expect great success, which I am certain you will earn. Oh yes, and we look forward to periodic contributions to TPG from the point of view of Nancy Price, the geological professional.

Should you decide to pursue a career in academia, I anticipate that we will hear of you bringing your students into the fold of professionalism and AIPG membership, and growing professionally as both a researcher and educator. Should you elect to pursue a non-academic career in geology, then obviously we expect see you remain an active member of AIPG, even serving as part of the Executive Committee in some capacity.

All that said Nancy, thank you for your contributions, and may the gentle breeze always blow at your back.
REQUEST FOR NOMINATIONS

The AIPG Awards Committee is seeking nominations for future recipients of the Ben H. Parker Memorial Medal, the Martin Van Couvering Memorial Award, the John T. Galey, Sr. Memorial Public Service Award, Honorary Membership, and Outstanding Achievement Award. The qualifications for these awards can be found below. Nominations for these awards, accompanied by supporting statement, should be sent to AIPG Headquarters, c/o Honors and Awards Chr., 1400 W. 122nd Ave., Suite 250, Westminster, CO 80234.

BEN H. PARKER MEMORIAL MEDAL

The Ben H. Parker Memorial Medal is the Institute’s most distinguished award. It was established by the Executive Committee in 1969 in posthumous honor of a truly great leader, who devoted much of his life to improve the quality of geology and geologists and the services they provide. The medal is awarded to individuals who have long records of distinguished and outstanding service to the profession.

The most important criterion for this medal is a continual record of contribution to the profession of geology. A wide variety of contributions can be considered, such as (a) the education and training of geologists, (b) professional development of geologists, (c) service to the Institute, (d) leadership in the surveillance of laws, rules, and regulations affecting geology, geologists, and the public, and (e) activity in local and regional affairs of geologists.

MARTIN VAN COUVERING MEMORIAL AWARD

The Martin Van Couvering Memorial Award was established by the Executive Committee in 1979 in posthumous honor of the first president of the Institute. Martin Van Couvering made the presidency a full-time occupation for the first two years of the Institute’s history. His dynamic leadership, diplomacy, and organizational abilities established the solid foundation from which the Institute has grown. Few, if any, have given so much to the Institute.

The most important criterion for the Martin Van Couvering Memorial Award is service to the Institute. As in other awards, a wide variety of contributions to the Institute may be considered. By far the most important contribution a geologist can make to the Institute is that of time. It is the contributions by individuals to the Sections, the committees, and special projects that enable the Institute to enhance the practice of geology.

JOHN T. GALEY, SR., MEMORIAL PUBLIC SERVICE AWARD

The American Institute of Professional Geologists’ Public Service Award was established by the Executive Committee in 1982 in recognition of one of its primary purposes: service to the public. In 1992, it was renamed the John T. Galey, Sr., Memorial Public Service Award, in posthumous honor of our fourth President, whose long professional career was a continuum of service to both the geological and the general public.

Recognition of public service is important because so many Members have distinguished themselves and the Institute by giving expert testimony to governmental commissions and committees, and by providing geological expertise where it was needed by the public at large.

The application of geology to the needs of the general public may be in many different forms. Recipients of this award have outstanding records of public service on the national, state, or local level well beyond their normal professional responsibilities.

AWARD OF HONORARY MEMBERSHIP

Since 1984, AIPG has conferred Honorary Membership to those who have an exemplary record of distinguished service to the profession and to the Institute.

OUTSTANDING ACHIEVEMENT AWARD

The Outstanding Achievement Award was established by the 1989 Executive Committee to honor a non-member of AIPG who is widely recognized as a major contributor to the profession of geology. The award is not necessarily given annually, but only when the Awards Committee recommends an outstanding candidate to the Executive Committee for their consideration.

American Institute of Professional Geologists
Nomination form for 2009 AIPG Awards

(Please check one)
- Ben H. Parker Memorial Medal
- Martin Van Couvering Memorial Award
- John T. Galey, Memorial Public Service Award
- Award of Honorary Membership
- Outstanding Achievement Award

NAME OF CANDIDATE: __________________________
Address: __________________________
Address: __________________________
NAME OF PERSON MAKING THE NOMINATION: __________________________
Address: __________________________
Address: __________________________
Signature: __________________________
Telephone: __________________________
Fax: __________________________
E-Mail: __________________________
DATE: __________________________
Supporting Statement (In brief here, please submit detailed letter of support):

RETURN TO: AIPG, Attn: Awards, 1400 W. 122nd Ave., #250, Westminster, CO 80234. Ph. 303-412-6205, Fax: 303-253-9220
DEADLINE: Completed nominations must be received by December 15, 2008.
Roy M. Huffington, CPG-01113, played a major role in developing Indonesia’s oil and natural gas sector and later served as a U.S. Ambassador to Austria, died July 11 while traveling abroad from his home in Houston. He was 90. A member of AIPG since 1966, he held a bachelor’s degree in geology from Southern Methodist University and a master’s and doctorate in geology from Harvard University.

Huffington served in the U.S. Navy during World War II, and upon his return became a field geologist from Humble Oil Company. He later established his own gas and oil firm, Huffco. He worked in Texas and Louisiana until 1968 when he struck a ground-breaking production-sharing contract with the Government of Indonesia.

Discoveries in East Kalimantan led to the development of a multi-billion dollar LNG export project between Indonesia and Japan, which became a major source of revenue for the country. Huffington sold his company after President George H.W. Bush appointed him as U.S. ambassador to Austria, where he served from 1990-1993.

He received the AAPG Michel T. Halbouty Memorial Human Needs Award in 1991.

Peter J. Kaczor, CPG-10513, died August 28, after being struck by a motorist while riding his bicycle in training for a triathlon. Born October 9, 1969 in Cass City, Michigan, he grew up in Lexington, Michigan. He attended Western Michigan University where he received a bachelor’s degree in Geology. In 1999, he moved to Edwardsburg, Michigan, where he worked for Peerless Midwest until his untimely death. It was in Edwardsburg where he met the woman who was to become his wife, and where they were raising their family. Pete was a beloved son, a committed husband, a loving father, as well as a treasured brother and dear friend. He was an avid outdoorsman who loved camping, hiking, hunting, canoeing, and anything else that involved spending time outdoors, especially with his family. He was a smart, hard working employee who enjoyed his job. He lived a Christian life, loved the Lord and was a role model to all who knew him. His absence will be felt and his presence missed by those who were privileged to have known him.

Charles Eugene “Gene” Trowbridge, CPG-03850, age 83, died June 27, 2008 in Houston, Texas surrounded by his loving family. Gene was born in Billings, Montana on December 17, 1924.

Raised in Montana, Gene loved the mountains and returned to his birthplace as often as possible to fly fish and share the beauty of the area with family and friends. As a boy, he earned his Eagle Scout and developed a love of music and books which he carried into his adult life. He was an avid reader, always encouraging others to do the same, and entertained family and friends playing the piano.

Gene served as Sergeant in the Army combat engineers in World War II serving in Europe and the Philippines. He was honorably discharged in 1946.

Following the war, he returned to school at the University of Oklahoma, earning a degree in Geological engineering. He began his career as a geologist in the oil and gas industry with Stanolind Oil & Gas, meeting his future bride Myrtis, while working in southern Louisiana. Following their marriage in 1955, they moved to Houston where he worked for F.A. Callary Inc., eventually becoming an independent consulting geologist. He specialized in oil and gas producing formations along the Gulf Coast and truly loved the hunt for this precious resource. He was a member of the American Association of Petroleum Geologists, Society of Independent Professional Earth Scientists, and American Institute of Professional Geologists. He also was very active in the Houston Geological Society, serving as an Executive Committee member from 1978 to 1980.

Following his retirement in the early 1990’s, Gene continued to remain active in the oil and gas industry through his involvement with the Pioneer Oil Producers (POPs). He always looked forward to POP’s gathering and keeping in touch with friends and new industry developments.

M.H. (Mach) Vaughn, CPG-03216, died on June 12, 2008 in Oklahoma City. He was born on November 6, 1927 in Clinton, Oklahoma, the son of Myra and Robert Vaughn. Mach graduated from Clinton High School and later attended the University of Oklahoma as a petroleum geologist. He married his high school sweetheart in 1949 and they were together until her death in 1983. Mach served in the U.S. Navy at the age of 17, during WWII and afterwards the Naval Reserve as an air photo intelligence officer. His interest and expertise allowed him to work all over the world as an exploration geologist. He worked for Sunray DX in the Texas Panhandle, Kerr McGee and Monsanto Chemical Company. He started Cheyenne Petroleum Company in 1971, worked briefly for Kerr McGee again in the late 80’s and worked as a consultant in the 90’s for Khanty-Mansiysk Oil Corporation, in the development of a Russian oil field in Siberia.
You Are What You Read?

Matthew J. Rhoades, CPG-07837

For many years, we have all been admonished to eat the right foods; load up on fruits and vegetables and watch our caloric intake. We’ve been told to eat more anti-oxidants, more beta-carotenes, and less processed sugar. We were told, “You are what you eat!” Well, to follow this train of thought, I must admit that I probably more closely resemble a slice of apple pie than I do a lean sirloin steak. Each and every day it has been my (somewhat unconscious) decision to pursue the slice of apple pie.

However, let’s look at a similar train of thought. I once heard a very learned lecturer admonish the audience that “Next year, you will be the exact same person you are today, except for the people that you meet, and the information that you read.” Simply distilled, he was telling us that “You are what you read!” Now on this train, my life has taken quite a different direction. I have read a great many geology books over the last few decades and I really believe that they have helped me keep my head in the game and move ahead, personally and professionally. Many of those books were technical, but most of them weren’t. I am often surprised, when in the company of really bright geologists, that some of the books I thought everyone had read were unknown to the entire group. Some of these books I considered to be really mainstream stuff, not the esoterica we can all read about in our professional niches. Some of the books are just really good picture books, with great outcrops and neat geology.

So, I thought to myself, if I had to recommend a list of books that every geologist, and I really mean EVERY geologist, ought to read and/or own; which books would make the list? It would have to be a shortlist, because each of us can easily wander off into our specialties, such as great structural books, hydrogeology books, or economic geology books. The list would also have to include books that can be easily acquired, are still in print, and still useful. The idea of this geology book list has been rattling around in my head like a BB in a boxcar for quite sometime now. So I am taking the plunge and putting forth my list of recommendations. Feel free to amend the list as you see fit, cut it out, or toss it altogether. However, there are some really good reads in this list and some really good pictures in these books. If you don’t recognize the titles or the authors, you might want to revisit your personal inventory to make sure you really are a geologist. Here goes:

- *Annals of the Former World*, by John McPhee. This recommendation really is an absolute must-read. McPhee is a brilliant writer, without peer. Some faculty have even included this big paperback as required course material. It is a compendium of four individual books (i.e. *Rising From the Plains, Basin and Range, Assembling California, In Suspect Terrain*) (plus one, Crossing the Craton that McPhee authored over the span of a couple of decades. It has won all sorts of awards (including the Pulitzer Prize), and in my mind rightly so. This book covers an unbelievably huge range of geologic topics from the east coast to California, from the deep, deep Achaean to the present. Trust me, you are well behind the curve if you haven’t read or even heard of this book. Read it, devour it, and get introduced to Karen Kleinspehn, Kenneth Deffeyes, David Love, Eldridge Moores, Randy Van Schmus and many other unsung heroes of modern American geology. You’ll be proud of yourself for what you’ve accomplished when you finish this book.

- A Crack in the Edge of the World by Simon Winchester. This is a fantastic read. It is the third book that Winchester, an Oxford geologist, has written about geology. His first two books, *The Map that Changed the World, and Krakatoa* were both good books, but this one is on the must-read list for some very specific reasons. Any 400+ page book on the 1906 San Francisco earthquake would soon descend into second-by-second minutiae if the quake was the only theme of the book. But no, this book recounts the history of the USGS, the ‘theory’ of plate tectonics and the various exploratory, survey parties that headed west for many years preceding the quake. This book is a veritable history of American geologic progress and is a really great read for that very reason.

- The *Glossary of Geology*, 5th Edition. This is an excellent product from AGI. I have to confess that I continue to work daily with the third edition, and it has proven to be indispensable. Isn’t it really about time that you ponied-up the $100 (thereby investing in yourself and your career) to own this end-all reference? This de facto dictionary is the only one you will ever need in your career. I’m pretty certain that you still have the AGI geology dictionary that you took to field camp with you, but this tome is the real thing. We used to refer to it as “Bates and Jackson” but the list of editors and compilers has morphed quite a bit over the last few years. I suggest you stop buming the one from the geologist down the hall from you and get your own. Put your name in ink in it.

- Field Geology Illustrated, by Terry S. Maley. I mentioned that some of these books were going to be really good picture books and this one takes first place. This book is chock-a-block full of excellent black-and-white photos and explanatory sketches. It is very, very well done. You must be sure to get the second edition (with the Hayden Party on the cover) and not the first. The second edition is nearly 700 pages and has ten times the illustrations of the first edition.

- Bedrock: Writers on the Wonders of Geology. This paperback came out a couple of years ago from AGI to rave reviews in the Wall Street Journal and elsewhere. It is a compilation of short stories, poems and writings on the subject of geology. The authors range from Pliny the Younger to Loren Eiseley to Stephen Jay Gould to Mark Twain. This is a very educational book, and an insightful read. Unlike the others on this list, this book really provokes some of the deeper thoughts about the science and our relationship to it.

- The *Geoscience Handbook: The AGI Data Sheets*, 4th Edition. You really can’t consider yourself a competent geologist without this book within arm’s reach. This book is a must read/must have. I bought the bright orange precursor version of this book in the early 1980s and...

Continued on Page 21
Russ Slayback, CPG-02305

Reprinted from the Northeast Section Newsletter.

My most unusual water supply project was in Yemen, then called North Yemen or more formally the Yemen Arab Republic, in 1976 to 1981. Yemen is a country of wide contrasts. A fairly wide coastal plain along the Red Sea gives way to mountains to elevations of 10,000 feet within 50 to 60 kilometers of the coast. The eastern part of the country is a vast desert, adjacent to the Rub al Khali or Empty Quarter of Saudi Arabia. This area was controlled by the ancient city of Marib and housed a large water-supply dam during the time of the Queen of Sheba, a Yemeni princess noted in the Bible.

Yemeni architecture is unique and notable. Two styles are prominent—a traditional white-washed masonry with unpainted wooden window and door frames, and a more modern architecture commonly used in new commercial buildings featuring wildly-colored and precisely-cut volcanic-tuff, stone masonry that is truly beautiful. Arches that reflect the Byzantine Empire heritage are an integral part of both architectural styles.

LBG was a sub-contractor to Hazen & Sawyer to develop a well field to supplement the failing water supply for the City of Taiz, the southernmost city in North Yemen. A previous investigation by a California firm had identified a valley known as Al Haima as the best source of additional water supply. I made seven trips to Yemen over that period, ranging in length from 10 days to seven weeks, and several other LBG staff did likewise.

Yemen is generally a fairly brown country, except for a month or so in spring when rains produce some green and wild flowers on the hillsides briefly. When I first drove over a dusty road and ridge into Al Haima for the first time, I came to understand the biblical concept of the Garden of Eden—Al Haima was emerald green, with all sorts of well-watered crops and prevalent date palms.

In that period, Yemen was emerging from being a very isolated, tribal country, known as an Imamate, to entering the modern world. A 1947 Rand McNally World Atlas in the LBG library doesn’t even recognize Yemen as an entity but shows it as part of Saudi Arabia. At that time, camels and horses gave way to automobiles, trucks and motorcycles, and Yemen Airways became a government-sponsored international carrier. Affluent countries, including the U.S., the U.K., France, Germany (East and West), Ireland, the Soviet Union, and China, were falling all over themselves with foreign aid projects, hoping to gain political advantage. South Yemen, also known as the People’s Republic of Yemen, was thought of in the west as a significant threat during those years when the Domino Theory dominated east-west relationships.

In North Yemen, young people were leaving the tribal villages in droves to live in the cities, causing strains on the infrastructure of cities, and especially water supplies, throughout the country. Strains between North and South Yemen, dating back to a civil war in the mid-1960s in which Egypt played a major role and which resulted in the North-South partition of previously tribal lands, led to strange security measures in North Yemen. The Yemeni have always been regarded as fierce tribal fighters, armed with the traditional jambiyah, a curved dagger almost all Yemeni men and boys wear strapped to their waist belt, and ancient Enfield rifles from World War I surpluses. The North-South tensions led to much more lethal weapons, as AK-47s became very common. On the roads, there were common checkpoints manned by young men and boys armed with AK-47s and grenade belts, and there were incidents of untrained, young troops firing their weapons without proper provocation or in situations of language differences.

It was my first immersion in Islamic culture, in this case a predominantly Sunni culture, which is so different from our own. I was struck time after time by how much the Muslim population thoroughly believes in fate, or kismet, or predestination, in their daily lives. The key phrase, heard over and over again, was (transliterated) “inshallah”—meaning “if it is God’s will” or “as God wills it”. It was my perception that Yemenis do dangerous things that we wouldn’t do, because in their religious culture, they believe that they will die and go to Paradise at a time predetermined by Allah.

For our water-supply project we were to use an in-country Ingersoll-Rand Drillmaster that had been given to the National Water and Sewer Authority by U.S. AID, and had a crusty Texas-born drilling superintendent who had converted to Islam and was a full-time resident of Yemen. My first assignment was to order everything we would need to run the rig and install up to two dozen wells in an alluvial valley that included interbedded lava flows—casing, drilling mud, drill bits, well screens, etc.—to be air-freighted to Taiz. When the drilling superintendent opened the shipping containers and found 23 Hughes tri-cone carbide-tipped drill bits, he drewled “Son, I think we might get along.”

We ended up installing 21 gravel-packed, screened wells set in sand and gravel that produced 10 million cubic meters of water per year, or about 7.2 million gallons daily. The public health benefits were enormous, as the City went from 4 gpd per capita to 40 gpd per capita. More important, and a factor many of us in the United States don’t fully appreciate, is that the distribution system stayed pressurized 24 hours a day, which meant that leakage was out of the mains and there was no possibility of water contaminated by cesspool discharges to leak into the water system.

Leisure time in Yemen was fun. A large expatriate community of English-speaking people gathered on weekends to party at various places around Yemen, including the old coffee port and Red Sea beaches of Mocha, the modern port city...
of Hodeidah, the capital city of Sana’a, the ancient city of Zabid where algebra is said to have been invented during the golden age of Islamic culture, as well as in Taiz. Mocha was the place where booze was permitted to be smuggled into Yemen, and I recall that Barday’s Bank in Taiz closed for the day when it was learned that a cargo of gin had arrived in Mocha. Every available bank vehicle became part of a convoy to retrieve the favorite potable of the Brits.

The Taiz assignment led to small other jobs for the National Water & Sewer Authority, in Sana’a and in the Red Sea port of Hodeidah. The latter city was the Soviet Union’s pet project – they built the port area into a military stronghold, with machine gun towers about every 200 meters along the walled citadel. Part of my assignment was to inventory the salinity of wells along the coastal plain, and I did so at the combined commercial and military airport that served Hodeidah. I was shown around by a civilian employee, sampled a few wells, and then was escorted to the military side of the airport. A colonel of the Yemen Air Force sat behind a desk and interrogated me while a group of what I learned later were Russian apparatchiks listened carefully. After some 15 minutes or so, the Russians apparently decided I was harmless and left the room. The Yemeni colonel then broke out the tea and regaled me about his flight training in Kansas.

Another memorable water-supply project in the late 1960s was for a new paper mill for the Riegel Paper Company on the east bank of the Mississippi River next to the Port Hudson Civil War cemetery, north of Baton Rouge, Louisiana. The water source was to be deep wells tapping several distinct Eocene sand zones that were part of the Mississippi Embayment, at depths of 700 to 2,500 feet and yielding an aggregate supply of 25 million gallons a day.

The project started in a rainy period and I gained first-hand experience of the meaning of Mississippi gumbo mud. When the heavy drilling rigs and support vehicles disturbed the former cattle pastures, the mud was all-consuming. I started the project with low-cut slip-on boots, and the gumbo mud literally sucked them off my feet. We had to bring in large dozers to move any of our equipment from site to site.

The experience of constructing wells at such depths was fairly new to me and the thick fine to very fine sands were a challenge for selecting screen sizes. The wells came in at yields ranging from 700 to 1,500 gpm. Only a few wells produced sand, which eventually cleared up after extensive surge development. Riegel eventually sold out and LBG served as consultants to several successor entities including the present owner and operator, Georgia Pacific Corporation, as the supply requirements grew to close to 10 mgd and aquifer modeling was required by regulatory agencies.

Finally, in the water-supply arena, LBG became consultants to the Suffolk County Water Authority in 1953, almost from the time of its inception, and remains in that capacity today. My involvement with the SCWA was mainly in the 1960s and 1970s, a time of rapid residential development and concomitant growth of water demand on their system. They were drilling 20 to 25 new wells every year during that period. We assisted with the location of proposed well fields, logged test wells and assisted their engineering department with the design and permitting of production wells. Whereas, the Water Authority was still placing some wells in the Upper Glacial Aquifer at that time – the “low hanging fruit” – the focus was mainly on the Cretaceous Magothy Formation.

The Magothy consists of interbedded sands of various grain sizes and silt and clay layers. Wire-line geophysical logs were the best means for determining the contacts between sands and lower-permeability units, and driven split-spoon cores were used to determine the grain-size distribution. The wells all were gravel-packed wells completed with long screens, generally 60 to 70 feet long, and sometimes with blanks between screen sections, and were mostly designed to yield 1,500 gpm. The gravel packs were closely matched to the formation gradation and, in turn, the screen slot sizes were matched to the gravel sizes. In later years, the last well at a given well field station, was designed to produce 2,400 gpm, with screens commonly 100 feet long or longer.

As the expansion focus on the Magothy grew, it became clear that certain layers of the Magothy at a given location would produce water with high iron content, causing customer complaints if not treated. Max Leggette drew upon the oil-field technology of drill-stem testing to institute a pre-testing routine to select depth zones with low iron in the water. When a pilot test hole was drilled as the first well at a proposed well field, the potential development zones were identified by the wire-line logs. Temporary test screens, usually 20 feet long, placed in the center of the target zone, were set, developed and then pumped for water quality testing. The method was highly successful at predicting the approximate iron content of water from production wells completed in any given zone, and was deemed an economic measure to obtain better water quality.
1) From the table below, calculate the hydraulic radius “R” for each of the five streams of width “w” and depth “d”. For streams that are wide in comparison to depth, what is the general relationship between “R” and “d”?

<table>
<thead>
<tr>
<th>Stream</th>
<th>Width “w” in feet</th>
<th>Depth “d” in feet</th>
<th>Hydraulic Radius “R” in feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>300</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1000</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

a. “R” values approximate “d” values.
b. “R” values are considerably greater than “d” values.
c. “R” values are significantly lower than “d” values.

2) An explosive volcanic eruption ejects more than 10 billion cubic meters of tephra. How can we best classify this eruption?

a. Strombolian/Vulcanian
b. Pelean/Plinian
c. Plinian/Ultra-Plinian

3) We wish to study the structural geology and tectonics of the mountain chain that is the southern continuation of the “Dinaric Alps”. Which of the following applies?

a. Sierra Maestra Mountains
b. Pindus Mountains
c. Cantabrian Mountains

4) An earth material tested in the lab has a liquid limit (LL) of 25 and a plasticity index (PI) of 10. Of the following choices, what is the composition of this material likely to be?

a. Kaolinite
b. Sodium smectite
c. Calcium smectite

Answers on Pages 28 and 29
We started this year discussing the need for the AIPG to align our member services with licensed Professional Geologists (PGs). This need is driven by the fact that over 60 percent of our members work in the environmental/hydrogeology business sector and more and more of these members rely on state Professional Geologists licenses for professional standing. This need has not changed and we need to continue to develop membership services that are aligned with this business sector while we continue to offer our traditional membership services to the core of our organization.

It is important to understand that our organization is changing. We are transitioning from an organization that relied on our CPG title as our main source of value to an organization that continues to provide the CPG title while offering membership services that provide value to our members who may be state licensed professional geologists. Some of the changes needed for this transition were made over a decade ago when the Executive Committee's with keen foresight added the “Member” membership category. You may have noticed that the number of CPGs has decreased over the last decade while the total membership of the organization has increased. This has occurred because of the increased number of our members who see value in our new “Member” category. In slightly over ten years, “Members” now make up roughly 15 percent of our organization. I don’t think it is stretch to think that this percentage will get larger and larger in the future; therefore, we need to transition AIPG to offer membership services that provide value to all of our members including CPGs, Members, and PGs.

Additional Value, Alignment with PGs, and Non-Dues Bearing Revenue

Two changes that were made this year to provide value to our membership and to provide much needed non-dues bearing revenue. First, National has taken a larger role in organizing Annual meeting. This year’s annual meeting held in Flagstaff was a huge success highlighting National’s ability to work with Sections to organize an extremely successful meeting. Second, National will host technical short courses for reduced cost Continuing Education units (CEUs) to our members. The first short course will be on Innovative Remediation Technology held in Denver, Colorado in November 6-7, 2008.

Climate Change

As a result of your numerous communications with me when my term as President started in January, we decided to form an Ad Hoc Climate Change Committee. The committee of ten was evenly balanced with members supporting both sides of the anthropogenic versus natural cycle climate change debate. The committee had three goals. The first goal was to debate the subject amongst themselves so they could understand each other’s views and supporting data. This occurred over six months and through hundreds of e-mails. The second goal was to present a series of articles in the TPG to vet the subject to our membership. I was very happy to see the numerous articles on climate change in the latest issue of the TPG. My hope is that these articles will continue so we all can learn more and appreciate different perspectives on the scientific merits of climate change. The third goal was to develop a position statement on climate change. I am very happy to report that the National Executive Committee approved a position statement on Climate Change drafted by the Ad Hoc Climate Change Committee and amended by the National Executive Committee. The Position Statement reads as follows:

The geological professionals in AIPG recognize that climate change is occurring and has the potential to yield catastrophic impacts if humanity is not prepared to address those impacts. It is also recognized that climate change will occur regardless of the cause. AIPG supports continued research into all forces driving climate change. The sooner a defensible scientific understanding can be developed, the better equipped humanity will be to develop economically viable and technically effective methods to support the needs of society. AIPG promotes public policy and development of mitigation plans based on
actual impacts or impacts that have a reasonable probability of occurring as projected by scientifically proven means, regardless of the cause. AIPG supports all research and policy that is based on the scientific method and free from political pressure.

It is important to understand that position statements are not static and can be changed by the Executive Committee. I ask you to understand that this statement was not created in a vacuum. It was created after hundreds of hours of debate and consideration by the Climate Change committee and numerous discussions I had with European and Canadian geologists and the leadership of many United States based sister geological societies.

**Marketing of AIPG**

As many of you know, we started an active marketing campaign to licensed professional geologists. We have over 100 new members yielding a three percent return. In the next few months, we will send out additional marketing materials as new state PG databases are made available to AIPG. I hope to have over 300 new members by the time we complete this initiative.

**Flagstaff Declaration**

The 3rd International Professional Geologic Conference held in conjunction with the AIPG annual meeting also facilitated the signing of the Flagstaff Declaration by:

- AIPG,
- European Federation of Geologists,
- Canadian Counsel of Professional Geologists,
- Institute of Geologists of Ireland,
- Geologic Society of London, and
- The Ilustre Colegio Oficial de Geolgos (ICOG) from Spain.

The Flagstaff Declaration was signed by these organizations to establish a global framework that will strive to improve cooperation on the following issues as they relate to the geologic profession:

- fostering of high standards for the betterment of society;
- harmonizing codes of ethics and their enforcement;
- sharing professional and technical expertise to enhance the professional development of geoscientists internationally;
- representing the importance of geosciences to such organizations as the UN, UNESCO, ICSU, IUGS, and IUGG;
- promoting, encouraging and applying scientific knowledge worldwide for example sustainable development, natural disaster mitigation and recovery, and the use of natural resources;
- raising the profile of geoscientists and geoscientists in society by disseminating geologic knowledge and its application; and
- promoting geosciences awareness and education for all citizens.

It has been an exciting year. Thank you for allowing me the opportunity to serve this wonderful organization that has provided so much value to my professional career. I hope to see you soon at our annual meetings.

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**STUDENT APPLICATION FORM**

American Institute of Professional Geologists  
1400 W. 122nd Ave., Suite 250, Westminster, CO 80234  
303-412-6205 • Fax 303-253-9220 • aipg@aipg.org • www.aipg.org

Application for Affiliation as a Student Adjunct

| Complete ALL sections. Read the Bylaws and Code of Ethics. If applying between November 1 and June 30, the application fee is $20; if applying after June 30, the fee is $10. Please PRINT or TYPE. |
| Current academic standing: | □ Sophomore | □ Senior | □ Doctoral Candidate |
| Geology Degree: | □ BA □ BS □ MA □ MS □ PhD □ None Year: |
| Last Name: | First Name: | Middle Initial: |
| College/University: | Address: | City: | State/Zip: |
| School Phone: | Home Phone: | E-mail: |

**ATTESTATION:** I attest that I meet the requirements for AIPG Student Adjunct (currently enrolled in a geological science degree program) and agree to abide by AIPG Bylaws and Code of Ethics.

Applicant Signature: Date:

Have your faculty sponsor complete the statement below before submitting OR AIPG will contact your sponsor (complete name & ph. #)

**Faculty Sponsor's Statement**

I certify that I am a member of the faculty of the _______ _______ department at _______ _______ with the rank of _______ _______, and that the statements made by the applicant in this application are true to the best of my knowledge or belief. I am ___/___ the applicant's faculty advisor.

Name: Phone:  
Sponsor: Signature: Date
Except for the Economy, 2008 was a Great Year!

William J. Siok, CPG-04773

The 2008 AIPG/AHS Joint Annual Meeting and 3rd International Professional geology Conference was an unparalleled success. Colleagues from Europe, Canada, the entire US, and especially Arizona made for lively interactions and the formation or renewal of personal and professional relationships. Interesting field trips and topical sessions were well attended and enjoyed. Collegiality, friendship, and intellectual satisfaction were the underpinnings of a memorable professional gathering.

Of course, the 2009 event scheduled for Grand Junction, Colorado promises to be equally memorable. The preliminary program is posted on the AIPG website, as is the call for abstracts. The geology of western Colorado and nearby Utah is fascinating and interesting whether or not you’ve studied it. Please place this event on your calendar for October 3 through 7 of next year.

By the time you read this issue of TPG, the results of our national elections will be known. (Perhaps with the campaign turmoil out of the way, we will now enjoy a modicum of optimism that the global economy will at least stabilize.) Without regard to what the next administration will be, AGI has prepared a transition document for both the new administration and all lawmakers and staffers. The transition document outlines the 7 most critical issues within the geosciences facing the nation (and the world). The document is the product of AGI and its member societies and available for all to use in efforts to educate and assist lawmakers and regulators in decision making pertaining to issues from energy sufficiency to education. The document is available on the AGI website <http://www.agiweb.org/gap/trans08.html>, please take a moment to read it. You are welcome to distribute the document as appropriate.

In another very important development, AIPG has formed an alliance with the Association for Women Geoscientists. This is a relationship which has been under development for a number of years and it promises to be a mutually beneficial effort. The leadership of AWG and AIPG is very enthused about the prospect of joint projects to benefit our respective societies as well as the larger geoscience community and the public. Of course, both AWG and AIPG are pursuing this alliance within the broader context of our mutual support of AGI and its goal of strengthening the geosciences and its contributions to national matters.

Best wishes for a very Happy, Healthy, and Prosperous 2009!

Introduction to Well Logs and Log Analysis for New Hires

- A review of well logs in petroleum exploration and development.
  - Prerequisites for finding commercial reserves.
  - Exploration techniques.
  - Integration of geophysical exploration records with log data.
  - Calculating reserves and field size.
  - Importance of economics and risk analysis.
  - Drilling and logging.
- Lithologic and mud logs.
- Electric logs.
- Basic and specialized porosity logs.
- Other logs and log curves used in exploration and production work.
- Selecting log suite.
- Basic log analysis (recognizing pay zones).
- Identification and classification of logs and well log data management.

A product of Geoscience Data Management, Inc.

Author: Robert Font, PhD, CPG, PG

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Alaska Board's Rules Appear to Violate Its Own Code of Conduct

AIPG was recently informed that the Alaska State Board of Registration for Architects, Engineers, and Land Surveyors (the Alaska Board) has defined "mining engineering" and "petroleum engineering" in a manner that appears to violate its own Code of Professional Conduct. The Alaska Administrative Code (ACC), section 12, part 36.990 Definitions, (12 AAC 36.990) states "(a) For the purposes of this chapter and AS 08.48, unless the context requires otherwise..." (10) ‘mining engineering’ means that branch of professional engineering which embraces studies or activities relating to the exploration, location, and recovery of mineral commodities; it is concerned with research, design, construction, and development of structures, devices, and facilities of production and the economic aspects related to these studies and activities;... (14) ‘petroleum engineering’ means that branch of professional engineering that embraces studies or activities relating to the exploration, location, and recovery of natural fluid hydrocarbons; ‘petroleum engineering’ is concerned with research, design, production, operations of devices, facilities of production, and the economic aspects of these studies and activities.”

The problem with these definitions of mining and petroleum engineering are the words "exploration, location, recovery, natural fluid hydrocarbons." Exploration and location (or delineation) of minerals and hydrocarbons is what mining and petroleum geologists do. While a few mining and petroleum engineers have acquired the necessary education, skills, and experience to engage in exploration and delineation activities, most that I know experience to engage in exploration and delineation activities, most that I know.

Indeed the governing Alaska Statute's definition of engineering is more circumspect. It states, "(AS 08.48.341) Definitions. In this chapter,....(12) ‘practice of engineering’ means professional service or creative work, the adequate performance of which requires the specialized knowledge of applied mathematics and sciences, dealing with the design of structures, machines, equipment, utilities systems, materials, processes, works, or projects, public or private; the teaching of advanced engineering courses in institutions of higher learning; the direction of or the performance of engineering surveys, consultation, investigation, evaluation, planning, and professional observation of construction of public and private structures, works, or projects and engineering review of drawings and specifications by regulatory agencies; ‘practice of engineering’ may by regulation of the board include architectural building design of minor importance, but it does not include comprehensive architectural services;..."

If you practice mining or petroleum geology in Alaska, particularly if you are a member Alaska Section, you are urged to act to change the Alaska Board’s unethical definitions.

Additional Answers to Ethics Question #1: Switching Sides

The question in the May/June 2008 issue was: an engineering geologist bid for a job to assist a developer in obtaining the permits needed for proposed development. When the geologist lost the bid, he approached and was retained by those opposing the proposed development. Is this a violation of professional ethics? If so, which part(s) of the AIPG Ethics Code are involved? What are the ethically critical elements of this example?

Fred Fox, CPG-01273 contributed the following answer: "No brainer. 1) It's not switching sides. He wants work, so he submitted a proposal (not a bid). Professionals don't bid (!). The proposed client turned it down. The PG is free to do whatever he wishes, having no commitment to the developer (the developer negated that possibility). He proposed services to the other side, and got the job. Good for him! As a professional, he supposedly would do the same work for either side, possibly with different recommendations. It definitely is not a violation of professional ethics in any case. There are no ethically critical elements in this example.

"I was involved in something similar. We did a job for a quarry owner and recommended that he blast a particular face and not blast another. He did not pay us, but instead blasted the face that we warned him against, causing a slide and taking out an access road to some very nice homes. After several bills, he still did not pay us. The other side approached us and asked if we would help them. Since we weren't paid, our report didn't belong to [the quarry owner], but belonged to us, free to do anything we wanted with it. We released the report to the other side and they paid the bill, thereby owning the report. The quarry owner retained a large consulting firm and paid them a large sum of money to prove he did nothing wrong. They held him blameless but of course were blindsided by our report. What some people won't do...

As I noted in column 117, an ethically critical part of this example is whether proprietary and confidential information
was provided in the request for proposal. Assuming, as was apparently the case in the situation Fox relates, that no confidential information was provided, then Fox is correct, there is no ethical violation. Yet another ethically critical feature of Fox’s case history is the fact that his group was not paid for their report and therefore their original client didn’t own it, thus allowing Fox et al. to switch sides.

Fox also points out an important principle in US consulting practice, namely that an independent consultant should be capable of working for either side of a dispute (assuming that a valid geoscience opinion is what is sought). The “US” qualifier is there because of the advice on Canadian practice I related in column 18 (May 1997). I was informed by a Canadian that in Canada, one practices for one side or the other to avoid the appearance of being a “hired gun.” This is the opposite of US practice.

Fox does not address the “appearance of conflict” issue that was the focus of the discussion by John Howard and me last month. What Fox’s case history suggests in this discussion is that the importance of the appearance question varies from casetocase. The fact in Fox’s casehistory that the original client didn’t pay for the report Fox et al. prepared is a critical element in the appearance discussion as well.

John J. Ward, CPG-06729, wrote, “The straightforward answer is ‘No,’ the engineer did not violate any professional ethics by soliciting others or agreeing to work for others after his proposal was rejected. The pertinent AIPG standard is 3.2, mostly Rules 3.2.1 and 3.2.2. However, since this standard applies to an ‘employer or client,’ its applicability is uncertain in this case. Solicitation for work itself is not an ethical problem, and since there was apparently no contractual relationship with the developer, there would apparently be no ethical problem with working for the ‘opposition.’ The engineer has expertise sought by both sides and his (potential) client’s interests by making himself available.

‘That said, could one conclude, inferred from the information provided, that the engineer did violate professional ethics? Yes. In the first answer we assumed that the engineer did not already work for the developer and/or possess confidential or trade-secret information. There are obvious ethical problems with offering services to the opposite side if continuing or previous work for another client gave him possession of such information, especially in this case where he may directly confront his client (Rule 3.2.1).

‘Bid documents often include information unavailable to others, in which case using this information as leverage in obtaining other work would be unethical (the bid documents may forbid their use for other purposes) and is a likely conflict of interest. Similarly, if the ‘opposition’ saw that the engineer’s familiarity with the project from his previous proposal gave them some tactical advantage in hiring him, then the engineer should decline involvement. Does the AIPG Codetouch on this? Yes, I think Standard 3.1 would apply here (although it might be inadvertent as AIPG seemed to be more interested in mineral interests in this standard): ‘Members should disclose any actual or potential conflicts of interest that may affect their ability to serve an employer or client faithfully.’

‘What about the propriety of switching sides? Ordinarily, professionals should probably work for all sides of issues during their careers, as this diversity of experience lends perspective and is an obvious asset. In this case however, even if he isn’t obviously conflicted out, it would appear rather sleazy for him to, in effect, show up on both sides of the table. On a practical basis, the opposition’s lawyer (I assume there would be one) would likely not want this engineer testifying for his client if he had a previous involvement with, or was rejected by the developer (Rules 3.1.3 and 3.2.1).

‘Finally, perhaps somewhat off topic. Regarding his task ‘to assist a developer in obtaining permits needed for proposed development,’ high ethical flags are raised in my mind. In my state, developers often must obtain permits called an Assured (or an Adequate) Water Supply, and over my career, I have been approached by many developers wanting to know what I charge for help in obtaining such permits. When I tell them I can’t/don’t guarantee permits, they typically go elsewhere (obviously, I don’t get much of this kind of work). If the engineer bid on the developer’s project to help ‘obtain’ permits, then I think he could have crossed the ethical line. (Perhaps Rule 3.3.1).’

Ward has cogently addressed most of the issues raised by my “switching sides” question. Ward’s last comment on my wording of the question, namely “to assist a developer in obtaining permits needed for proposed development,” highlights an issue I had not considered nor even intended in drafting the question. I intended “to assist” to mean doing the required technical work, regardless of outcome. But as Ward points out, some clients want technical reports that support the conclusions they prefer and will shop for consultants until they find one who will give them what they want.

Charles Dimmick, CPG-03886, wrote, “It certainly is thought-provoking. I don’t know for sure whether or not there is an ethics violation here, but it gives the outward appearance of one. I think the part that bothers me the most is the part where he approached the opposition. It would make a great deal of difference to me if he had not made the initial approach, but rather was approached by them. It is analogous to the infamous ambulance-chasing lawyers. A professional in any field should be willing to work for either side in a dispute, as long as he/she honestly represents the issues in dispute, even if he/she may personally feel more sympathy for the other side.

“Several years ago I was approached by a developer who proposed development of a project which I was personally opposed to. I told him this, and he replied that he wasn’t surprised, but that he wanted to work on certain hydrologic aspects of the project that were in dispute. I did a quick review of the site data and agreed with him that the opposition was misrepresenting the facts, and therefore agreed to work for him, as long as it was clearly understood that I was not in favor of the project as a whole. As it turns out, he withdrew his application before I really had a chance to get started. This cheered me immensely, as it removed me from what would have been an uncomfortable position.”

Dimmick displayed some real integrity by agreeing to work for a developer whose project he opposed, particularly as the side he favored was misrepresenting data.

Ethics Question #3: Subpoena for Confidential Reports

Susan received a subpoena for her testimony and a copy of a confidential report prepared for a client. The subpoena called for compliance in two days from the date of receipt. Susan’s last conversation with the client suggested to her that client was no longer interested
You Are What You Read?

Continued from Page 12

I used it frequently for a couple of decades. I was originally somewhat circumspect about this new version, with color graphics, spiral binding and larger format. However, I went through the details of this book, have used it for over a year and strongly recommend you get it soon. The price tag of $50 seems a little steep, but not for a book you might use for two decades. Besides, bar none, this is THE book to prepare you for the ASBOG test to get registered. What? You haven’t done that either?

The Roadside Geology of Your Home State. If you haven’t heard of this paperback book series, you just might be a lost cause. Good grief, I know people who aren’t even geologists who take these books on road trips. You should have at least the latest version for your home state, and maybe even for a few of the adjoining or surrounding states. This one is so obvious it pains me to even bring it to your attention. Have you wandered through the science section of a bookstore lately? As soon as you can, buy one of these books, or something similar, like the Geology Underfoot series, and start yourself back on the road to recovery.

A good Handbook of Minerals and a Handbook of Fossils. I prefer the Audubon field guide series, but Simon and Schuster have very good versions too. This way, you’ll at least know how dissimilar barite is from stibnite and a brachiopod is from a crinoid.

“Rite in the Rain” All-Weather Geological Field Book No. 540F. That’s right, a bright yellow field logbook made just for scribbling geologists. Accept no substitute. Why have we always used field logbooks intended for surveyors, foresters and botanists? Now, we have our very own, thanks to the “Rite in the Rain” folks. The back of this book has 20 pages of very handy geologic reference stuff and a pocket for a handy photocopy, north arrow. You really, really, should own, and use, one of these books. The next time you take a geo field trip (you do take field trips, don’t you?), you can pull out one of these books and every one around you will recognize you for who you really are... an accomplished, real-life, from the outcrop, geologist.

It is generally accepted that just about all of us use the very good products generated by the USGS. I ask that you please support your state geological survey by buying and using your state geologic map and any geologic quadrangles or publications that they produce that could prove helpful in your line of work. We know that if you’re really going to benefit those around you who know nothing about geology, you are the one who is going to have to share your knowledge about your local, state and regional geology. If not, then who is kidding who? Do you know the name of the topographic quadrangle where you reside? Shouldn’t you?
IDENTITY THEFT AND RISK MANAGEMENT

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Over the past few years I have pretty much been writing about professional liability and risk management. In this column, I’d like to change things up a little and write about personal risk management. What triggered this? Well, admittedly I was having a tough time coming up with a professional liability topic for this issue. But what happened was that one of my co-workers became the victim of identity theft. Apparently, her debit card was “skimmed” and the skimmers managed to drain her checking account. This was not discovered until the debit card wouldn’t work at the gas station. Not only was the money gone from the checking account, but she was also hit with overdraft fees from checks that bounced. This happened about three weeks ago and the bank has rescinded the overdraft fees, but is still investigating the theft and has not restored the money that was drained from the checking account.

SKIMMING

Skimming is the theft of credit card or debit card information used in an otherwise legitimate transaction. One of the more high tech methods is to actually put a device over the card slot of an ATM. The device reads the magnetic strip and transmits the information wirelessly to a nearby crook. The victim is able to process their transaction at the ATM and is unaware that their card has been skimmed. In some cases a small camera is set up in order to get the user’s PIN. Check http://www.snopes.com/fraud/atm/atmcamera.asp for more information on how this is done.

IT CAN HAPPEN TO YOU

Two weeks ago, just after my co-worker told her story of woe, I came home to two voice mails from my VISA card provider’s fraud and security department. When I called, they asked about a couple of recent purchases. Turns out these were purchases that neither I nor my spouse had made. At that point, the bank told me that they were cancelling the card immediately and that I would have a replacement card within 5 business days. They would also be sending an affidavit for my wife and I to sign with regard to the fraudulent charges. We received that affidavit yesterday. The two charges were relatively small $49.95 and $29.95, but both were done over the internet. One was from an account in Nicosia, Cyprus and the other was an account in Philadelphia. From the info, I could not tell what was ordered or purchased as both websites were for what would be considered third-party clearinghouses that various businesses may use.

At this point, I do not know how my card was compromised and it’s very likely I will never know.

NOW JUST WHERE DID I PUT THAT FILE

In addition to credit and debit cards being compromised by thieves, we also are at the mercy of various entities that have personal information that thieves would love to get a hold of. I have a colleague at another firm whose personal information was potentially exposed, when a third party vendor who maintained a human resources database for his firm had a laptop stolen from the vendor’s employees home. This laptop had personal data such as name, Social Security Number and address (just what an ID thief needs) on this laptop. The vendor’s employee was in clear violation of the vendor’s own security protocols by taking a laptop home with such personal information stored on it. It is probably unlikely that the thief knew about the data but still it could be out there. My colleague was provided with two years of ID Theft monitoring by his employer (at the vendor’s expense) as a protection in case the data was compromised. But this type of carelessness happens everywhere. This past May, here in my own school district, a 15 year old student came across a data file on the school’s computer system that contained names, addresses, and social security numbers of district staff and thousands of taxpayers. The student didn’t have to do any hacking to access this data. The district was just careless with securing various directories on their server. This week, I received a letter from BNY Mellon Shareholder Services regarding an incident where a courier hired by Mellon lost some boxes containing data backup tapes. Turns out these tapes contained the names of 12 million clients. http://www.darkreading.com/document.asp?doc_id=162651&WT.svl=news1_1. I haven’t done any business with Mellon, but Mellon provides services to other companies to help them manage their stock programs including employee stock purchase plans. So you can even be victimized by parties you have never interacted with.

WHAT CAN YOU DO?

There are things that you can do on a defensive basis to help protect you from identity theft or limit the impact in the event your identity is compromised. There are a lot of resources out there. The Federal Trade Commission has a whole section of their website dedicated to identity theft: http://www.ftc.gov/bcp/edu/microsites/idtheft/ . Below is a list of prevention tips from www.identitytheft.org:
1. Buy a cross-cut type shredder (you can purchase cross-cut type shredder very cost effectively for approximately $60 - $70.) Shred all your important papers and especially pre-approved credit applications received in your name and other financial information that provides access to your private information. Don't forget to shred your credit card receipts.

2. Be careful of “Dumpster Diving.” Make sure that you do not throw anything away that someone could use to become you. Anything with your identifiers must be shredded (cross-cut) before throwing away.

3. Be careful at ATM's and using Phone Cards. “Shoulder Surfers” can get your “Pin Number” and get access to your accounts.

4. Get all of your checks delivered to your bank - not to your home address.

5. Do not put checks in the mail from your home mailbox. Drop them off at a U.S. Mailbox or the U.S. Post Office. Mail theft is common. It’s easy to change the name of the recipient on the check with an acid wash.

6. When you order new credit cards in the mail, or your previous ones have expired, watch the calendar to make sure that you get the card within the appropriate time. If it is not received by a certain date, call the credit card grantor immediately and find out if the card was sent. Find out if a change of address was filed if you don’t receive the card or a billing statement.

7. Cancel all credit cards that you do not use or have not used in 6 months. Thieves use these very easily - open credit is a prime target.

8. Put passwords on all your accounts and do not use your mother’s maiden name. Make up a fictitious word.

9. Get a post office box or a locked mailbox, if you possibly can.

10. Ask all financial institutions, doctors’ offices, etc., what they do with your private information and make sure that they shred it and protect your information. Tell them why.

11. Empty your wallet of all extra credit cards and social security numbers, etc. Do not carry any identifiers you do not need. Don’t carry your birth certificate, social security card, or passport, unless necessary.

12. Memorize social security numbers and passwords.

13. When a person calls you at home or at work, and you do not know this person, never give out any of your personal information. If they tell you they are a credit grantor of yours call them back at the number that you know is the true number, and ask for that party to discuss personal information. Provide only information that you believe is absolutely necessary.

14. Do not put your social security number on your checks or your credit receipts. If a business requests your social security number, give them an alternate number and tell them why. They do not need that to identify you. If a government agency requests your social security number, there must be a privacy notice accompanying the request.

15. Do not put your telephone number on your checks.

16. Get credit cards and business cards with your picture on them.

17. Do not put your credit card account number on the Internet (unless it is encrypted on a secured site.) Don’t put account numbers on the outside of envelopes, or on your checks.

18. When you are asked to identify yourself at schools, employers, or any other kind of institutional identification, ask to have an alternative to your social security number. Unfortunately, your health insurance carrier often uses your social security number as your identification number. Try to change that if you can.

19. In conjunction with a credit card sale do not put your address, telephone number, or driver’s license number on the statement.

20. Monitor all your bank statements from every credit card every month. Check to see if there is anything that you do not recognize and call the credit grantor to verify that it is truly yours.

21. Order your credit report at least twice a year. Review it carefully. If you see anything that appears fraudulent, immediately put a fraud alert on your reports by calling the numbers below.

22. Immediately correct all mistakes on your credit reports in writing. Send those letters Return Receipt Requested, and identify the problems item by item with a copy of the credit report back to the credit reporting agency. You should hear from them within 30 days.

23. Take your name off all promotional lists. Call the three credit reporting agency numbers to opt out of pre-approved offers.

   - Experian: (888) 567-8688
   - Equifax: (888) 567-8688
   - TransUnion: (888) 567-8688

   Write to the following to get off promotional lists:

   - Direct Marketing Association
   - Mail Preference Service
     P. O. Box 9008
     Farmingdale, NY 11735

   - Direct Marketing Association
   - Telephone Preference Service
     P. O. Box 9014
     Farmingdale, NY 11735

24. Write to your State and Federal Legislators to demand stronger privacy protection. Also, ask that identity theft be considered a crime in your State. Demand that the State Finance and Banking Committees pass legislation to protect consumers from negligent bank and credit reporting practices.

25. Consider making your phone an unlisted number or just use an initial.

26. Make a list of all your credit card account numbers and bank account numbers (or photocopy) with customer service phone numbers, and keep it in a safe place. (Do not keep it on the hard drive of your computer if you are connected to the Internet.)

The only thing I would add to the list, is to expand #26 to include a list of sites/accounts like Ticketmaster or Amazon where you may have your credit card info stored. Also, a list of the periodic automated debits that you may have for things like your health club, internet provider, etc.

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Cash Flow is King

Duane A. Carey, CPG-10305

Columnist’s note: This column occasionally strays from pure marketing issues into broader business topics. In this case, given the current economic conditions, I thought you might benefit from an article that we recently published on behalf of one of my clients in Maryland Entrepreneur Quarterly. My thanks to that newspaper and my client, Mr. Marc Rubin, CPA of the accounting firm Berman, Goldman & Ribakow, for allowing me to reprint it in TPG.

Growing companies fold. Profitable companies get sued for not paying their bills. Innovative companies can’t make payroll. How can this be?

They simply lack control over their cash flow.

Although showing a profit on paper is very important, for small or growing businesses the most critical measure is often cash flow. It determines whether or not they can pay their most important people – their vendors and personnel. There are numerous ways to improve cash flow in your business, and they can be broadly classified in two ways: cash coming in and cash going out. Below are some tips for both.

Cash Inflows

One of the more important aspects of cash-flow management is getting paid quickly. Not only to make cash available to run the business, but also to mitigate risk. Put simply, the quicker you get paid, the lower the probability that you’ll be left holding bad debt; conversely, for every month that a receivable stays on the books, the chances are increasingly smaller that you’ll get paid.

• Obtain a deposit when the order/contract is written.
• Offer terms of “2/10, net 30”. This means that you will give the customer a 2% discount for paying within 10 days; otherwise, the net balance is due within 30 days. The implied interest of these terms in about 45% per year - that is, if your customer does not take advantage of the early payment, he is effectively taking a loan at 45% per year to pay at 30 days! If he does the math, he’ll likely pay early.
• Issue invoices promptly. Ideally, issue your invoices with the delivery of your product/service or earlier.
• Clearly indicate on the invoice when payment is due. Customers will delay payment as long as they can. It’s your job to let them know that slow payment is a problem.
• Send self-addressed, stamped, remittance envelopes with your invoices to save your customer time and effort in paying you.
• Charge interest for slow payment. Of course, you might alienate customers by doing this, so choose wisely. However, you should at least maintain it as an option and include an interest provision in your terms and conditions. If you ultimately go to court for nonpayment, you’ll want the ability to recover interest.
• Promptly deposit checks. Also, if your business processes hundreds of checks per day, consider “remote deposit” with your bank, where you simply scan the check and the deposit is automatically transferred to the bank without anyone leaving your office.
• Accept credit cards. Although there are associated fees, you get paid much more quickly.
• Sell old inventory at a discount for a quick cash influx and to minimize holding costs.

Second only to getting paid up front, the next most important cash-flow tactic is to minimize bad debts by avoiding them in the first place. Fortunately, all it takes is a little diligence.

• Run credit checks on new clients and call several business references.
• Closely monitor accounts receivable and don’t allow small problems to turn into huge problems. Requires slow payers to pay up front in the future.
• Refuse future orders when bills remain unpaid.
• At a minimum, establish payment plans for slow payers - slow payments are better than no payments.
• Whether in-house or outsourced, establish collection procedures and stick to them. You’re not a bank – don’t let customers treat you like one by giving themselves loans with your receivables.

Cash Outflows

Just as you want to get paid quickly when you’re the creditor, you want to pay slowly when you’re the debtor. Obviously, you don’t want to be excessively slow and damage either your credibility or your relationship with your creditor, but there are some small and reasonable approaches that can have a big effect.

• If payment terms are 30 days, don’t pay the bill before that, unless you’re offered terms of 2/10, net 30 (see above) or similar.
• If you have subcontractors or vendors, try to pay them only after you’ve been paid by the client. This may require some negotiation on your part.
• Use electronic funds transfer to pay at the latest time, without worrying about a check getting lost in the mail.

As good as it is to maximize the amount of cash coming in the door, it’s equally good to minimize the amount going out. Although there are dozens of tips available for reducing costs in the office, such as using recycled toner cartridges for the printers, there are some key tips to reduce expenses from a cash-flow perspective:

• When choosing vendors, understand that sometimes better payment terms and discounts are better than a lower price.
• Minimize inventory and adopt just-in-time practices. Every day that an item
sits on your shelf costs you money. Conversely, if your inventory is short and you have to incur shipping fees and other higher costs to meet a customer’s need, that will also sap your cash. Analyze your inventory to find the optimal level.

• In addition to looking at profit margin when choosing which products/services to sell, remember to look at turnover – how quickly you can sell those items and get paid. Some high-profit items might take six months to get paid, which can be the death knell for many companies. But a slightly lower margin product might yield much quicker payment.

• Analyze credit-card processing fees. That industry is very complicated, with dozens of hidden and hard-to-understand fees. Bottom line: divide your total credit card expenses by your total credit card sales. If the amount exceeds 3.5%, you’re probably paying too much.

Finally, one of the most important tactics to guard against cash-flow troubles is to be prepared for surprises. What if the IRS audits you and demands $80,000 in back taxes and penalties, could you pay it? What if your low-cost supplier goes out of business and you must switch to one with 20% higher costs? You will likely face a cash shortage during the time it takes to adjust your own prices to accommodate the increase.

• Build a cushion of accessible cash.
• Establish a line of credit.
• By all means, when you find yourself in a cash crunch, stay in touch with your vendors and subcontractors. Explain what’s happening, tell them you’re focused on getting them paid, and advise them when you will be able to pay. Suppliers will rarely take you to collections if you maintain open communication.

Duane Carey is President of IMPACT Marketing & Public Relations in Columbia, Maryland. He was a consulting hydrogeologist for 11 years prior to launching a marketing consulting firm in 2003. He earned his MBA at Johns Hopkins University (JHU), and is a Certified Professional Geologist (#10305) and past President of the Capitol Section of AIPG. In late 2005, he took over the helm of IMPACT, which was founded in 1990 by one of his professors at JHU. He can be reached at 410-312-0081 or duane@MilkYourMarketing.com

What is the International Year of Plant Earth

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The Connections Between Academia and Industry

It is a good time to be a geologist. The demand for academically well-prepared employees in geology-related professions is rising. The petroleum, mining, and environmental consulting industries are all looking to fill positions vacated by a retiring workforce, in competition with new companies focused on areas like water resources and energy alternatives. The career choices have never been more numerous for geology students and recent graduates. Yet, it is possible that these students aren’t being made fully aware of all these choices by the faculty members that advise them. How can this be?

In the ultra-competitive environment of academia, there is an informal formula to success that involves a direct path from undergraduate education, through graduate school, to a post-doc, and then ultimately to a tenure-track position at a research university or liberal-arts college. Too much unaccounted for time away from this path is discouraged and few students seeking advanced degrees on this track consider employment outside of academia. In fact, the 2006 AGI study “Study and Faculty Employment Attitudes in Geosciences” states that 81% of Ph.D. students list academia as the preferred career path. As a result, geoscience faculty may be poorly equipped to advise students on careers in the private sector. The AGI report comments on just that when it states:

“Part of this trend may be related to the career advice that these students receive from faculty advisors, many with limited direct exposure to private industry careers. This limited exposure may reduce the number of students that have had access to non-academic experiences either through internships or collaboration with other sectors during their degrees.”

Furthermore, with a lack of geoscience industry experience outside of academia, a faculty member has little appreciation for the value of the private sector, thereby presenting unintentionally biased advice. In some cases, even ideological concerns of a faculty member may have an influence on the options presented to the students. For example, students can be steered away from petroleum industry because of the specter of working for the “big bad oil companies” (for an additional perspective, see Joseph Fiore’s two part article on the negative attitudes toward the petroleum industry). If a faculty member holds this view, the effect can be all the more damaging.

Efforts by AIPG in recruiting student members may also be hampered by lack of exposure by traditional academic advisors and faculty to professional resources and societies. A new geology student most often has little if any awareness about the geoscience societies, so introduction by a faculty member to one society is a way to expose the student. I for one was not encouraged to join AIPG at my undergraduate institution by a faculty member to one society at the expense of another biases the student. I was surprised at how closely intertwined career choices. This disconnect not only extends to a deficiency in collaboration between companies and university-based project leaders. Collaborations (and not just internships), as the quote from the AGI report states, are an important way of exposing students to the applicability of the geosciences outside of academia’s pursuit for knowledge. Without these collaborations, a student who does not have an internship experience to learn from is left with only the academic model as a guide.

I’ve had the opportunity to vicariously experience life as a chemical engineering graduate student through friends, and I was surprised at how closely intertwined academia and industry are in that field. Pure intellectual research is coupled with the need to innovate and then patent and market discoveries. Students are often supported by private funds and are expected to produce results relevant to the company’s product. Upon graduation, professional prospects are clear and students are arguably more equipped for employment in industry. Obviously, the chemical engineering model does not directly transfer over to the geosciences, but there is much that we can learn from their collaboration-based system. Collaborations can be a winning game for both sides. Companies can have a ready pool of trained applicants that have proven their intelligence and drive. University-based research groups can
get financial support that is not tied to the National Science Foundation, which is important given the current state of federal spending on research and development. Students can receive professional training beyond the typical geosciences curriculum while at the same time gaining the satisfaction of applying their science to practical problems. With all these benefits, why is it that there is only a limited amount of collaboration between academia and geosciences industry?

Professional collaborations appear to be the way of the future for some areas of the geosciences. In fields where knowledge can be directly applied to everyday problems, the insights from research can be developed into a viable and marketable product. One example of this is in the biogeochemistry research field. By studying the interaction of microbes with the natural world, scientists can discover ways in which microbes can help in the removal of toxins from contaminated waters, the development of new fuel sources, and the breakdown of wastes. If such a discovery is economically feasible, then there is a direct connection between research and industry making that research project ripe for collaboration. In such a case, it makes sense for a company to support university-based research. Yet, this example follows the engineering model in that a discovery is made that can be directly translated into a marketable product or service. What about the other areas of geosciences where such a tangible or defined product is not directly produced? Conceivably, there is room for student research in areas where more in-depth geologic information may be needed. Students have the time and passion to really dive into the petrology or geochemistry of a productive mining deposit, for example, and a successful research project might provide greater insight into why a deposit is where it is or where one might go to find more of the same. Students could also play an important role in understanding complex groundwater systems, which could be useful information to hydrogeology consulting companies. The goal is not to have a student’s work replace the work of a salaried geologist, but rather to bring a level of collaboration that could drive innovation of ideas and products while at the same time strengthen connections between students and industry. There are problems out there in industry that professionals do not have the time or attention to tackle and may be perfect for the minds of academia to ponder.

Collaborations are important for research-oriented universities, but what about those smaller institutions that don’t have organized research programs? If faculty members do not have experience with industry and if collaboration is not an option, then exposure to career options can still be limited for a portion of the geosciences student population, as well as for the faculty member. Internships are an option, but a single internship towards the end of a student’s college tenure is not the best way to help a student choose his or her way in the geosciences field.

This is when the lack of significant communication between academia and industry really does the student a disservice. AIPG has stepped in and is working hard to fill that gap, but there is still a lot of work left to do. The standing of AIPG among geosciences societies needs to be enhanced. Only when AIPG is viewed on an equal footing with more academic societies will academic advisors emphasize the importance of AIPG membership. The resources for students are there, they just don’t know about them. Does your local college or university have a student chapter of AIPG? If so, then get involved. If not, start a chapter. Do your faculty even know about AIPG? If not, then enlighten them. Don’t wait around for academic or faculty advisors to bridge the industry-academia gap. If direct collaboration is not possible, then make your company known to local students and be sure to bring AIPG along with you.

I regret to inform the readership that this will be the last article of my regular student column. A Ph.D. is a time-consuming endeavor and I am forced to the realization that I have to take my own advice on time management and end this four-year writing experience. Although I may contribute articles from time to time when my schedule permits, it is nice to know that Joseph Fiore is there to take over writing a regular column from the student perspective. Thanks for all your ideas and feedback. I enjoyed sharing my thoughts with you, diligent reader, and I hope that you have equally enjoyed reading them.

Now, if anyone will be looking for a structural petrologist in three years, drop me an e-mail. I’ll be on the market looking for the next challenging experience.

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Answers:

1) The answer is “a” or “R” values approximate “d” values. The proof is shown below.

\[ R = \frac{\text{cross sectional area}}{\text{wetted perimeter}} \]
\[ R = \frac{(w \times d)}{(w + 2d)} \]

<table>
<thead>
<tr>
<th>Stream 1</th>
<th>Stream 2</th>
<th>Stream 3</th>
<th>Stream 4</th>
<th>Stream 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width “w” in feet</td>
<td>10</td>
<td>100</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>Depth “d” in feet</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>

From the table and graph shown above, please note that for streams that are wide in comparison to depth, the value of the hydraulic radius approximates the depth values.

2) The answer is “c” or “Plinian/Ultra-Plinian.

The volcanic explosivity index (VEI; C. Newhall and S. Self, 1982) was devised to describe the type and magnitude of volcanic eruptions. The magnitude of the VEI depends on factors such as total volume of ejected material, the height reached by the eruption column and the length of time the eruptive blast lasted. VEI magnitudes range from 0 to 8, as shown in the table below.

Note that an eruption that ejects >10 billion cubic meters of tephra is described as "colossal" and classified as "Plinian/ Ultra-Plinian with a VEI value of approximately 6.

<table>
<thead>
<tr>
<th>VEI</th>
<th>Type</th>
<th>Description</th>
<th>Volume of ejecta in cubic meters</th>
<th>Plume height in meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Hawaiian</td>
<td>Non explosive</td>
<td>&lt;10^4</td>
<td>&lt;100</td>
</tr>
<tr>
<td>1</td>
<td>Hawaiian/Strombolian</td>
<td>Gentle</td>
<td>&gt;10^4</td>
<td>100-1,000</td>
</tr>
<tr>
<td>2</td>
<td>Strombolian/Vulcanian</td>
<td>Explosive</td>
<td>&gt;10^6</td>
<td>1,000-5,000</td>
</tr>
<tr>
<td>3</td>
<td>Vulcanian/Pelean</td>
<td>Severe</td>
<td>&gt;10^7</td>
<td>3,000-15,000</td>
</tr>
<tr>
<td>4</td>
<td>Pelean/Plinian</td>
<td>Cataclysmic</td>
<td>&gt;10^9</td>
<td>10,000-25,000</td>
</tr>
<tr>
<td>5</td>
<td>Plinian</td>
<td>Paroxysmal</td>
<td>&gt;10^9</td>
<td>&gt;25,000</td>
</tr>
<tr>
<td>6</td>
<td>Plinian/ Ultra-Plinian</td>
<td>Colossal</td>
<td>&gt;10^10</td>
<td>&gt;25,000</td>
</tr>
<tr>
<td>7</td>
<td>Plinian/ Ultra-Plinian</td>
<td>Super colossal</td>
<td>&gt;10^11</td>
<td>&gt;25,000</td>
</tr>
<tr>
<td>8</td>
<td>Ultra-Plinian</td>
<td>Mega colossal</td>
<td>&gt;10^12</td>
<td>&gt;25,000</td>
</tr>
</tbody>
</table>

Volcanic Explosivity Index (VEI) and Type of Volcanic Eruption – Based on C. Newhall and S. Self, 1982 (USGS and Univ. of Hawaii, respectively).
3) The answer is "b" or "Pindus Mountains". This range extends about 161 kilometers south from the southern border of Albania to northwest Greece. The Pindus range formed the border between ancient Thessaly and Epirus.

The "Sierra Maestra" is a mountain range in southeastern Cuba that runs westward across the south of the old Oriente Province from Guantanamo to Niquero.

The Cantabrian Mountains extend for over 300 kilometers across northern Spain, from the western border of the Pyrenees to Galicia.

4) The answer is "a" or "kaolinite".

In A. Casagrande’s Plasticity Chart (shown below) silts are typically found below the “A” line and clays generally above it. Earth materials with high plasticity and compressibility lie to the right of the “B” line (e.g., the vertical line with LL = 50), whereas earth materials with lower plasticity and compressibility lie to the left of the “B” line.

In our example, the LL = 25 and PI = 10 depicts an “inorganic clay of low plasticity”. Of the three possibilities given, kaolinite best fits the profile. In contrast, smectites are characterized by high plasticity. Smectites with absorbed monovalent cations (e.g., sodium) generally have a greater potential volume change than smectites with absorbed divalent cations (e.g., calcium).
Oil Needs a Facelift: Part Two of Two

Joseph J. Fiore, Jr., SA-01164

To follow up on last issue’s discussion of the petroleum industry’s generally unpopular image, let’s continue by discussing some of the damage control options the industry has available to improve its standing with so many disenfranchised consumers. Since writing the first article, I have noticed some increased television presence, specifically from ExxonMobile. Kudos Exxon; still, it is unfortunately just the tip of the iceberg, with plenty more left to be done. For those of you who may have missed the first article, we were discussing the oil industry’s image here. The price-at-the-pump this summer has elicited a lot of negative sentiment towards the petroleum industry, in addition to that already existing from environmental concerns. Without a clear presentation of the industry’s own positions and side of the story, people are forced to consider petroleum as they see it portrayed in the media and popular culture. There are a lot of impressions and beliefs people carry around about the industry, based on reality, and many more that aren’t. Leaving it to the media is not favorable to the industry, and we may be seeing repercussions from this as a profession. Bottom line? The petroleum industry needs to step up their outreach efforts, big time.

The light at the end of the tunnel is that these consumer reactions are based on an image, an image frequently wrought with misinformation or even no information. So, the way to change those reactions and prevent such negative press in the future is to change that image. The petroleum industry needs to take their coverage into their own hands, and initiate an aggressively proactive public relations (PR) campaign. Sure, there is some PR being done now, but it’s not enough, and it’s unevenly distributed throughout the industry.

An effective campaign would consist of both directly combating existing stereotypes and promoting a commitment to proactively move into the next era of energy research and production. It should be delivered through multiple media, including the television ads already employed by some companies, as well as radio spots and other traditional means; but also by effectively utilizing the internet and more direct advocacy within major media outlets. Petroleum representatives need to get right in there and talk it up with Bill O’Reilly, Larry King, and Matt Lauer. Addressing the complicated economic and political issues leading to oil prices can’t be done appropriately by pointing fingers in a commercial; rather, it needs to be actively discussed in a conversation or forum setting on talk programs.

Of chief importance is the content of the message. First and probably most importantly, efforts should be made to reconcile the industry with the environment. For as long as there is an association between oil and degradation of the environment, people are going to have negative impressions. New technology, clean and safe practices, and a focus on prevention have left the industry with considerably fewer incidents over the past few years. A serious commitment to these new institutions and effectively preserving nature needs to be the crux of the campaign effort. And this has all got to be done with attention to confidence and sincerity, as any effort being perceived as overtly conciliatory may do more harm than good. President Bush has been doing a good job of expressing this philosophy in the face of the steep oil prices this summer, by lobbying Congress to allow “environmentally friendly” development of our resources. Whether new areas should be opened to drilling or not is another story altogether, but Bush has been wisely specific in noting the goal of minimal environmental impact. Many Americans may not even be aware that we can do so, without being informed of it, or even of how minimal impact can be from well planned, responsible industrial operations. Oil companies are not evil corporations, they provide the things that we need now for our everyday lives, from drugs to plastics, and they can be marketed as such.

The second part of any campaign should revolve around commitment to energy, not just oil. This is a decision individual petroleum companies need to make, as to whether they want to indefinitely pursue oil and oil alone, or if they want to become energy companies. Many companies have already come to this crossroads. By moving towards concentrating on energy, and in doing so developing alternative forms of energy, the perception of remorseless association with climate change and carbon emission can be eroded. This negates the other side of major dissatisfaction people now have with oil, and will prevent further momentum of negative sentiment in the future.

Besides, this is essentially a natural progression for these companies. To deal in oil alone until it’s dried up would be akin to Microsoft selling all remaining inventory of XP and then checking out. For a handful of the world’s largest corporations to do so doesn’t make any sense, and will likely have detrimental effects on at least the American economy. It makes sense for petroleum companies to be at the forefront of alternative energy research and development. Already being in the energy business and with the capital to do so even now during tough economic times, the long term stability of these organizations can be ensured.
Right now within the industry there is a wide gap between the efforts of the various companies, some very successful in controlling their press, but many lagging behind. BP has thus far been the clear leader in changing its image. They've adopted a corporate motto of “Beyond Petroleum”, and as noted in their material, dedicated significant resources to developing alternative energy. Their entire image is literally green, with a flower logo and repeated assertions that they are committed to being an environmentally friendly corporation. Their newest ad campaign, “Energy Security”, highlights their numerous energy ventures and outside of oil. Still, BP has caught media flak in the last decade for environmental issues, specifically spills in Prudhoe Bay Alaska and refinery accidents in Texas. Incidents like this work hard against the image being built, by providing staunch opponents with fuel to refute the company’s environmental claims. Obviously every effort should be made to prevent such incidents anyway, but the ramifications of such an event now are direr than ever before.

T. Boone Pickens is a one man PR machine himself right now. The tycoon has been hitting many of the big news talk shows throughout June and early July, and built significant buzz over his energy plan to construct massive wind farms and replace foreign oil with domestic natural gas to fuel automotives. His television spots have noted how, although an oil man, he knows alternative energy is the future. Content wise, he further bolsters his message by touching on the economics of our foreign independence and breaking down how much money we ship away every year, appealing to both fiscal sense and patriotism. Beyond the appearances and television ads, he has been the topic of numerous articles recently, has employed a very modern website and is even running a video blog to his “army” of supporters for the campaign. After unveiling his 300 million dollar “We” technology campaign aimed precisly at bringing about emission curbing policy change, similar efforts will undoubtedly end up in some regard targeting the oil industry. Public sentiment will continue to do the same until oil gets a facelift.

For the sake of civilization, petroleum needs to show off a cleaned up act to the world. By doing so, they will not only protect society from the harsh economic realities of jumping off oil before alternatives are ready, but themselves, and us. Our profession has powered the industry since its inception, and it can return the favor by helping to secure our future position within society. So, when 50 years from now humanity needs to begin mining operations on the moon, we can get to work without society worrying about the effects of doing so. It really won’t be too hard to turn opinions around, and of any industry, oil can afford it right now. Even if the benefits are limited, any step to help bring more people into the profession at this point is a big step. These are some of our bread and butter companies, and they can do it. So next time you’re watching the game, don’t get up during commercials. Instead, let’s hope to see some more spots for Chevron and Shell. And yes, it’s okay to cheer if you see them, because you’re really cheering on our profession.

The company with perhaps the longest way to go is ExxonMobil, despite recent efforts. While boasting the highest profits in history is something you’d typically think of as a great American accomplishment, it tends to put people off when it doubles the cost of getting from point A to point B and all the necessities in between. If somebody is going to use a supposedly evil big business for propaganda, there’s a good chance it’s going to be the oil giant. They were hurt by their strong efforts to disprove any global warming initially, and must overcome association with that denial now as media discussions of climate change have proven to captivate and worry society. As the world’s largest private company, it would certainly behoove companies like ExxonMobil to demonstrate a greater commitment to development of alternative energy sources, and relatively recent changes to include such considerations on their website show they are on their way.

Although supporting a commitment to alternative forms of energy may appear to be counterproductive to the advancement of our profession, it shouldn’t have any significant impact. In fact such a shift may very well benefit us in the long term; especially by helping to prevent an untimely end to fossil fuel operations caused by uninformed public opinion bringing about uninformed legislation. I may discuss this further in another issue.

Oil companies are not bad; at the end of the day they are the entities that provide 21st century society with the resources we need to continue to grow and prosper. In fact, you could call oil the blood coursing through society’s veins, as it moves people and products, and powers the places that make up the manufactured substance of our world today. Unfortunately a reputation has developed that casts them in an undesirable light, and it’s likely having effects on our profession as a result. Al Gore has unveiled his 300 million dollar “We” campaign aimed precisely at bringing about emission curbing policy change, and similar efforts will undoubtedly end up in some regard targeting the oil industry. Public sentiment will continue to do the same until oil gets a facelift.
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Are We Ready To Store Large Quantities of Carbon Dioxide in the Michigan Basin?

LeRoy W. Smith, CPG-03385

Abstract

This paper presents a survey of the status of completed work and work in progress in carbon dioxide (CO2) geologic storage in Michigan. It concludes that if policy makers dictate reductions in CO2 emissions in Michigan, a major commitment of technical resources and capital expenditure would be necessary to realize the potential to store CO2 in rocks of the lower peninsula of Michigan.

Introduction

The consensus of most organizations and governments is that the earth is warming and that anthropogenic CO2 is the cause. As pointed out by Corbett and Dannemiller (2007) there are many reasons to question the basic premise that anthropogenic CO2 causes global warming, but nevertheless fifteen coal fired plants were cancelled in 2007 due to concerns about global warming (SourceWatch, 2007).

Michigan is a major source of CO2 with the emission of over 90 million metric tons of CO2 each year from large point sources (NETL, 2007). Michigan is not on a path to reduce its CO2 emissions since plans to construct over 2000 MW of new coal fired electric generating capacity are being actively pursued. Estimates developed by the Department of Natural Resources (2007) lead to the conclusion that CO2 emissions from a new 1000 MW super-critical pulverized coal (SCPC) facility would have an annual CO2 output of over 6 million metric tons.

Bryant (2007) makes a convincing case that replacing substantial amounts of coal-fired electric generation with nuclear power plants or renewable sources of electricity is unlikely to happen rapidly and that geologic storing of CO2 emissions from coal plants will be an essential part of any effective CO2 avoidance strategy. Therefore the availability of documented geologic storage sites is a key element in the reduction of CO2 emissions. The steps necessary to have sites in Michigan ready to accept CO2 are, at a minimum: detailed reservoir studies, a broader and accelerated program of comprehensive field tests, and the development of legal and regulatory provisions for CO2 storage.

Three Favorable Attributes of the Michigan Basin for CO2 Storage

The lower peninsula of Michigan is underlain by a sedimentary basin that contains over 108,000 cubic miles of sediments. Michigan has produced over 1.3 billion barrels of oil and several trillion feet of natural gas from the sedimentary rocks in the Michigan Basin; these conventional hydrocarbon reservoirs are ample proof that the seismically inactive Michigan Basin reservoirs could contain a buoyant fluid like CO2.

Besides the known conventional hydrocarbon reservoirs where hydrocarbons have remained stored for millions of years, the Michigan Basin contains a layer of black shale, the Devonian Antrim Formation, that holds methane and CO2 in place by adsorption (the same attribute that holds coal bed methane in place). Extensive research on coal bed methane reservoirs elsewhere has demonstrated that, given the proper conditions, large quantities of CO2 could be stored in coal bed seams (Bustin et al., 2008).

Finally, extensive oil and gas drilling has demonstrated that in addition to hydrocarbon reservoirs, the Michigan basin has large volumes of saline sedimentary reservoirs that could be used as storage locations for CO2.

In spite of all the geologic attributes only a small volume of CO2 is currently being captured in Michigan and injected into the sedimentary rocks in the Michigan Basin. Why is this?

Enhanced Oil Recovery with CO2

Viewed from the vantage point of a proven concept, injecting CO2 into oil reservoirs for enhanced oil recovery (EOR) is an obvious economic activity that can lead to large scale carbon emission reductions. As noted by Kuuskraa (2007), the U.S. has a history of productively using CO2 for EOR and therefore the proof of the efficacy of CO2 EOR has been well established. Today, over 40 million metric tons of CO2 are purchased and injected every year for EOR in the U.S.

CO2 EOR that reinjects the CO2 back into the depleted oil reservoir after it has accomplished its task of providing for the removal of oil has these advantages:

- Converts CO2 from a waste product with only negative value into a product that has economic value;
- Utilizes some components of existing infrastructure (wells, pipelines, rights of way, etc.) thereby reducing the cost of CO2 storage; and
- Provides storage with known integrity thereby making it likely that EOR fields could obtain verifiable credit for CO2 storage.

Two critical geologic questions need to be answered in evaluating the use of EOR for CO2 emission reductions: (1) are the proper reservoir characteristics present for the enhanced recovery to be an economic success (pay for the CO2 that is used) and (2) what contributions to the reduction of CO2 emissions does EOR provide given the injection rate and the total volume required for a given EOR project. Burruss (2007) has stated that the CO2 storage requirement for a 1000 MW power plant for 50 years is the volume equivalent of a 2-3 billion barrel oil field.
Michigan Candidates for CO₂ EOR

Two of the most promising areas for utilizing CO₂ for enhanced oil recovery are the central Michigan oil reservoirs of Devonian age and the northern Michigan Silurian Niagaran reef reservoirs. In general, many of these Devonian and Silurian oil reservoirs contain porosity and permeability characteristics that would be favorable to CO₂ injection and are present at a depth where CO₂ EOR would be possible. A review of these two areas is illustrative of the challenges of CO₂ EOR as a way to jump-start large scale CO₂ storage in Michigan.

The Ordovician Trenton-Black River dolomitic reservoirs found in the Albion - Scipio and Stoney Point Fields are not considered here because they are not thought by the author to be good candidates for CO₂ EOR. Recent work completed by Gillespie et al. (2007) has shown the Albion-Scipio and Stoney point reservoirs to be fractured, hydrothermal dolomitic reservoirs. CO₂ injection into these thick fractured reservoirs would not efficiently recover the remaining oil in the reservoirs in a manner similar to most successful CO₂ floods. Top-down CO₂ injection similar to that described by Nelms and Burke (2004) could possibly be applied to these Trenton – Black River reservoirs but the expense of providing the necessary CO₂ versus the probability of successful economic recovery of oil would make an EOR project a speculative undertaking.

Central Michigan Devonian Age Reservoirs - Dundee

Luczaj et al. (2006) in a study of the Dundee found that more than 375 million barrels of oil have been produced from 137 fields located in an east-west band across the central portion of Michigan. The locations of most of these Dundee fields taken from this Luczaj et al. paper are shown in Figure 1.

It is important to note that after over 60 years of production the total production from the Dundee in the Michigan Basin is 375 million barrels (Luczaj, 2007). A typical geographic grouping of Dundee fields will have cumulative productions of from 22 million barrels to a few hundred thousand barrels of oil (Montgomery, 1998). Although one is tempted to apply, as rule of thumb for the CO₂ EOR recovery potential, some percentage of the original oil produced from the Dundee Fields, a cautionary note should be added that the devil is in the details of the characteristics of the Dundee reservoirs.

Harrison (2001) describes two main reservoir types in the Dundee: one reservoir is a primarily limestone reservoir where water production was low and the drive mechanism for the primary recovery of the oil was probably solution /expansion gas, and the second reservoir type is a dolomitized example of the same depositional fabrics seen in the limestones. The second type, the pervasively dolomitized reservoirs, is described by Harrison to have water production that is abundant early in the life of the field and reservoir pressure that drops little due to strong water drives. Maness (2001) points out that field studies have shown that 60% to 70% of the original oil in place has been recovered in the water-drive reservoirs, and very efficient primary recoveries were achieved from these water-drive reservoirs despite the lack of modern production practices.

The potential for CO₂ enhanced recovery considered to be best by Nelms and Burke (2004) is where the primary recovery has been low and where uniform low permeability of the rock in the reservoir allows for a uniform sweep of CO₂ from injection wells. The author considers the pervasively dolomitized reservoirs to be generally poor candidates for CO₂ enhanced recovery because of their high original oil recoveries and because the high permeability in these reservoirs would lead to an inefficient sweep of the reservoirs by CO₂.

In addition to the fact that detailed consideration of Central Michigan Dundee reservoirs would eliminate many fields as candidates for CO₂ EOR, detailed work would also need to be done to consider the unique well bore and land ownership problems that come with fields that in most cases are over 60 years old. Any field tests for the central Michigan location of the Dundee Fields would also need to develop a supply of CO₂.

To the author’s knowledge, no work is in progress at this time on these central Dundee Michigan fields to evaluate their potential for CO₂ injection. It should be noted that historically successful CO₂ EOR projects have been undertaken on large fields by major companies with large technical staffs and large financial resources (Amarnath, 1999). No major oil companies have oil production operations in Michigan at this time. The technical and financial demands of initiating CO₂ enhanced recovery are further magnified when one considers that, in order to justify the infrastructure of a CO₂ pipeline to service the CO₂ floods, it would probably be necessary to have several Dundee Fields available for EOR.

Central Michigan Devonian Age Reservoirs - Richfield

Work is in progress to evaluate the potential of the Middle Devonian Richfield Member of the Lucas Formation (Wahr, 2007). Initial oil and gas production began from the Richfield in 1939 in the general vicinity of the Dundee Fields. Cumulative primary production from over thirty Richfield fields is now in excess of 55 million barrels of oil. The most common reservoir type reported by Wahr is a classic high porosity-low permeability peritidal, algal laminated, dolomomite. In addition to whatever potential may exist for CO₂ EOR in known fields, Wahr sees potential for the Richfield to serve as dual CO₂ EOR and saline reservoir for geologic CO₂ storage. No pilot CO₂ projects have been planned to date for the Richfield. The evaluation of the potential of the Richfield reservoirs for CO₂ storage is at the initial screening stage.

Figure 1. Location of fields in the lower peninsula of Michigan that produce oil from the Dundee Formation modified from Luczaj et al. (2006) AAPG©2006 Reprinted with permission of the AAPG whose permission is required for further use.
Silurian Niagaran Pinnacle-Reef Belt in Northern Michigan

The Michigan Basin pinnacle-reef belt in the northern part of the Michigan basin is about 170 miles long and 10 to 20 miles wide (Gill, 1979). According to Toelle et al. (2007a), over 700 reefs are located in this belt (see Figure 2). Initial production from 27 reef fields reported by Wood et al. (2006) was from 11 million barrels to less than 100,000 barrels per field. Hydrocarbon productive reefs are about 50 to 400 acres in size and have relief ranging from 150 to 700 feet (PTTC, 2004).

CO2 EOR operations are presently in progress in five fields by Core Energy in the Northern Reef belt (Maness, 2007).

The implementation of EOR in these five fields has been aided by following advantages that have not been available to other locations in the Michigan basin:

- Specific applied research with a budget of over $2 million was funded to study CO2 EOR from these reefs (Wood et al., 2006);
- High purity CO2 was available from nearby natural gas processing plants which required the construction of a CO2 pipeline of only 8 miles to deliver the CO2 for EOR;
- Because of the small areal extent of these reefs, a relatively small amount of acreage and small number of old wells were involved.

Work on the potential of the reefs is currently being advanced by a $9 million project of NELT and Slumberger Data & Consulting Service (Toelle et al., 2007b).

The good news story with Niagaran reefs is the small size of each reef that makes them manageable targets for CO2 enhanced recovery. The bad news is that although individual EOR reef projects may be financially successful, each reef needs relatively small volumes of CO2 for EOR purposes. The expansion of the volume of CO2 that can be stored in reefs beyond that needed for EOR will depend on detailed studies of what would happen if the volume of CO2 injected into a reef exceeded the original hydrocarbon volume by a significant amount.

Wood et al. (2006) point out, based on experience with their study of injecting CO2 into the Dover 35, that not all levels and compartments in a reef can be reached with a single injector at a single point. The compartmentalization possible in reefs is also described by others (Sandomieski et al., 2006). This compartmentalization in individual reefs, which is a complication for EOR operations, may limit the migration of CO2 from individual reefs. However, regional studies of the reefs would need to be conducted to determine whether groups of reefs are hydraulically interconnected through the Lockport Formation as postulated by Gill (1979).

Gill (1979) contends that the distribution of hydrocarbons in the northern Michigan reefs demonstrates that, at least at the time of hydrocarbon migration, reefs were hydraulically interconnected through the Lockport Formation. If reefs are presently hydraulically interconnected it would provide the possibility that injected CO2 could be forced out of the bottom of individual reefs into the Lockport Formation and into adjacent reefs (see Figure 3). This migration possibility could present the possibilities for complications in monitoring the location of CO2 after it was injected into a reef. Determination of the flow patterns of CO2 in reefs is one of the objectives of Toelle’s (2007b) continuing investigations.

Enhanced Natural Gas Recovery with CO2

The Devonian Antrim black shale is a major natural gas (methane) producing area in northern Michigan. Over 9,000 producing wells have been drilled in a twelve county area. Goodman and Maness (2007) report that production from the Antrim reached 2.5 trillion cubic feet of methane in 2007 and ultimate production is expected to total 5 Tcf. The Antrim shale is fractured, organic-rich, black shale. Frantz (1996) estimates that 25% of the production comes from free gas in the fractures and 75% of the gas is desorbed from the clays and organic matter found in the shales.

Extensive work has been completed by Nuttall et al. (2005) in Devonian black shales in Kentucky to determine whether the same mechanism that holds the methane to the organic material and clay material in the reservoirs would hold injected CO2 in these rocks. Since injected CO2 would displace methane, injecting CO2 could have the added benefit of increasing the natural gas recoveries from these black shales. Nuttall reported (2005) that 6.8 billion tonnes of CO2 could be sequestered (stored) in the black shales in a five county area in eastern Kentucky. As of this date no field tests have been completed in Kentucky to document the CO2 storage capacity of these black shales.

Unfortunately studies of the potential of the Antrim Devonian shale like those conducted on the Kentucky Devonian...
shales for CO₂ storage and enhanced methane production have not been done.

**Saline Aquifer Storage**

Michigan is noted as having the highest potential for CO₂ storage in saline aquifers in the Midwest (NETL, 2007). Advantages of saline storage of CO₂ in Michigan are:

1. Geologic formations that are good candidates for saline storage underlie virtually all areas of the lower peninsula, so disposal sites could be located close to sources.
2. Previous widespread drilling of oil and gas wells has developed a broad data base of the formation characteristics of the rocks in the Michigan Basin.
3. Saline aquifers are potentially large enough to contain the volume of CO₂ that will be emitted over the life of large CO₂ sources.

Barnes et al. (2007) estimate that in the Michigan Basin the Silurian Bass Island Group alone has a geological CO₂ storage capacity of 1.4 Gt (billion metric tons) to 6.8 Gt of CO₂ at critical point conditions. Other saline formations identified in the Michigan Basin with Gt potential for saline formation storage of CO₂ are the Ordovician St. Peter Sandstone and Cambrian Mt. Simon Sandstone (NETL, 2007).

One field test was completed in northern Michigan in March of 2008 which injected approximately 10,000 tons of CO₂ to evaluate the potential of the Bass Island as a CO₂ storage target. (MRCSP, 2008). An extensive post-injection monitoring demonstration is presently in progress for this test. Unfortunately other than this one test, no other saline aquifer evaluations have reached the field test stage in Michigan.

**Conclusion**

If Michigan or Federal regulatory authorities should apply the same requirements to present and planned emission of CO₂ as have been applied in other states, Michigan does not have documented sites ready to store large quantities of CO₂. In spite of the fact that Michigan’s geology has great potential for CO₂ storage, the prerequisites for CO₂ storage have not been accomplished.

A summary of some of the prerequisites that would need to be completed for Michigan to realize its potential to store large volumes of CO₂ are as follows:

1. Reservoir properties of Michigan oil fields that are potential candidates for EOR and saline aquifer storage need to be characterized in detail.
2. Evaluation of the potential of the Antrim Shale as a place to store CO₂ needs to be done.
3. A much broader and accelerated program needs to be implemented to move the evaluation of the potential of saline aquifers to the field test stage. Part of this work would need to be the development of the legal and regulatory system in Michigan for the long term geologic storage of CO₂.
4. Protocols for the remediation of old well bores that are present in many of Michigan’s oil fields which were developed in the 1930’s and 1940’s need to be completed.

Based on the lack of readiness in Michigan, the clear implication is that geoscientists professionals will need to be engaged should CO₂ emission reduction become a priority.

To obtain an excellent review of the magnitude of the CO₂ storage challenge on a national basis, a reading of Bryant’s (2007) article is strongly recommended.

**References**


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Reviewed by AIPG Associate Editors: Solomon Isiorho, CPG-07788, and Doug Perisutti, CPG-10055.

LeRoy (Lee) Smith is President of Optimal Value Energy, which provides services to utility and industrial users of natural gas and electricity to assist them with energy procurement and carbon management strategies. From 1988 to 2004, Mr. Smith was employed as part of the management team of the Midland Cogeneration Venture Limited Partnership (MCV), Mr. Smith received Bachelor of Science and Master of Science degrees in geology from Michigan State University and is both a Certified Professional Geologist (CPG-03385) and a Certified Petroleum Geologist (CPG #819).

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This year’s AGI/AIPG summer interns had the unique experience of interacting with Congress in not only an election year, but in a presidential election year, affording them the opportunity to see political maneuvering at its height. Additionally, the key issues of Congress centered around areas where the geosciences can contribute, with the interns delving into climate change, energy policy, natural hazard mitigation, and water policy, including the protection of our oceans.

Laura Bochner, the first of three summer interns in the Government Affairs Program, completed her internship in mid-August, returning to Lafayette College in Easton, PA where she is a rising junior. Though she entered college as a pre-med biology major, Laura changed her major after taking field courses in Utah and Hawaii and is now studying geology. During her internship, Laura was especially interested in understanding the details of climate change and energy legislation. She quickly became our resident expert on climate change, attending and reporting on the unprecedented number of hearings held on the topic as well as closely following the first substantial debate on climate change on the floor of the Senate.

Jillian Luchner, the second intern to arrive completed her internship in early-September. Jillian came to us from Boston, MA by way of California where she is nearing the completion a second undergraduate degree in geology at Humboldt State University. After receiving an initial degree in economics from the University of Rochester, Jillian worked with an AmeriCorps*VISTA program in California’s Central Valley. There she became interested in helping local governments better understand issues of science. In D.C. Jillian has focused on the issues of water policy, renewable energy, and science, technology, engineering and mathematics (STEM) education.

Corina Cerovski-Darriau, the last of the summer interns, completed her internship in mid-September and recently graduated from the University of California, Berkeley with a B.A. in geology and a minor in peace and conflict studies. She was also recently sponsored by the Geological Society of America to attend UNESCO’s International Year of the Planet Earth as the U.S. Student Representative. She was selected for this honor based on her essay about minimizing the risk/maximizing the awareness of natural hazards. While in Washington, Corina continued to focus on her interest in natural hazards, but she also examined energy issues, in particular the debate regarding offshore drilling in the Outer Continental Shelf.

Climate Change Legislation: Coming Soon?

By: Laura Bochner

In June, 2008, twenty years after he first testified before Congress on the need to take action against climate change, Dr. James Hansen, of the NASA Goddard Institute for Space Studies, again appeared before Congress to talk about the climate. This time, he was there to explain why he is almost certain the long-term safe level of atmospheric carbon dioxide is 350 parts per million. Hansen’s policy prescription for achieving this target: a carbon tax, with a 100% dividend returned equally to the American people on a per capita basis.

While carbon tax legislation has been proposed in the 110th Congress, a carbon tax is largely politically unpalatable. What has garnered more support is a market-based cap and trade system, whereby the federal government would set yearly caps on the total number of tons of carbon dioxide that can be emitted and then distribute allowances—tons of carbon dioxide or equivalent—among the major emitting sources that sum to the cap total. The system would allow for the trading of allowances and would establish a price for carbon, encouraging
companies to invest in emissions reduction technologies.

Atmospheric carbon dioxide levels have been increasing at an unprecedented rate, but unprecedented, too, is the amount of attention Congress has been giving climate change over the past two years. At the start of the 110th Congress, House Speaker Nancy Pelosi inaugurated the House Select Committee on Energy Independence and Global Warming to devote additional resources to the twin issues. There have been countless hearings held on topics related to climate change and about fourteen bills have been introduced with the purpose of mitigating climate change. Only a couple of bills would enact a carbon tax; the majority would enact cap and trade systems.

Including resolutions and amendments, lawmakers in this Congress have introduced around 200 measures related to climate change, according to the Pew Center on Global Climate Change. Comparatively, there were 106 bills, resolutions, and amendments introduced in the 109th Congress, about 100 pieces in the 108th Congress, 70 pieces in the 107th, and about 30 in the 106th.

Of all the bills introduced to this Congress, America’s Climate Security Act (better known as the Lieberman-Warner bill after its two principal sponsors, Senators Joe Lieberman (I-CT) and John Warner (R-VA)) has advanced the farthest in the legislative process. It moved quickly through subcommittee and full committee late in 2007 and was debated on the Senate floor in early January 2008. While the debate was criticized as being insufficient and unproductive—for example, TIMES reporter Eric Pooley called it “nasty, brutish, and short”—it was a milestone for climate change policy. The bill did not make it beyond the Senate floor debate, and it is unlikely to be revived and reconsidered in the waning months of the 110th Congress.

Nonetheless, the impetus for Congress to again take up climate change legislation comes from multiple fronts.

Eighteen states—Arizona, California, Connecticut, Florida, Hawaii, Illinois, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont, Virginia and Washington—have set greenhouse gas emissions targets, and others are working to set their own. Moreover, coalitions of states are committed to reducing greenhouse gas emissions and have created their own carbon credit trading markets. Seven northeastern and mid-Atlantic states are parties to the Regional Greenhouse Gas Initiative (RGGI); seven states and four Canadian provinces are partners in the Western Climate Initiative; and ten states have signed onto the Midwestern Greenhouse Gas Reduction Accord. The RGGI and Western Climate Initiative have cap and trade programs for centerpieces.

While an increasing number of states are cobbling together a collage of climate change action plans, industrial leaders are growing nervous. A patchwork of regulations and standards is less friendly to business than national, comprehensive policy.

To demonstrate their preference for a universal standard rather than multiple ones, industrial leaders have testified before Congress in support of federal climate change legislation. Speaking on behalf of the American Petroleum Institute (API)—which represents over 400 corporate members of the oil and gas industry—before the Energy and Air Quality Subcommittee of the House Energy and Commerce Committee, John Felmy reported “API believes it is important to address global climate change and manage greenhouse gas emissions. We are committed to working with members of Congress on policies that are environmentally effective, economically sustainable and fair.” Speaking on behalf of American Electric Power (AEP)—an electricity generator with over five million customers in eleven states—Michael Morris testified that “AEP supports the adoption of an economy-wide cap-and-trade type GHG reduction program that is well thought-out, achievable, and reasonable.”

Furthermore, as industry representatives testify, constituents are calling congressional offices to state their support for climate change legislation. For example, in a June House hearing on legislative proposals to reduce greenhouse gas emissions, Darlene Hooley (D-OR) reported her constituents are urging her to take action now, saying that they want Congress to do something about climate change. An ABC News/Planet Green/Stanford University poll conducted in late June 2008 found that 61% of adults polled believed the federal government should do more to try to reduce global warming.

Now, however, there is less public support for government action on climate change than there was a few years ago: in 2006, 68% of those polled said the government should do more to try to reduce global warming, and in 2007, 70% expressed that opinion. Voters are fickle, and any directives they have for Congress are now being influenced by the harder-hitting issues of high energy prices and an economy in a downturn. Despite believing the federal government should move on climate legislation, the public is largely unwilling to pay more for energy. Anticipating high gas prices, a majority (54%) of respondents in a May 2008 Gallup poll said they were in favor of suspending the relatively small federal gas tax for the summer. When gas did, indeed, soar above $4 per gallon, constituents contacted their legislators and demanded relief.

Any climate change legislation, though, would raise energy prices via a price on carbon. Some people are of the belief that “when it comes to climate change, it’s either pay now or pay a lot later,” and some are willing to pay more for clean energy. But perhaps the greatest hurdle for climate change legislation, if it’s debated again next Congress, will be the hurdle of energy price increases.

The 110th Congress spent a significant amount of time and energy on climate change legislation even though major action is unlikely to be completed before this Congress adjourns. Besides a closely divided Congress and debate about the best approach to mitigating climate change, the rise in gasoline prices has added an additional bottleneck to resolution.

Even so, the next Congress is expected to act on climate change. Both presumptive presidential nominees favor some action on climate change (both Obama and McCain support cap and trade) and will work with Congress to get legislation passed. Likewise, the American public and stakeholders in the public and private sector favor some action by their legislators. There is still a lot of speculation, however, as to when climate change legislation will be enacted and what the constituent parts of the final bill will be. Undoubtedly, for any climate change legislation to pass, there will be compromises on both sides of the aisle and from all sides of the issue, and compromise is not always easy to forecast.

A Resurrection for Buried Heat - The Potential of
Geothermal Energy in the United States' Energy Portfolio
By: Jillian Luchner

Geothermal Recent History

Geothermal energy has been stagnating. After seeing an initial period of rapid growth between the 1970's and early 1990's, lower fossil fuel energy prices and lack of government support curtailed its competitiveness. Between 2002 and 2006, the Energy Information Administration reported just 0.05% increase in geothermal production and overall, geothermal is responsible for just about 0.03% of total U.S. electricity generation. Only now, with rising and unpredictable fossil fuel prices paired with growing consideration for the effects of climate change and air quality, are the turbines once again turning in favor of geothermal.

Geothermal power generation, which creates electricity from steam or hot water generated from Earth’s heat, does not require carbon-based fuels. As a result, the domestically produced energy source emits few to no greenhouse gases or other pollutants into the air. Land use and freshwater use as reported by the Geothermal Energy Association, are also significantly conserved compared to fossil fuels. Geothermal energy plants operate more reliably than alternate energy sources, offering a strong dependable source of base load energy.

While applauded as clean and lean, there remain some hurdles to a full throttle geothermal approach. The hurdles include higher up-front costs, inconsistent government policies, and geographic/geologic limitations, which demand new developments in technology.

The Costs

Geothermal energy requires high up front costs for exploration and plant construction. However, with no need to mine, transport and dispose of fuel for electricity production, operation costs become minimal. To help deal with costs and policy obstacles, the federal government extended a production tax credit (PTC) of 1.9 cents/KWh to geothermal electricity production in the Energy Policy Act of 2005 (EPACT). Unfortunately, the tax credit is set to expire in December of 2008.

The Potential

In response to geographic limitations, a 2006 Department of Energy (DOE) sponsored project undertook the most comprehensive geothermal resource capability assessment since the 1970's. The final report entitled “The Future of Geothermal Energy - Impact of Enhanced Geothermal Systems (EGS)” was led by Massachusetts Institute of Technology (MIT) scientist Jefferson Tester.

Developed in the 1970's during government sponsored investigations of heat mining from “hot, dry rock” at Los Alamos National Laboratory, EGS requires a fracturing of reservoir rocks and/or an injection of fluids to create the ideal conditions of porosity, fluid flow and heat essential to geothermal electricity generation. By doing so, it allows a broader range of hot underground spaces that can act as a reservoir. Yet, though promising, questions of water availability, the fluid flow rates and the heat extraction rates in the reservoir are still being resolved. To date, EGS has not been developed on a commercial scale.

The MIT report suggested that federal investments of $300 to $400 million over the next 15 years would make EGS technology commercially available and the energy source cost competitive. With EGS in place, the report determined, the available national heat reservoir base would total 2000 times the U.S. annual consumption of primary energy in 2005. Moreover, energy would be accessible 3-10 km below the surface in nearly every U.S. state.

The report suggests, with EGS technology between 10-20% of current U.S. electricity demand could be met with geothermal power by 2050. The goal would require an increase in current geothermal electricity production from 2800 MWe to 100,000 MWe over the next 38 years. In 2008, the DOE held a series of working groups to discuss the MIT report. Their findings, suggested the requested funding level might be insufficient, but overall found the capability to commercially produce EGS “reasonable, but optimistic.” The working groups concern that geothermal may not reach the level of potential outlined by the MIT report further suggests investment in research, development and demonstration (R&D) is essential for geothermal to play a role in diversifying our energy portfolio.

Research, Development and Support

Almost a year after the release of the MIT report, the federal government reestablished its support for geothermal. In December of 2007, H.R. 6, the Energy Independence and Security Act (EISA) was signed into law. The law includes a new national scope for geothermal development.

EISA contains strong support for geothermal, including the “Geopowering America” program, support for a Center for Geothermal Technology Transfer, a nationwide resource assessment, a study of geothermal environmental impacts, geothermal R&D, international efforts and advanced technologies.

Opportunities in advanced geothermal in EISA have been designated authorizations of $10 million a year for development. They include the use of heat to enhance production of oil shale and tar sands, the co-production of electricity from hot water by-products of oil and gas extraction, valuable mineral extraction (such as lithium and zinc) from sludge residues of geopressed brines (mineral laden waters), and carbon sequestration opportunities, which may also enhance heat extraction.

Another important component of the Act is the exploration of new reservoirs for hydrothermal power (not requiring EGS). In the 1970’s, the DOE ran a successful program of industry coupled drilling in which government and industry shared the costs of geothermal exploration. The resulting knowledge of reservoir locations led to substantial industry growth. By utilizing current technology, revitalized efforts in exploration have the potential to reveal new sources, not found in the 1970’s, and ready for development.

Funding for now, however, seems focused more on EGS and advanced systems. The DOE issued its first funding announcement in June 2008 offering $10.5 million in available funds to support R&D in the EGS program. (Even private industry giant Google.com has invested $10 million in EGS through Google.org, its philanthropic arm.) And though the EISA authorizes up to $90 million a year for the geothermal program, the link with actual appropriations is tenuous. The budget request for FY09 suggests a $30 million allocation, but marks a sharp reversal by the Bush administration, which had sought to terminate the government’s geothermal research program in the previous year.

Geothermal advocates are pleased, but still see much room for progress. An extension of the production tax credit is a high priority.
credit was not included in EISA, though many believe it is essential to encourage investment. Additionally, geothermal would largely benefit from a federally mandated renewable portfolio standard (RPS), which requires utilities to purchase a percentage of energy from renewable sources. The MIT report recommended policies “similar to those that oil and gas and other mineral-extraction operations have received in the past including provisions for accelerated permitting and licensing, loan guarantees, depletion allowances, intangible drilling write-offs, and accelerated depreciation.” There is great anticipation that climate legislation, resulting in a price for carbon, would further investment in geothermal energy as well as other low carbon emitting technologies.

The Resurrection

Regardless of some remaining questions in science and policy, what is indisputable is that the increased attention toward geothermal electricity production has been healthy for the industry. Stagnant for many years, the Geothermal Energy Administration (GEA) now reports 20 percent industry growth in the last year alone. As of the writing of this article, Ninety-seven new geothermal projects are now looking to come online.

Looking Forward in the Domestic Drilling Debate: What Direction Should Policy Take on Offshore Drilling

By: Corina Cerovski-Darriau

Energy policy issues are typically focused regionally, only gaining publicity in states with vested interests. However, with gas prices at $4 a gallon nationwide, the issues have become more politicized with opinions falling along party lines. As both parties are struggling to get relief to their voters, the almost evenly divided Congress is struggling to get relief to their voters, along party lines. As both parties are more politicized with opinions falling nationwide, the issues have become more politicized with opinions falling nationwide. However, with gas prices at $4 a gallon nationwide, the issues have become more politicized with opinions falling nationwide. As both parties are more politicized with opinions falling nationwide.

Outer Continental Shelf Potential

The potential for domestic oil production on and offshore is widely speculated. Between undiscovered reserves, proven reserves, offshore oil fields, and possible additional sources like oil shale, the prospects are enormous. The U.S. currently has 21 billion barrels of just proven crude reserves. Focusing on the contentious OCS region—the area under U.S. jurisdiction extending from 3 to potentially 350 nautical miles offshore—the Minerals Management Service (MMS) cited 86 billion barrels of potential, yet undiscovered, oil resources in its 2006 assessment. Based on estimations, it looks like domestic oil production could alleviate some demand on foreign oil markets. However, there are limitations. For example, widespread exploration and seismic assessment of potential offshore oil resources are sparse, incomplete, or outdated making it hard to accurately determine oil reserves.

Legislative Debate

In mid-June 2008, President Bush gave Congress four ideas to increase domestic supply and lower prices, including lifting the Outer Continental Shelf (OCS) drilling moratorium. Congress resisted, causing President Bush to lift the executive restriction in mid-July. The move on its own does not allow any new drilling because Congress continues to renew a ban implemented in the early 1980s as part of the Department of the Interior (DOI) appropriations bill. However, it did heighten the domestic drilling debate, with Republicans demanding new offshore drilling and Democrats insisting that lifting the ban would not reduce current gasoline prices. The heightened debate resulted in a flurry of bills using a variety of tactics to reduce prices and foreign dependence. Measures varied from curbing oil market speculation, to expediting drilling in leased areas, to opening up new leases, to working on new developments like oil shale.

Looking Towards the Future

With increasing prices at the pump and calls to become less reliant on foreign oil, the offshore drilling option has been gaining political and public support. Even Democrats who have been staunchly opposed in the past are working on measures to open up offshore leases, or at least pass legislation showing their support of domestic production. Still, Democratic leaders in both the House and the Senate remain adamant about upholding the ban explaining that it is not the easy solution it is touted to be. If offshore drilling were allowed, the price at the pump would not instantly decline. It would still take at least 5-10 years for oil from OCS leases to reach the market if the ban was lifted today. More importantly, we have no clear alternatives to meet energy demands for transportation in the coming decades.

Oil demand is rapidly catching up to, and at times surpassing, supply. The transportation sector relies heavily on oil production that cannot be readily
replaced by renewable energy prospects like wind, solar, or geothermal. For the time being we are stuck at a crossroads, whether to increase investments in oil exploration and production or increase investments in alternative energy developments for transportation. It remains a question of infrastructure, resources, research, cost, and willingness to accept alternatives in the future. Right now the best option is to pair traditional oil production with increased research and development for more fuel efficient vehicles and better batteries for hybrid vehicles for example.

The debate continues as to whether there is oil on the 68 million acres of already leased offshore land, or if companies are sitting on unprofitable pieces of real estate. Congress continues to fight over who favors and how to best conduct domestic drilling. All the while gas prices are rising. It is clear no quick fix is possible to salvage prices or the demand on foreign oil. As support grows for offshore drilling, others worry we are not working hard enough to wean ourselves from fossil fuels. Despite a lack of direction being dictated by national policy, consumers may be taking matters into their own hands as petroleum saw its steepest drop in demand over the past 17 years in July. Still national policy will emerge, so we need to focus on the best action plan for the long term. A plan that dictates further research and infrastructure development for alternatives to oil, and most likely, a continued search for those undiscovered reserves will surely emerge for the future.

Photo (from left to right): Corina Cerovski-Darriau (AGI/AIPG Summer Intern), Jill Luchner (AGI/AIPG Summer Intern) and Laura Bochner (AGI/AIPG Summer Intern) in front of the American Geological Institute.

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When I applied for the AIPG/AGI Geoscience and Public Policy Internship, I was particularly interested in climate policy and energy policy, and my 12-week summer internship has provided ample opportunities to cover these two policies. With the steady release of climate change studies and the price of a gallon of gas exceeding four dollars, Washington, D.C., is abuzz over matters related to climate change and energy. Though few believe legislation on either topic will pass in the final months of this Congress, the 110th Congress has been holding an unprecedented number of hearings on climate change and energy issues. The two topics have been debated concurrently as they are intimately coupled, and impetus is growing for national policy to deal with both at the same time.

In the Senate, the Energy and Natural Resources and Environment and Public Works Committees have jurisdiction over energy and climate legislation. In the House, the corollary committees are the Energy and Commerce and Science and Technology Committees. These committees have arranged the hearings I have attended this summer. Hearing topics included enhanced oil recovery (EOR) using carbon dioxide, the deployment of carbon capture and storage (CCS) technology, the role of hydropower in America’s energy future, cap and trade legislation to reduce greenhouse gas emissions and the connection between global warming and extreme weather events. Attending hearings and tracking legislation have been instructive as to how Congress works and how scientific information is used in lawmaking. Furthermore, I have found fascinating the hearing testimony presented by prominent geoscientists such as Dr. James Hansen, Dr. Michael Oppenheimer, and Dr. Ken Caldeira as well as other experts such as Dr. Neil Hirst of the International Energy Agency. (My hearing summaries are available on AGI’s Government Affairs Program (GAP) web page at www.agi-web.org/gap.)

Other early highlights of the internship include assisting GAP with the June Hazards Caucus Alliance Congressional briefing on levee protection, helping with the June Coalition for National Science Foundation (CNSF) Exhibition, and meeting my Pennsylvania congressional delegation.

The Hazards Caucus Alliance briefings are opportunities to disseminate information on preparing for, mitigating against, and responding to natural disasters and man-made hazards. For the levee briefing, I created a one-page fact sheet about the science, engineering and emergency management of levees. It was an excellent opportunity to learn about levees and to meet engineering geologists and engineers who work on levee projects. The fact sheet I prepared is available at the Hazards Caucus Alliance website at www.hazardscaucus.org and is meant for policymakers, geoscientists, and the public.

At the CNSF Exhibition, an event to showcase the research supported by the National Science Foundation for members of Congress and their staffs, I aided the geoscience presenters in setting up their posters and convinced some congressmen to check-out the geoscientists’ posters. The five geoscientists had intriguing research to present on the seismic songs of Antarctic icebergs, sedimentation in and origin of the Grand Canyon, and activity at Yellowstone. The CNSF Exhibition was well-attended, the geoscientists’ presentations were very popular and, hopefully, attendees came away with a better appreciation for the research that the geoscience community is conducting.

In July, I had the opportunity to meet with Senator Robert Casey and Representative Charlie Dent, who represent my state and district in Congress. Soon I will be meeting with a staff member from Senator Arlen Specter’s office also. It was very exciting to meet Senator Casey and Congressman Dent. Both are aware of critical geoscience-related issues facing Pennsylvania and the nation, and both were interested in gaining more information about geoscience-related issues, such as CCS, water resources, and levees. I gave each of

Caption: Laura Bochner (AIPG/AGI summer intern) showing Senator Robert P. Casey Jr. a copy of her levee fact sheet in the Dirksen Senate Office Building on July 10, 2008.
them the levee fact sheet I prepared, and invited both to join the Congressional Hazards Caucus. Senator Casey has joined the caucus, demonstrating his interest and concern for geoscience-related issues.

Senator Casey asked me to prepare a one-pager on CCS, which I am now working to complete. I will send a copy of the one-pager to Congressman Dent as well. When I arrived and began covering energy and climate change hearings, I learned a great deal about the intersection of geoscience and policy. Now that I am preparing a fact sheet on CCS, a policy issue that connects energy and climate, I can bring the most important aspects of geoscience directly to some important policymakers.

I look forward to more opportunities to connect geosciences and policy before I return to Lafayette College in Pennsylvania for my junior year. After completing the CCS fact sheet, I will be attending more hearings, visiting several federal agencies, and inviting geoscientists to attend the first annual Geosciences Congressional Visits Day from September 9-10, 2008. I would like to conclude this update on my activities with a thank you to the AIPG Foundation, which provided support for my internship, and an invitation to all AIPG members to consider coming to Washington, D.C. for congressional visits with other geoscientists.

Geologic Mapping with Scaled 3D Images

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Abstract

An important contribution to rock mass characterization is related to the mapping of discontinuities. Contact-free measuring principles tremendously improve conventional geologic mapping due to the ability to take measurements fast and consistently without access and time restrictions, as well as to provide objective records of the rock mass.

This paper describes an approach for rock face characterization using scaled three-dimensional images. Two digital photos taken with a zoom-lensed, calibrated off-the-shelf camera serve for a three-dimensional reconstruction of the rock face geometry. The related principles originate from computer vision, allowing highly-flexible picture taking and automatic image processing.

The rock face is represented on the computer by a photorealistic spatial representation – a 3D image. From it, measurements are taken by marking visible rock mass features, e.g. spatial orientations of joint surfaces and traces, as well as areas, lengths, or positions. Orientation measurements are depicted in hemispherical plots together with statistics on their spatial distribution and rock mass parameters such as joint spacing are provided. Two commercially available systems have been used for a variety of mapping projects proving their significant support to conventional field work.

Key words: 3D image, geologic mapping, rock mass characterization, photogrammetry, computer vision, discontinuity

1. Introduction

The acquisition of geometric information on rock discontinuities is an integral part of ground investigation of excavation and construction works. There is potential to enhance conventional geologic mapping due to existing access restrictions, sampling difficulties, human bias, and instrument errors. However remote (contact-free) data acquisition techniques provide several benefits, including:

• efficient, detailed, and accurate outcrop and discontinuity data acquisition, including orientation, geometry, and position;
• enhanced worker safety (e.g. avoiding personnel at the rock face threatened by rock falls);
• data archiving (permanent digital records are acquired allowing later assessments without time restrictions); and
• data base for further analyses, such as slope stability assessments or numerical simulations.

The idea of using photos for geologic mapping is straightforward and not new. Restrictions due to limited time and access were already identified and addressed by several authors, such as Linkwitz (1963), Rengers (1967), Hagan (1980), or Crosta (1997). These previous approaches showed the successful application of photos for supporting geologic mapping; however efforts were too high for reasonable and economic daily use.

Emerging digital imagery and mobile computing power at reasonable cost opened new possibilities as described more recently by Roberts & Poropat (2000), Gaich et al. (2004), or Haneberg (2006).

In the following, a brief introduction on the measuring principle is given, followed by the use of 3D images for geologic mapping, and ending with a brief description of case studies.

2. 3D image generation

2.1 Background

A 3D image is a combination of a real (digital) photograph with the geometric information on the objects it shows. In the actual cases the objects are rock faces and walls. The geometry of the exposed rock mass can be reconstructed from digital images using methods of Photogrammetry (Slama, 1980; Wolf & Dewitt, 2000). Stereoscopic photogrammetry deals with the measurement of three-dimensional information from two images showing the same object or surface but taken from different angles. This principle is also referred to as Shape from Stereo (see Figure 1). The geometric relationship between two corresponding points in a stereoscopic image pair is used to determine the position of the original object point in space. This requires accurate information on:

• the image formation process of the camera (interior orientation) – see below; and
• the camera position and angular orientation when taking the pictures (exterior orientation).

Historically, the first issue led to purpose-built cameras relying on mechanically accurate imaging (so-called metric cameras), thus being expensive. The second issue was handled either by observation of control points (points with known co-ordinates visible in the images) or by external measurements (Roberts & Poropat, 2000), which is elaborate.

Beyond undertaking classical photogrammetry, computer vision in the 1990’s brought new algorithms and mathematics to the same topic (Faugeras, 1993). The computer vision approach had sig-
nificant impacts on field handling and image data processing as it caused several improvements such as:

- Zoom lenses can be applied. This significantly eases the usability and increases the flexibility in the field;
- Pictures can be taken freehand. The relative orientation between two images is determined fully automatically without any control points;
- Generic 3D images can be computed fully automatically. There is no need for explicitly knowing or determining the interior and exterior camera orientation, i.e. generic 3D images can be generated from pictures of virtually any digital camera;
- Metric 3D images can be generated without information on the external orientation of the cameras. By observing an object with known size, a generic 3D image can be scaled to a metric 3D image and
- Simplified procedure for calibrating a camera, i.e. determination of the interior. The interior orientation comprises the focal length, the intersection of the optical axis with the image plane, and a description of the lens distortions.

2.2 Data acquisition
Utilizing the computer vision approach data acquisition on site comprises the following steps:

- Installation of reference elements:
  - Either a range pole (a vertical pole with two targets mounted at a known distance) for local coordinate measurements or
  - Installation ground control points (surveyed in a given coordinate system) for global coordinate measurements or
- Taking two images (freehand) of the rock face from different positions ensuring the reference figure(s) being visible in both images. Measuring the length of the base line (see Figure 1) is not required. However, practical experience showed that this length should be approximately one fifth to one eighth of the mean imaging distance and almost parallel to the strike of the face; and
- Calibration of the imaging system. Camera calibration is crucial for obtaining accurate results. Usually pre-calibrated cameras are used, thus this step can be skipped on site.

2.3 Combination (merging) of 3D images
Practical tasks often involve dealing with large areas, complex shapes or high resolution, each of what go beyond the capabilities of a single stereoscopic image pair. In these cases, the rock wall is to be acquired by several overlapping 3D images. They are connected to a larger 3D model that allows for taking measurements (see Figures 2 and 3). During processing, common image information in the overlapping regions is used to determine a transformation from one 3D image to the next.

3. Assessment of 3D images for rock mass characterization
Once a 3D image is ready, measurements can be taken directly from it. A purpose-built 3D software component is used that allows rotating, panning, as well as zooming a 3D image in and out, thus allowing a thorough inspection. The photorealistic representation of the rock surface together with the three-dimensional shape provides a natural impression and allows for decisions on the geologic relevance of certain structures and their geometric properties.

In the following possible uses for geologic assessments are briefly addressed. They are subdivided into basic mapping features and higher level features, i.e. rock mass related properties and evaluations.

3.1 Basic mapping features
Geometric measurements are taken by placing graphical markers onto the 3D image. These markers denote points or regions of interest, e.g. visible discontinuity traces or discontinuity surfaces. All measurements taken from a 3D image are inherently three-dimensional in the given coordinate system. Point-based, line-based, and area-based items are available as basic mapping features.

Co-ordinates and distances
Basic magnitudes are related to surface point measurements (x,y,z coordinates) and the determination of the Euclidean distance between arbitrarily chosen surface points which correlates to a virtual tape measure. By clicking on the designated position(s) the metric information is instantly provided.
Individual orientations

Any location on the 3D image can be touched with a spatial cursor that follows the actual 3D shape of the reconstructed surface. It changes its pointing direction according to the actual orientation of the surface (see Figure 4). In this way orientation measurements are taken which is comparable to the application of a compass-dinometer device on a particular location.

Linear features

The measurement of linear rock mass features such as joints, lithological borders, or strata is performed by marking discontinuity traces on the 3D image. A marked trace consists of sample points on the surface connected to a spatial line (a 3D poly-line). If the 3D poly-line shows a sufficient variation in depth, a plane is fitted automatically to the sample points. The orientation of the fitted plane corresponds to the spatial orientation of the discontinuity trace that has been marked, thus it determines the three-dimensional orientation of the linear feature (see Figure 5).

Figure 4. Orientations can be measured at arbitrary locations on the 3D image. Dip angle and dip direction are instantly provided.

Figure 5. A discontinuity trace marked by a 3D poly-line. A plane is fitted through the sampling points. Its orientation corresponds with the orientation of the marked trace.

Areas

Regions of similar geologic attributes (e.g. lithology or same degree of fracturing) or joint surfaces are marked with areas. An area is defined by marking a closed poly-line on the 3D surface. The enclosed parts of the 3D surface are used to compute the mean orientation which is instantly provided by dip angle and dip direction. Figure 6 depicts an example of a marked area and the resulting surface normal indicating the spatial orientation of that area.

Figure 6: Measurement of orientations at joint surfaces. By marking points and calculating the mean orientation of the surface normal the orientation vector is determined. Additionally, it delivers the size of the area.

3.2 Higher level features

From the basic measurements several higher level features are derived with the aim of obtaining descriptive rock mass parameters. Basically, all rock mass parameters based on geometric information of rock structures can be determined.

Structure maps

Basic features, such as joints and areas, orientations, as well as co-ordinates, or distances are assigned to structure sets that represent geologic units, e.g. a discontinuity set. Figure 7 shows an example of a 3D image with several structure sets marked.

All structure sets together form a structure map.

3.2.1 Hemispherical plots

The measurements taken from the 3D image are grouped to sets by the operator. Each set is instantly visualized within a hemispherical plot (stereonet) in order to get an instant impression of the spatial distribution of the orientation measurements assigned to a set (see Figure 11). Since measured structures can be touched either within the 3D view or from the hemispherical plot, the proper assignment to sets is supported.

Calculated statistical parameters on the spatial distribution of a structure set include the spherical aperture, concentration (Fisher’s constant), and the cone of confidence. The output is instantly updated when new orientation measurements are applied.

Spacing

Structure maps inherently contain the lengths and spacing of traces. Spacing is referred to as set spacing, normal set spacing, and total spacing according to definitions given in the textbook by Priest (1993).

The software features two possible methods for calculating spacing. The first one is similar to conventional scan line mapping: the user places a virtual scan line on the 3D image and the software calculates spacing values of the intersected joints. The second method is a kind of multiple scan line spacing: traces of an entire structure set are projected onto a reference plane. The distances between adjacent discontinuities are determined along scan lines perpendicular to the mean orientation. Figure 10 shows an example of multiple scan line spacing. In includes an automatically generated sketch that is also used for visually reviewing the spacing calculation.

Surface Roughness

3D images at a sufficiently high resolution can be used for obtaining discontinuity roughness values. The required resolution for measuring discontinuity roughness is not a fixed value, but depends on the scale of analysis (looking at waviness requires less resolution than analyzing roughness). Figure 8, for instance, shows a roughness profile along a discontinuity plane. The point density of the corresponding 3D image is approximately 1.2 pts/cm². The
obtained roughness profiles can then be compared with standardized profiles (ISRM, 1978).

Figure 8: Roughness profile evaluated from a 3D image. The point density is approximately 1.2 pts/cm².

4. Applications

In the following, case studies using the commercial systems ShapeMetriX³D and JointMetriX³D are briefly touched upon in order to highlight the capabilities of the 3D imaging technology.

4.1 Rock slope

The stability of a rock slope with a height of about 150 m was assessed. Several parts were inaccessible, so contact-free measurements proved to be a proper way to gather reasonable quantitative geometric information on the discontinuity network and the free surface.

A highly detailed 3D image (70 megapixels) was generated in order to allow a geologic assessment also of smaller structures. Figure 9, Figure 10 and Figure 11 show the achieved results of the 3D imaging and assessment activities using the ShapeMetriX³D software. Within the software measured orientations are instantly displayed together with statistics on their spatial distribution. Furthermore spacing and joint length statistics are provided.

4.2 Tunnel face mapping

In conventional tunnelling, face mapping has to be performed quickly. Two photos of the tunnel face can be taken within a minute without significant disruption of excavation works (cf. Gaich et al. 2004). This provides the geologists with more time on site for the analysis of other parameters as the actual geometry is already captured.

Assessments (see Figure 12) are performed on the computer without further time and access restrictions. Subsequent 3D images of tunnel faces (see Figure 13) represent an objective, reproducible record of the rock mass conditions encountered during excavation delivering a good data base for any later review of a project.

5. Conclusion

3D imaging is a powerful technology for the documentation and characterization of exposed rock faces. Using only two images of a calibrated imaging system together with a reference figure allows generating a scaled 3D image of the observed rock face for both visualizing the actual conditions and obtaining accurate measurements on rock structures. 3D imaging based on computer vision is easy to use, can be handled by one person, involves only light-weight equipment, and avoids operator hazards due to its remote application.

It can be used from close range (below 1 m) to large distances (beyond 1,500 m) on the surface and underground. Applications include documentation of the encountered rock mass conditions, support of geologic mapping and rock mass characterization, or discontinuity and keyblock analysis. Practitioners and engineers may explore additional applications of this technology.

3D imaging with according assessment software will have a significant impact on the current analysis and design practice in rock engineering. However, these tools are intended as a support and not a substitute to conventional field work.

Figure 9: Application of 3D imaging technology for the analysis of a 150 m rock slope.

Figure 10: Computer generated sketch of joint traces for one set together with statistics for determining normal spacing and joint frequency.

Figure 11: Lower hemisphere equal-area projection polar plot of identified discontinuity sets.

Figure 12: 3D image of a tunnel face (cross section about 25 m²) with main features mapped.

Figure 13: Subsequent 3D images of a drift tunnel excavation in an underground marble mine.
References


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