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ON THE COVER - Mount Humphrey overlooks Flagstaff, Arizona, site of the AIPG/AHS/3rd IPGC 2008 Symposium.
Outreach: Small Steps Forward, Large Steps Backward

Gail G. Gibson, CPG-09993
Florida Community College at Jacksonville, 1154 Morgan Circle E, Orange Park, FL 32073, ggibson@fccj.edu

A lady my wife and I met at the “big kid toy store” (Home Depot), has been telling us about her grandmother’s interest in Geology. So the other day they came to the house, or more specifically the garage, with its shelves, boxes of minerals, rocks, and fossils. The vehicles sit outside. This eleven-year-old young lady is knowledgeable, interested, and inquisitive. She politely asked if she could come back some time with her collection, and compare her samples with our materials. At eleven years old, she was asking how to distinguish black tourmaline from hornblende, and wondering about chemistry and mineral colors. She is thinking of geology for college. Outreach takes many forms, and the results of these couple of hours are several years down the road, but still a small step forward.

Betty and I teach introductory geology on a part time basis at a community college. Last fall, Betty had a class that included dual enrollment students (high school students taking college credit courses), a 20+ year military veteran; and a mixture of ages, maturity levels, and interest in between. An enjoyable class.

The veteran was considering a second career, as a middle school or high school science teacher. Of course the dual enrollment students told him all of the reasons not to teach in middle and high school grades. But, they also listened to him, asked his advice, and worked well with him on group projects. About half way through the term, he announced that not only did he want to teach, but to teach Geology / Earth Science! Ah, a step forward.

During the spring term, the veteran would “drop by” my wife’s class on lab day and ‘help out’ (learning some of the techniques of a good teacher, and don’t tell my wife I said that). He graduated with his AA degree (nearly a 4.0 GPA) in May, and applied to transfer to the state’s four-year flagship institution to pursue a dual major in Geology and Secondary Education. His application was denied! What a disappointment! A big step backward!

My wife’s initial question to me was “Who do you know in that Geology Department?” “Nobody, they have all either died or retired.” “Okay”, she said, “get in the car we are going to meet the current crop of faculty.” Well, we did, with positive responses and assurances of support. We also knocked on a few administrative doors as well. A string of letters behind one’s name on a business card does help open doors.

This future teacher followed up with an appeal letter and a face-to-face visit. This future teacher/ geologist is now accepted at that institution, and by the time this issue of TPG is in press will be taking classes to complete his baccalaureate in Geology and Secondary Education. Outreach, genuine interest, and support are going to result in a knowledgeable secondary teacher, or perhaps a practicing CPG. But oh, the stumbling steps to get there.

In the 1980s I was part of a statewide effort by academicians and geological professionals that resulted in Earth Science / Geology becoming a required science for high school graduation. In some high schools chemistry was a pre-requisite or co-requisite for that Geology / Earth Science! I helped a teacher friend earn his masters degree in Geology, and move along the track more like that of a geological professional in terms of continuing professional development, research, and publication. For years he has unselfishly shared his interest and expertise with peers in his county, introduced his students to his enthusiasm for geology in the field, and had the support of this school administration for lots of “out of classroom” teaching. A big step forward!

Unfortunately, the supportive people have moved on, and his current school administration is “much less tolerant of out-of-classroom teaching and discipline-related professional development.”

The State is relegateing the Geology / Earth Science to a science requirement for those students not planning on college, and even discussing moving it out of high school altogether, and into the elementary grades. One of the reasons cited is a lack of trained geology / earth science teachers. Talk about a step backward, but all too familiar.

My friend has elected to retire early as the enjoyment of teaching high school geology is being taken from him. A big step backward! We as geological professionals bemoan the fact that there are too few truly qualified college graduates to fill vacant positions, or member slots in our organizations. Be aware of similar disturbing trends in your states. After all, most geologists are cultivated, nurtured, and groomed to be productive employees in your company via outreach…..beginning in the elementary grades.
FULBRIGHT AWARD AT AFEKA COLLEGE OF ENGINEERING, TEL AVIV, ISRAEL

James A. Jacobs, CPG 07760
Hydrogeologist
Environmental Bio-Systems, Inc.

It is a great honor to have been selected by the Council of International Exchange of Scholars (CIES) for a Fulbright Specialists Grant. My grant started on March 30th with 17 hours of flying from San Francisco to Tel Aviv, Israel. I was met at the airport by Amit Tal and Liz Harpez, representatives of the co-sponsors of the two-week workshop I was about to conduct under the auspices of the grant to provide specialized training to Israeli environmental professionals on risk assessment, fate and transport, assessment and remediation methods used in California and the United States.

After receiving notification of the Fulbright award, I invited other California-based environmental professionals to join me in Israel, expanding the scope of the specialized environmental training. Bringing in that expertise from geology, chemistry, engineering, toxicology and other disciplines, resulted in a discipline-integrated workshop titled “Remediation of Contaminated Soils and Groundwater: The California Experience.”

The forty-hour post-graduate seminar was presented April 6 to 11, 2008 at the Afeka College of Engineering. The workshop focused on regulatory perspectives, risk assessment and remediation technologies. The workshop was also made possible by corporate sponsorship and logistical assistance provided by RPC of Israel, Ami Adini & Associates and Amphibio. Although Hebrew is the official language of Israel, most everyone I met in the country was fluent in English, making communication easy and effective for the workshop.

During my first week in Israel, I toured the modern water treatment plants operated by Mekorot Water Company, Ltd. with Nellie Tal. Mekorot is the Israeli national water company which supplies 1.3 million cubic meters of water per year. This amounts to 90% of Israel’s drinking water and 70% of all the water supply in the country. Water resources experts come from around the world to Mekorot’s facilities to learn water treat-
ment and conservation methods from the Israelis.

The workshop took place during the second week of the trip. I made more than a dozen presentations, which covered topics such as the environmental history of the United States and California, brownfields experiences in the United States, Phase I Environmental Assessment. I also discussed soil, vapor and groundwater sampling methods. After describing the fundamentals of sampling, soil and groundwater remediation methods were discussed, including in-situ chemical oxidation, enhanced bioremediation, metals stabilization and two phase extraction methods.

One topic that seemed to be of great interest in the workshop was the determination of risk and exposure levels for soil, vapor and groundwater. The participants also wanted to know how to determine what level of remediation should be required to obtain case closure. In addition, passive vapor sampling methods were described in detail and a lively discussion followed on how to use the results and the limitations of these type of data.

The other American presenters included Ravi Arulanantham, Ph.D. a Principal Toxicologist with Geomatrix Consultants in Oakland, California. He was formerly the Chief Toxicologist with the State of California, and he led discussions on risk assessment, as well as the risk based corrective action method (RBCA), which he helped design. Dr. Chin Man W. Mok, Ph.D., P.E., P.G. G.E. Principal Engineer and Hydrogeologist at Geomatrix Consultants in Oakland, California, provided insight into the fate and transport of chemicals in the environment. Ami Adini, born in Israel, but now living in Los Angeles, California, is the Principal Engineer at Ami Adini & Associates and Rejuvenate Performance Company (RPC), an Israeli environmental consulting firm, discussed rapid site closure methods and remediation funding sources in California. Several Israeli regulators presented specific environmental challenges or case studies for the class to discuss.

The President of the Afeka College of Engineering, Dr. Mordechai Sokolov, introduced the workshop and initial presenters on the opening day. At the end of the workshop, he returned to say a few words about possible future workshops before the participants were awarded their certificates in a brief conclusion ceremony.

The workshop provided an introduction to the topics discussed. It was attended by about 50 Israeli professionals, who were equally divided between Israeli regulatory and water agencies, environmental consultants, potentially responsible parties and landowners. Given the significant interest by the participants, the presentations themselves were more like technical conversations with numerous discussions and questions interspersed throughout the duration of the talks. These interactions provided valuable insights into the needs of the Israeli regulators to develop realistic and meaningful cleanup levels that are attainable and designed to evaluate exposure pathways to protect human health and the environment. Since California has been performing risk assessments and has had environmental regulations for over 30 years, the presenters provided first-hand experience to the Israeli participants on what has worked and what has failed in California.

The hosts at Afeka College of Engineering provided great hospitality and also provided touring opportunities for the visiting presenters in the evenings and for two days after the workshop. The visiting American lecturers were taken to the old city of Jaffa in Tel Aviv, a day tour in Jerusalem and a day in the area around the Sea of Galilee, among other historic destinations. Being a hydrogeologist, I wanted to see Abraham’s personal well in Beersheba in the Negev Desert. Beersheba, according to the Old Testament, is the place where Abraham made a pact with Abimelech for the use of the well for his animals (Genesis 21: 25-33). Strangely, the story of Abraham is about 4,000 years old, yet the well at the tourist location was only 1,000 years old. Oh well!

Participant interest in future environmental workshops was encouraging. Based on observations and participant interviews, Afeka College of Engineering determined that a series of workshops, and possibly a regional environmental meeting will be considered for the future.
to address these and other environmental topics in much more detail. In addition, several Israeli environmental projects may be developed using some of the concepts proposed in the workshop as well as some of those commonly used American remediation technologies. More exchanges will likely occur with the Israeli regulatory agencies in order to assist them to develop their environmental policies.

Our hosts arranged for the lecturers to stay at the lovely Melody Hotel in Tel Aviv. The hotel was right across the street from the beach and all the rooms had wonderful Mediterranean views. I thank the generosity of the American contributors: Ravi Arulanantham, Chin Man Mok and Ami Adini to provide the time to participate with me in the environmental workshop. I also thank the corporate sponsors and Afeka College of Engineering for making the workshop a success. This portion of my Fulbright assignment concluded on April 12, 2008. The experience in Israel was terrific and I thank the Council for International Exchange of Scholars (CIES) for the Fulbright grant that allowed the Israeli workshop to be possible. The U.S. Department of State, Bureau of Educational and Cultural Affairs funds the Fulbright program and CIES is a division of the Institute of International Education. The Fulbright Program is an important part of American educational exchange and is used to help build and maintain U.S. international relations throughout the world. The goal of the Fulbright Program is to promote mutual understanding and respect between the United States and other nations. Unfortunately, Congressional funding for the Fulbright Program has been drastically cut over the past several years. Readers interested in the continuation of international exchanges should contact their representatives in Congress, reminding them that the CIES program is an important part of building and maintaining U.S. international relations and should be funded generously.

James A. Jacobs, Environmental Bio-Systems, Inc., 707 View Point Road, Mill Valley, CA 94941. Tel: 415-381-5195; Fax: 415-381-5816, Email: jimjacobs@ebsinfo.com

SECTION NEWS

Alaska Section

Fairbanks, a city in the northern tier of our Section’s membership, was the location for our Spring meeting. Each spring we showcase technical and state-of-the-art practices current in both government and the private sector. We invited Dr. Anupma Prakash, of the University of Fairbanks Department of Geology and Geophysics, to talk about what is new for remote sensing for geological, mining and environmental geoscientists. She is currently researching various satellite and leading edge technologies to capture surface imaging. Her work includes complex data capture with field observations for ground validation.

Later at our dinner meeting, we were fortunate to have Thomas K. Bundtzen, of Pacific Rim Geological, share current findings of the geochronology of the plate and volcanic activities spanning across the continents. Geomapping and ground investigations can provide a network of plausible rock movement scenarios. Mr. Bundtzen is presently conducting geological and mineral resources investigations in Alaska, Yukon and eastern Russia. We enjoyed the duel forum for our Section meeting. We congratulate our Fairbanks members for their fine hospitality.

Dr. Anupma Prakash

Arizona Section

AGS Elects Walt Heinrichs Honorary Life Member

Walter E. Heinrichs, Jr., CPG-00688, was elected an honorary life member of the Arizona Geological Society at the April 3 society dinner meeting. A plaque was presented to Walt at the meeting.

Susan G. Browne, CPG-08886, AK Section Secretary

Thomas K. Bundtzen
that stated in part that the award was “…in recognition of his high attainments as a scientist and of his service to the society.”

Walt has contributed to and participation in AGS, for 50 years. He is the only original member of the 60-year-old Society. Among his many contributions to the geology community, Walt found the Pima ore body, using geophysics. Walter is a Charter member of AIPG.

Walt’s wife and sons, who attended the ceremony as guests of AGS, are shown with Walt holding his plaque.

**Georgia Section**

**Monitoring Well Installation Demonstration**

In December 2007 the Georgia Section made arrangements with Kilman Brothers, Inc, an Atlanta-based drilling company which serves the southeast, to have student members observe the drilling, installation, and sampling from a newly installed monitoring well. The drilling was scheduled so that it occurred after semester finals in the hope that more students would attend. The site where the monitoring well was installed was a former UST site where corrective action was ongoing. The environmental consulting firm representing the owner of the site was Mill Creek Environmental Services, Inc. owned by AIPG member Dan Centofanti. John Kilman, owner of Kilman Brothers, Inc. also visited the site along with a driller and three helpers. Before the monitoring well was drilled there was a discussion with the students regarding contracting, utility clearance, and site safety. The monitoring well was drilled to 40 feet deep in order to get a representative groundwater sample. Split spoon samples were collected every five feet and shown to the students. A discussion on proper sample description, soil screening, and sampling for laboratory analysis was also conducted. The students were shown the PVC well screen and riser before well completion and shown the sand and bentonite used to complete the well. The purpose of these items used in the construction of monitoring wells was discussed. The well was developed and the students were shown the proper way to collect groundwater samples for BTEX analysis.

As part of the demonstration the students were given a notebook that included a variety of typical field forms used in the environmental industry. After the completion of the field demonstration there was a discussion with the students on the contents of the notebook which included proper soil classification, boring logs and well completion forms, well development, purging and water level forms, pilot testing and remediation data sheets, chain of custody, and field check lists. The last section of the notebook were tables summarizing the amount of sample required, type of container, preservative, and holding times for many typical analyses, characterized by media. To increase the student attendance in the future, we would like to get help from a professor and combine this demonstration with a hydrogeology class. We hope to have a demonstration in the spring on geoprobe drilling and sampling.

The Georgia Section would like to give a special thank you to both Kilman Brothers and Mill Creek Environmental Services for their time and resources while installing this monitoring well for the students.

Drillers collecting a split spoon.

Jake Irwin with Mill Creek describing the soil sample to the students.

John Kilman (center) talking to the students.

Free product in a bailer.

**Colorado Section**

Matt Sares of the Colorado Geological Survey discusses ground water balance in the Raton and San Juan Basins. Photo by D. Peters.

It’s nearly over now, but winter was here in full force. Can anyone identify the Colorado location? Photo by Jim Burnell.

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| Free product in a bailer. |
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**SECTION NEWS**

It's nearly over now, but winter was here in full force. Can anyone identify the Colorado location? Photo by Jim Burnell.
AIPG Georgia Section Field Trip to IMERYS

I just wanted to take a moment to let you know that I thoroughly enjoyed the field trip to your Deepstep facility. Ed and Jessica's (I'm sorry, but I can't remember their last names) put on an excellent "show-and-tell" of the operations, including a nice slide presentation of the background and nature (both geologic and economic) of the Kaolin deposits. They also provided a nice lunch in between the mine visits.

Ed and Jessica represent IMERYS very well. I hope you will let them know that we all appreciated their efforts and look forward to seeing them in the future.

Excellent job!

River Hills Environmental, Inc.
Rick Ricci, CPG-11174, PG

Michigan Section
Why Did You Choose Geology as a Major in College?

Field trips! Many of us chose a career in geology for the opportunity to be outside all of those great experiences on the class field trips. The geology field trips were always the envy of the other sciences. We like being outdoors, exploring, collecting specimens, learning about new things, and enjoying a tasty beverage or two together.

In the spirit of enjoying the outdoors, collecting specimens, and enjoying the company of fellow geologists, the Michigan Section in conjunction with the Geologist Outreach Committee, has planned a field trip in late July or early August to visit the Rockport Quarry in Alpena and the Lafarge Presque Isle Quarry as a weekend trip. All interested geologists, not just AIPG members, including Michigan Basin Geological Society (MBGS) members are invited to attend the weekend trip.

Families are also invited. More details will be provided by special announcement in the next few months.

If you would like to assist or have suggestions for the quarry trip, please contact Sara Pearson at pearsons@michigan.gov or (616) 356-0253.

In addition to the planned quarry trip, there are several other upcoming field trips sponsored by the MBGS that AIPG members are welcome to join. These trips are listed in the "Coming Events" section of this newsletter. For more information on the MBGS trips listed below, please contact Mark Wollensak, CPG at wollensak@hampmathews.com or (517) 641-7333.

Sara Pearson, CPG-10650 Michigan Section Vice President

Michigan Section Membership Challenge

The following membership challenge was submitted by Larry Austin just prior to the last Section meeting in an effort to encourage our student members to attend. The challenge has been slightly modified and is renewed for the May Section meeting. If the challenge is successful, it will likely continue for future meetings.

The March meeting saw costs covered for four students to attend. The executive committee would like to see that number double for the May meeting. Please consider pledging your support by either offering to buy a student dinner or to transport them to the meeting.

I have an offer for one of the student members. I'll buy dinner at the next AIPG Section meeting and provide transportation for one major if they are willing to attend the meeting. I hope other members will take up the gauntlet and help cover costs as well.

By way of providing this information to Adam, whom I hope will distribute it to everyone in the section, I'm also:

1. Issuing a challenge to other AIPG members to do the same.
2. Offering to provide transportation from my office to the meeting for up to five additional students if other members will pick up the cost of their meal.
3. In the unlikely absence of sufficient students to fill my Durango, offering to share the ride with other members in the Grand Rapids area.

For interested students, please submit your willingness to attend the meeting and accept one of the paid dinners to Adam Heft no later than April 30, 2008 so that reservations can be made. Paid student dinners will be available on a limited, first come, first served basis. Members that are willing to pay for a student to attend the meeting should also notify Adam as soon as possible so we will know how many students will have their costs and/or transportation covered and can confirm with the student(s).

South Dakota Section

The South Dakota Section of AIPG met at the Ramkota Hotel in Pierre, South Dakota on March 26, 2008. Business of the section was conducted.

SD Section AIPG Annual Luncheon Meeting (3/26/08). Left to right: Sheldon Hamann (SD DENR), Kevin Elliott (DENR), Damon Powers (Summit Envirosolutions), Larry Stetler (SDSM&T), Gary Haag (SD DENR), Perry Rahn (retired, SD DENR), Derric Iles (DENR), Bill Siok (AIPG National), Joanne Noyes (DENR), Kelli McCormick (DENR), John Foster (DENR), John Foster Sawyer (DENR). Not pictured: Bob Townsend (DENR) and Tom Durkin (SDSM&T).

Dr. Alvis Lisenbee (left) 2008 "J. P. Gries Geologist of the Year" award winner and Dr. Perry Rahn (right) Past President, SD Section AIPG Award announced March 28, 2008 at Annual Luncheon Meeting of SD Section, AIPG -- Pierre, SD.
## AIPG/AHS/3rd IPGC 2008 Symposium

### PROGRAM

#### Saturday, September 20, 2008

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:00 am - 5:00 pm</td>
<td>Registration at Radisson</td>
</tr>
<tr>
<td>7:00 am - 8:00 am</td>
<td>AIPG - Executive Committee Breakfast</td>
</tr>
<tr>
<td>8:00 am - 12:00 pm</td>
<td>AIPG - Executive Committee Meeting</td>
</tr>
<tr>
<td>12:00 pm - 1:00 pm</td>
<td>AIPG - Foundation Luncheon</td>
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<tr>
<td>1:00 pm - 4:00 pm</td>
<td>AIPG - Advisory Board Meeting</td>
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<tr>
<td>4:00 pm - 5:30 pm</td>
<td>AIPG - Joint Executive Committee Meeting and Business Meeting</td>
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<tr>
<td>8:00 am - 5:00 pm</td>
<td>Field Trip - San Francisco Volcanic Field</td>
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<tr>
<td>8:00 am - 5:00 pm</td>
<td>Field Trip - Lake Mary/Walnut Creek Watershed</td>
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<tr>
<td>9:00 am - 4:00 pm</td>
<td>Workshop - Writing for the Reader: Strategies for Communicating Technical Information Effectively</td>
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<tr>
<td>9:00 am - 4:00 pm</td>
<td>Workshop - Water Education Project WET</td>
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<tr>
<td>9:00 am - 4:00 pm</td>
<td>Workshop - GIS I - Introduction to ArcGIS for the Earth Scientist</td>
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#### Sunday, September 21, 2008

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<th>Time</th>
<th>Event</th>
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<tr>
<td>7:00 am - 5:00 pm</td>
<td>Registration at Radisson Hotel</td>
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<tr>
<td>12:00 pm - 8:00 pm</td>
<td>Registration at High Country Conference Center</td>
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<tr>
<td>12:00 pm - 4:30 pm</td>
<td>Workshop - GIS II - Introduction to ARC Hydro</td>
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<tr>
<td>12:00 pm - 4:30 pm</td>
<td>Workshop - Students, Your First Steps in the Profession and the Future</td>
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<tr>
<td>2:00 pm - 5:00 pm</td>
<td>AESE - Board Meeting</td>
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<td>7:00 am - 5:00 pm</td>
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<td>8:00 am - 5:00 pm</td>
<td>Field Trip - Grand Canyon/South Rim</td>
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<td>8:00 am - 5:00 pm</td>
<td>Field Trip-Sunset Crater/Wupatki</td>
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<tr>
<td>5:00 pm - 6:00 pm</td>
<td>AHS - Foundation Board Meeting</td>
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<tr>
<td>6:00 pm - 8:00 pm</td>
<td>Welcome Reception</td>
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<tr>
<td>6:00 pm - 8:00 pm</td>
<td>Exhibit Area Open</td>
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#### Monday, September 22, 2008

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<td>Registration at Radisson Hotel</td>
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<tr>
<td>7:00 am - 6:00 pm</td>
<td>Registration at High Country Conference Center</td>
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<table>
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<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:00 am - 8:00 am</td>
<td>AESE - Surveys Breakfast Meeting</td>
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<td>7:00 am - 9:00 am</td>
<td>AIPG - Past President’s Breakfast</td>
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<tr>
<td>8:30 am - 5:30 pm</td>
<td>AESE - Sessions</td>
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<td>8:30 am - 10:00 am</td>
<td>Plenary Session/3rd IPGC</td>
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<td>8:00 am - 5:00 pm</td>
<td>Exhibits Open</td>
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<tr>
<td>10:00 am - 5:00 pm</td>
<td>Technical Sessions/3rd IPGC</td>
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<tr>
<td>11:30 am - 1:00 pm</td>
<td>AESE - Business Meeting Luncheon</td>
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<tr>
<td>12:00 pm - 1:00 pm</td>
<td>AHS - Awards Luncheon</td>
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<tr>
<td>5:00 pm - 6:00 pm</td>
<td>AHS - Membership Meeting</td>
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<tr>
<td>8:00 am - 5:00 pm</td>
<td>Field Trip - Grand Canyon Sightseeing</td>
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<tr>
<td>8:00 am - 5:00 pm</td>
<td>Field Trip - Jerome Mining District/Sedona</td>
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<tr>
<td>6:00 pm - 8:00 pm</td>
<td>Dinner and Cultural Entertainment Event at Radisson</td>
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#### Tuesday, September 23, 2008

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<tr>
<td>7:00 am - 4:00 pm</td>
<td>Registration at High Country Conference Center</td>
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<tr>
<td>7:00 am - 8:00 am</td>
<td>AESE - Freelancer’s Breakfast</td>
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<td>8:00 am - 3:00 pm</td>
<td>Exhibits Open</td>
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<tr>
<td>8:00 am - 5:00 pm</td>
<td>Technical Sessions/3rd IPGC</td>
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<tr>
<td>8:30 am - 5:30 pm</td>
<td>AESE - Sessions</td>
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<td>12:00 pm - 1:00 pm</td>
<td>Luncheon with Speaker</td>
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<td>8:00 am - 5:00 pm</td>
<td>Field Trip - Sedona</td>
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<tr>
<td>8:00 am - 5:00 pm</td>
<td>Field Trip - Meteor Crater</td>
</tr>
<tr>
<td>6:30 pm - 8:30 pm</td>
<td>AESE - Awards Banquet</td>
</tr>
<tr>
<td>6:30 pm - 8:30 pm</td>
<td>Reception/Awards at the Museum of Northern Arizona</td>
</tr>
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#### Wednesday, September 24, 2008

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>8:00 am - 9:00 am</td>
<td>Registration at Radisson Hotel</td>
</tr>
<tr>
<td>7:00 am - 8:30 am</td>
<td>AESE - Board Meeting</td>
</tr>
<tr>
<td>8:00 am - 3:30 pm</td>
<td>Workshop - Important Areas of Law-What Does the Future Hold?</td>
</tr>
<tr>
<td>8:00 am - 5:00 pm</td>
<td>Field Trip - Grand Canyon/South Rim</td>
</tr>
<tr>
<td>8:00 am - 5:00 pm</td>
<td>Field Trip - Flagstaff’s Water Supplies: Past, Present, and Future</td>
</tr>
</tbody>
</table>
# AIPG/AHS/3rd IPGC 2008 Symposium

**Changing Waterscapes and Water Ethics for the 21st Century and Global Geoscience Practice, Standards, Ethics, and Accountability**

**September 20-24, 2008**  
Flagstaff, Arizona, USA

## REGISTRATION FORM

<table>
<thead>
<tr>
<th>NAME (Last)</th>
<th>(First)</th>
<th>(Middle Initial)</th>
<th>NAME FOR BADGE</th>
<th>Member of:</th>
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<thead>
<tr>
<th>COMPANY/AFFILIATION</th>
<th>MEMBERSHIP NO. (if applicable)</th>
<th>AHS</th>
<th>AIPG/AHS (both)</th>
<th>AESE (AIPG)</th>
<th>CCGP (AIPG)</th>
<th>EFG (AIPG)</th>
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<tr>
<th>ADDRESS</th>
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<tr>
<th>*SPOUSE/GUEST NAME</th>
<th>NAME FOR SPOUSE/GUEST BADGE</th>
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## FEES AND PAYMENT INFORMATION

**ANNUAL MEETING REGISTRATION**  
(All fees are in US$ and include all sessions, Monday, September 22, through Friday, September 26, 2008)

<table>
<thead>
<tr>
<th></th>
<th>On or By 6/30/08</th>
<th>7/1/08–8/31/08</th>
<th>After 9/31/08</th>
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<td>&quot;Spouse/Guest&quot; (Includes Registration Packet and Admission to Welcome Reception and Exhibits)</td>
<td>$100.00</td>
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<tr>
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<tr>
<td>Daily Student Registration</td>
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**FIELD TRIPS (Must be Registered)**  
(All field trips depart from the Radisson Hotel)

<table>
<thead>
<tr>
<th>Field Trip</th>
<th>On or By 8/31/08</th>
<th>After 8/31/08</th>
<th>No. Attending</th>
<th>Amount</th>
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<tbody>
<tr>
<td>San Francisco Volcanic Field (Sat., 9/20, 8:00 am – 5:00 pm)</td>
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<td>Lake Mary/Walnut Creek Watershed (Sat., 9/20, 8:00 am-5:00 pm)</td>
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<tr>
<td>Fossil Creek (Sun., 9/21, 7:00 am – 5:00 pm)</td>
<td>$100.00</td>
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<tr>
<td>Grand Canyon/South Rim (Sun., 9/21, 8:00 am – 5:00 pm)</td>
<td>$100.00</td>
<td>$150.00</td>
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<td>Sunset Crater/Wupatki (Sun., 9/21, 8:00 am – 5:00 pm)</td>
<td>$80.00</td>
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<td>Grand Canyon Sightseeing (Mon., 9/22, 8:00 am – 5:00 pm)</td>
<td>$100.00</td>
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<td>Jerome Mining District/Sedona (Mon., 9/22, 8:00 am – 5:00 pm)</td>
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<td>Meteor Crater (Tues., 9/23, 8:00 am – 5:00 pm)</td>
<td>$100.00</td>
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<td>Grand Canyon/South Rim (Wed., 9/24, 8:00 am – 5:00 pm)</td>
<td>$100.00</td>
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<tr>
<td>Flagstaff's Water Supplies (Wed., 9/24, 8:00 am – 5:00 pm)</td>
<td>$150.00</td>
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<td>Montezuma Castle and Well (Wed., 9/24, 8:00 am – 5:00 pm)</td>
<td>$90.00</td>
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**WORKSHOPS**

<table>
<thead>
<tr>
<th>Workshop Description</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Writing for the Reader: Strategies for Communicating Technical Information Effectively (Sat., 9/20, 9:00 am – 1:00 pm)</td>
<td>$99.00</td>
</tr>
<tr>
<td>Water Education – Project WET (Sat., 9/20, 9:00 am – 4:00 pm)</td>
<td>$25.00</td>
</tr>
<tr>
<td>GIS I – Introduction to ArcGIS for the Earth Scientist (Sat., 9/20, 9:00 am – 4:00 pm) (0.7 CEUs)</td>
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<tr>
<td>GIS II – Introduction to Arc Hydro (Sun., 9/21, Noon-4:30 pm) (0.5 CEUs)</td>
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<td>Students, Your First Steps in the Profession and the Future (Sun., 9/21, Noon – 4:30 pm)</td>
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<tr>
<td>Important Areas of Law – What Does the Future Hold? (Wed., 9/24, 8:00 am – 3:30 pm)</td>
<td>$99.00</td>
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<tr>
<td>SOCIAL EVENTS/MEETINGS</td>
<td>On or By 8/31/08</td>
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<tr>
<td>------------------------</td>
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<tr>
<td>AIPG Foundation Luncheon (Sat., 9/20, Noon – 1:00 pm)</td>
<td>$30.00</td>
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<tr>
<td>Welcome Reception (Sun., 9/21, 6:00 pm – 8:00 pm)</td>
<td>Included with Registration</td>
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<tr>
<td>AIPG Past-Presidents Breakfast (Mon., 9/22, 7:00 am-9:00 am)</td>
<td>Invitation Only</td>
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<tr>
<td>AESE Surveys Breakfast (Mon., 9/22, 7:00 am – 8:00 am)</td>
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<tr>
<td>Dinner and Cultural Event (Mon., 9/22, 6:00 pm – 8:00 pm)</td>
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<tr>
<td>AESE Freelancers Breakfast (Tues., 9/23, 7:00 am – 8:00 am)</td>
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<tr>
<td>Museum Reception/Awards (Tues., 9/23, 6:30 pm – 8:30 pm)</td>
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<table>
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<tr>
<th>DONATIONS TO FOUNDATIONS (Voluntary)</th>
<th>Suggested Amount</th>
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<tbody>
<tr>
<td>AIPG Foundation</td>
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<tr>
<td>AHS Foundation</td>
<td>$25.00</td>
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</table>

**TOTAL AMOUNT DUE**

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Organization Meetings (see Program for Dates and Times) – Please Indicate if Attending

<table>
<thead>
<tr>
<th>Attending</th>
<th>Attending</th>
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</thead>
<tbody>
<tr>
<td>AIPG National Executive Committee Meeting (9/20)</td>
<td>yes / no</td>
</tr>
<tr>
<td>AIPG 2008 Advisory Board Meeting (9/20)</td>
<td>yes / no</td>
</tr>
<tr>
<td>AIPG 2008-2009 Joint Executive Committee (9/20)</td>
<td>yes / no</td>
</tr>
<tr>
<td>Welcome Reception (9/21)</td>
<td>yes / no</td>
</tr>
<tr>
<td>AESE Business Meeting Luncheon (9/22)</td>
<td>yes / no</td>
</tr>
<tr>
<td>AHS Membership Meeting (9/22)</td>
<td>yes / no</td>
</tr>
</tbody>
</table>

**Note**

Full Registration includes Welcome Reception, Technical Sessions, Exhibits, Student Poster Sessions, Continental Breakfast, Lunch, Refreshments, and Registration Packet.

I understand that by registering for this event, I release and agree to indemnify the American Institute of Professional Geologists (AIPG), the Arizona Hydrological Society (AHS), the 3rd International Professional Geology Conference (3IPGC) and the agents, officers, volunteers and employees of AIPG, AHS, 3IPGC from all liability for any loss, damage or injury sustained by me while involved in any way with the convention and its events including field trips except that each of AIPG, AHS, 3IPGC is not released from such liability to the extent the same is caused by its actual gross negligence or willful misconduct. I have read and understand this waiver and release.

I also understand that submission of this registration form gives AIPG the authority to utilize any photograph taken of me at the conference for conference related publicity (e.g., photo gallery on cd, web site, TPG, etc.). AIPG agrees not to use my likeness for any other purpose. Please contact Vickie Hill at AIPG if you DO NOT wish to have your image used.

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**METHOD OF PAYMENT**

**PLEASE CHECK METHOD OF PAYMENT**

- [ ] Check No., Enclosed (drawn in U.S. Dollars on a bank located in the US or Canada)
- [ ] International Postal Money Order (in U.S. Dollars)
- [ ] VISA □ MasterCard □ American Express (Credit cards are processed in U.S. dollar amounts only)

Card No.________________________________________ Expiration Date___________

Print name of cardholder:________________________________________________________

REQUIRED: Credit Card Billing Address (street, city, state, and zip):

________________________________________________________

Authorized Signature______________________________________________________

Mail to:
American Institute of Professional Geologists
1400 W. 122nd Avenue, Suite 250
Westminster, CO 80234
or fax to (303) 253-9220 or register on-line at www.aipg.org
National AIPG Phone Number is (303)412-6205

Refund Policy: A 90% refund of total fees paid (10% withheld to cover administrative costs) will be given upon receipt of a written request until 7/18/08. Cancellations made by written notification received between 7/1808 and 9/1/08 will be assessed a charge of 20% (to cover administration costs) of the total fee paid. NO refunds will be given for cancellations received after 9/1/08 or for no-shows after the meeting. Based on the decisions of AIPG/AHS/3rd IPGC, field trips and workshops are subject to cancellation due to lack of participation. Notification and a full refund for field trips or workshops will be given in case of required cancellations.
2008 AIPG Student Scholarship Winners!

The AIPG Executive committee is pleased to announce the awardees for the 2008 AIPG Student Scholarships. This year three scholarships were awarded. The recipients were Anna Perry, University of Nevada, Reno, Nevada; Garrett Mitchell, University of Maryland, College Park, Maryland; and Nina Fitzgerald, Southern Utah University, Cedar City, Utah.

Congratulations!

Anna Perry, SA-1340

Confucius once advised all job seekers: “Choose a job you love, and you will never have to work a day in your life.” I have always known that this ideal career would lie in the field of earth science. My studies and work experience in geology as I further my education at my university has only made me more certain that it is my passion.

I was lucky to be exposed to the earth sciences at an early age. Both my parents have geology degrees, and during much of my early life, my mother was working as an exploration geologist in northern Nevada. While other parents take their children on trips to Disneyland, mine took me to Berlin-Ichthyosaur State Park and La Brea Tar Pits. We spent weekend digging fish fossils in a river shale deposit north of my hometown, and every Christmas and birthday I received a scientifically accurate dinosaur model. It was not until later in life that I learned to appreciate what my parents did for me by stopping the car so many times to ask if the canyon we were driving up was formed by a river or a glacier.

When I was thirteen years old, I was given the opportunity to see how exciting geology could really be. My family moved to Indonesia when my dad took a job at a copper mine there. It was then that I had the chance to travel. I have fond memories of marveling at the enormity of Ayer's Rock, climbing a live volcano on the island of Java, and walking alongside the geothermally-heated Champagne Lake in Rotorua. I also saw the role geologists played in the field of natural resources and the part that they played in turning the vast, untamed wild into a busy, working mine, providing jobs for hundreds of people. Not only was I seeing more of the world during this chapter of my life, but I was also seeing what an adventure geology could be.

My interest in geology was rekindled as I started taking geology courses and going on field trips while at the University of Nevada, Reno. My interests went beyond what I had been exposed to previously to include engineering geology. I want to be a part of society’s need for geologists to work on construction and engineering projects to solve problems and improve the way we live in our country and throughout the world. As a geologist, I also want to be a part of finding the balance between the need for resources and environmental stewardship of our earth. After I graduate with a B.S. in geological engineering, I plan to attain a graduate degree in geology and work for a small natural resource company or engineering geology firm. Eventually, I hope to be able to work overseas myself to face new career challenges by working in different cultures and environments. Later in my career, I would like to return to Nevada and possibly start my own engineering geology firm.

Whatever career path I choose in geology, I know the future ahead of me will be exciting and may take me to the ends of the earth. And because I am going to work in something that I know I love, according to Confucius, I will “never have to work a day in my life.”

Anna Perry at Death Valley on a University of Nevada, Reno stratigraphy field trip in the Spring of 2008.
Garrett Mitchell, SA-1341

I became interested in the field of geology very early in my childhood. In fact, geology was probably my first hobby as I was fortunate enough to grow up on seven acres in the Maryland countryside with a stream that bordered our property. Our stream was an endless source of adventures and exploring for me that fueled my imagination about Earth processes and history. The first scallop fossil that I found on the stream bed one summer was so well preserved that I had thought it was a toy that someone had lost. It wasn’t until I brought the fossil back to my mother and grandmother that I was told that this was a remnant of a past world, an ancient world where most of Maryland was under a shallow ocean. This discovery and my interest in fossils provided me with many trips to the Smithsonian Natural History Museum in Washington D.C. and countless rock and mineral shows.

Finding this first fossil provoked an obsession for me with our stream and its discoveries. I would spend most of my days down by the stream exploring it in both directions for miles and searching for more fossils and rocks. Years passed and my interests turned from natural history to sports in high school to the sport of scuba diving. Scuba diving provided me with the long lost feeling of exploring new worlds that I had when I was younger and as I entered college, I was set on a career in marine biology and the study of coral reef ecology. As I became more involved in diving, I progressed from diving on relatively shallow coral reefs in the Bahamas to deeper decompression diving off the coast of California and the caves of Florida. My interest in geology and in particular marine geomorphology reemerged with dives on seamounts called the “Santa Barbara Alps” off the Californian coast. These seamounts were actually peaks of the smaller Channel Islands that were not high enough to pierce the surface and were essentially virgin unexplored mountain tops. These exploratory dives provided me with my motivation to pursue a career in the marine geosciences.

Currently, I am a junior at the University of Maryland, College Park and am pursuing a double degree with honors in geology and geography. My interest in tectonics and bathymetry has led me to working as a research assistant on campus with a geophysicist to study mid-ocean ridge tectonics through geodetic techniques and computer modeling. I would like to continue studying tectonics and mid-ocean ridge processes in a doctorate program after graduation.

I’d like to spend a career in scientific research by becoming a geologist to have what I had as a child – to explore and study little known regions of Earth, whether it is a new bend in my stream or a mid-ocean ridge. I’ve never met a geologist who didn’t have the childhood enthusiasm that I had when I was younger and I believe there is something very pure and special about that.

Why I Want to Be a Geologist

Nina E. Fitzgerald, SA-1280

As a non-traditional student with 20 years experience as an RN, I left that profession in 2004 and returned to school at Southern Utah University to pursue a Bachelor of Science degree in geology. I want to become a geologist because geology has been my passion for decades, and I realized that I can pursue my dream no matter the obstacles. When I finally do pass those blasted 2 semesters of calculus and 2 semesters of physics and walk in that graduation line, I know I will have accomplished something way beyond just getting up in the morning. I’ll throw that cap in the air so hard that my arm will probably go along with it.

I have been doing preliminary mapping (undergraduate research) in the Beaver Dam Mountains of southwest Utah. My senior project will be further mapping the metamorphic rocks of my specific study area which has never been previously mapped. The work I accomplish with my advisor in these mountains will have important implications for the tectonic history of the Mohave province of the southwestern U.S. The very fact that I can personally make a contribution to this field of study is why I returned to school and the primary reason I want to be a geologist.

After I obtain my BS I would like to continue on to the graduate level in metamorphic petrology. I would like possibly to teach, whether it is at the junior college level or as a naturalist in our national park system.

I am looking forward to having the rest of my life revolve around geology. I feel I can impart my knowledge and fascination with geology to everyone with whom I come in contact and do so with all the energy and enthusiasm the subject deserves.

Nina at an amphibolite outcrop in her study area at the Beaver Dam Mountains of extreme SW Utah.
Dear Editor,

When Is Information “Good Enough?”

I was at a dinner party the other day and was talking to with a gentleman from the intelligence community about Wikipedia and the intelligence analyst’s analogous version, called something like Intellipedia (I think I may have made up this name, but you get my point). I am a proponent of Wikipedia and occasionally use it judiciously to obtain quick reminders of a forgotten definition or the use of some technical terms or practices that have temporarily escaped me. I will usually follow up with additional confirming research. This dinnertime discussion centered on the reliability and accuracy of information that we find on the Web; especially on sites which are self-policing, like Wikipedia. My argument was that most of the time the information on the web is good enough for most purposes. The gentleman argued that “good enough,” but not totally accurate, throws the entire account into a credibility vortex.

My own attitude somewhat bothers me as a scientist, but was a necessary way of operating during my fellowship on Capitol Hill. The American Geological Institute was generous enough to sponsor me as a Congressional Science and Technology Policy Fellow in 2000 and 2001. As you may recall, those were years of tremendous national trauma, not only from September 11, but because of the anthrax attacks on Congress and others. As it turns out, our office in the Longworth Building was contaminated by anthrax spores that came to us through our Trenton mail. Although anthrax has been around rural communities for centuries, its use as a weapon of terror was new and the technical community was not set up well to respond (Makeig, Geotimes, February 2002). Being that I had decades of experience collecting and analyzing environmental samples and remediating hazardous waste sites, it fell to me to act as the technical advisor to our staff and my boss, the Congressman. Never in my life had I been asked by an earnest, young intern whether “they” had collected enough samples in our office to identify where all of the contamination was and had “they” cleaned it up sufficiently for us to safety go back in? To add to my anxiety, a briefing by the Physician of the Capitol’s office gave us information, but no recommendation as to whether we should receive the anthrax vaccine. How could I make such important decisions, based on the scant information that was available and my limited ability to interpret it all? However, we either did or did not get the vaccine and someone had to make that decision.

The dilemma of too little information was a daily occurrence on Capitol Hill. When lobbyists on two sides of an issue would come and talk to me, as a legislative aide, for 15 minutes each and the Congressman would ask me for my opinion about the wisdom of one position over the other, I was forced to make a decision. I had had a total of half an hour’s exposure to the issue, but the meeting was in 10 minutes and Congressman had to take a position.

During our careers we have to make all kinds of decisions based on limited data. As scientists, we are ravenous consumers of data. More data can reduce uncertainty and, therefore, our chances of rendering the wrong judgment. However, time and budget constraints rarely allow the practitioner to completely satisfy our cravings. So where do we draw the line and say that what we have is good enough?

If a car bomb goes off in India and Intellipedia reports that 25 people were killed rather than the 10 people who actually died, does it really matter? Of course it depends on a large extent on how the data will be used. When characterizing a site, it sometimes doesn’t matter whether the center of the plume has 10 or 13 ppm of deadly Ethyl Mertz; as long as the difference won’t bump things in another category. When the data are not available or are not validated to the extent dictated by “sound science,” can good judgments still be made? I argue yes – that’s what professional judgment is all about. Most of us are blessed with a logical and reasonable brain and a conscience. We are better than computers at seeing shades of gray, using intuition, drawing on past experience, and understanding the context. I often joke that I can do a site investigation using whatever budget my client gives me – I can do a $10,000 study, a $100,000 study, or a $1,000,000 study. It all depends on how much uncertainty we can tolerate. Will the million-dollar study allow me to render a judgment that is a thousand times better that the $10K study? I doubt it.

The following are some factors to consider when deciding how information is “good enough:”

• Define what questions to answer – This is not unique to studies with limited data, but essential to all of our work;
• Define the boundaries of the study – This may sound intuitively obvious, but knowing the magnitude of the study in the context of what resources you have allows you to pace yourself;
• Identify information that can uncover fatal flaws – This is looking for the dead-killers; if a facility containing hazardous materials is to be built next to a school, your limited resources should be focused first on that potential risk, not on characterizing the geology;
• Define the absolute minimal amount of information you need to provide a credible service – This is the amount it takes to pass the Red Face test; in my previous example, I obviously could not perform a credible site investigation for $100;
• Articulate an acceptable level of uncertainty – This is what you, as an honorable scientist, can live with and it is the level of risk your client is willing to accept; both of which are quantified as much as possible prior to accepting the assignment;
• Make sure what data you have is reliable – If you must be making decisions based on very limited data, you had better make sure what you use is accurate, credible and verifiable because any error will be compounded by applying an acceptable uncertainty factor;
• Use your skills – It is presumed that the reason the client is asking you to make a judgment rather than merely guessing is that you have experiences, training, education and judgment that can be used to reduce the uncertainties (unless he is just looking for someone to sue); and
• Don’t do it if you can’t live with it – Don’t let anyone force you into a position that makes you professionally uncomfortable.

This last point is a particularly interesting one. In most cases, clients are reasonable and, if the professional tells him that it can’t be done, they often will surrender the needed resources. However, there are times, like my Capitol Hill example, when the situation is controlled by external forces and there is no opportunity to extend the timeframe, obtain additional funding, or do more research.

Let’s assume that the client is reasonable and has listened to the professional. The professional has done the study, decided that it is good enough, and has delivered the report. How does the client decide whether the study is good enough? The prudent answer is that the client needs to understand the study so well that he or she can make an informed decision. So how do we get the client to understand the study? A concrete example of a site investigation may help. Let’s assume that the client wants to know if a facility containing hazardous materials is in an area where people might walk by it. The professional does an investigation, and based on the investigation, finds a plume 100 feet long, 30 feet wide, and 6 feet deep. Is it good enough? Based on the client’s request, it appears to be. However, the professional must explain that the 100 feet is just the center of the plume, not the extent of the plume. The plume could extend far beyond 100 feet on either side. Is it good enough? Based on the client’s knowledge of the extent and depth of the plume, it appears to be.

In order to provide a credible service, the professional must be able to communicate the uncertainties to the client. The client has a right to expect a credible service, and the professional has a right to expect that the client understands the uncertainties. The professional has a right to expect that the client understands the uncertainties.
Someone is going to be making a decision based on the scant available information. I would prefer that it be a well-trained, intelligent, experienced professional, if possible.

Katy Makeig, 
CPG-06137

Dear Editor,

The problem with developing an AIPG “Position Statement” on global warming, as called for by President St. Germain, is that it is not a geologic issue- and probably no longer even a scientific one. As with other planetary issues in history, it is more a matter of politics and religion.

It has become a slimy business. The advocates on both sides claim biased research on the part of those who contradict them. Even terminology has shifted to allow untenable positions a means of surviving scrutiny.

Human-Caused Global Warming has subtly been metamorphosed into Climate Change- a far more defensible concept than the original, rather specific one.

The president’s message calls for input from members who “…believe that carbon dioxide plays a major role in climate change…” “That is a far cry from the concept of Anthropogenic Global Warming. Carbon dioxide is a major constituent of our planet’s atmosphere. It pours from volcanoes, including those beneath the sea. It becomes dissolved in the aqua-sphere and is gobbled up by the biosphere.

In 1972, meteorologist, Edward Lorenz, delivered a speech entitled Predictability: Does the Flap of a Butterfly’s Wings in Brazil set off a Tornado in Texas?

It was an idea that had been around since the 1860’s. If that is the criterion for determining the possible influence of a minor phenomenon on the generation of a major meteorological event, one must indeed conclude that carbon dioxide has an influence on global warming- global cooling, global turbulence and any other meteorological or geophysical phenomenon one might put under the microscope.

Therefore, given the admissibility of the Butterfly Wing premise, one must conclude that former Vice-President, Al Gore, is right. Humans and their activities generate carbon dioxide, therefore they must be influencing the climate. But how much? Where? Everywhere? And are they causing warming, cooling, or what? One should remember that Mr. Gore did not study meteorology. He was a divinity student. Are we looking at history, politics, science, religion, or all of the above?

AIPG President, St. Germain, closed his message with a personal anecdote about some “…geologist from one northern European country who smiled and said… come up and live in my country… and we’ll see if your opinion changes.” I have no idea what that meant. Was this fellow snowed-in, awash in seawater, struggling with vegetation-gone-wild, or what? Where I live, the roofs of both the local supermarket and the Catholic church collapsed this year beneath an unprecedented winter snowfall. Does that mean we’re experiencing global cooling in Chama, New Mexico?

I wouldn’t try to convince any scientist I respected of such a conclusion simply by exposing him or her to such unique evidence as proof of a poorly understood and controversial phenomenon.

I repeat, as I began- the matter of global climate is not a geologic issue. We can say what we know about the past and suggest that we are experiencing a likely iteration of such an event. Does that mean we are not experiencing something new? You can’t prove a negative, just inject a bit of logic into the discussion. Logic suggests that phenomena that have repeatedly occurred in the past should be considered as a likely explanation for a current experience- especially if political devotion to a current, semi-religious agenda may suggest we adopt a new and poorly supported conclusion that has many possible sociopolitical ramifications.

My suggestion for an AIPG “Position Statement” would be Anthropogenic Global Warming- Maybe yes. Maybe no.

Consult your Spiritual Advisor
Charles R. Barnett, Ph.D.,
CPG-02107

OPINION PIECE-
Species Extinction

Dear Editor,

I applaud Mr. McClenny’s driving another well aimed stake into the heart of the shibboleth of anthropogenic global warming. However, apparently not wanting to let us off the hook, he invokes another shibboleth which probably warrants a stake of two, that of a current mass extinction. We have often heard that extinctions are occurring at a super rate (try one species per hour) unprecedented in the geologic record, AND IT IS ALL OUR FAULT!

First it is necessary to differentiate a species from a subspecies. For example, the Florida panther, on whose behalf much time, money, and effort has been spent, is a variety of mountain lion. If the last one should hand in his portfolio (and I am not advocating this), this would not be a species extinction, there are plenty of mountain lions left in North and South America, so many that they are eating people again. So we must differentiate species from subspecies. Since the extinction of the mega fauna at the end of the ice age, I am not award of a single mammal species that has become extinct in North American and less than ten birds species. Although birds and mammals are the tip of the iceberg of living species, this is not in the ball park of one extinction per hour. Thus, we must look elsewhere for our guilt trip.

We might feel guilty about deforestation. We are told that 50 percent of the world’s forests have been destroyed. Perhaps, but the largest forest in the world is the northern coniferous forest that circles the globe. There is some logging, but during the ice age it was obliterated under miles of ice some twenty times, each in a relatively short timespan, and always it grew back. I am not advocating deforestation, but I hope that those UN specialists that estimated the pace of deforestation aren’t the same as those who worked on global warming. It is well to put things into perspective. You may say, that was a short time geologically, but now we are at warp speed. How about the three supereruptions of Yellowstone Park, which produced thousands of times more magma, ash, etc. than Mount St. Helens? How many pupfish, insect, amphibian, and reptile species, to say nothing of bird and mammal species, become extinct in a flash? Or if you like the tropics (more species there) was Toba in Indonesia during the same time frame. I might also mention the mega floods in the channel scablands, an area in eastern Washington state larger than Maryland. Here during the last glacial advance an ice dam broke, reformed and broke again numerous times, many of these times releasing an amount of water greater than that in lakes Erie and Ontario combined. It took that huge volume of water just hours to reach the Pacific, much to the distress of anything in between. Just a perspec-
tive that we have company, nature sometimes goes into wrap speed in the extinction department, and I haven’t even mentioned rocks from space.

Well, how about all those creatures on the endangered species list? First we must realize that nature is not a seeker of equilibrium. Like with lemmings there are peaks and valleys. During a recent visit to Alaska the fisherman spoke of the largest pods of orcas they had ever seen, sweeping in on steller sea lion and sea otter colonies, and guess what, those species are suddenly declining. The marine mammal protection act cuts both ways. How soon will wolves in Yellowstone have to be managed to protect a declining elk herd? But this is how nature works, catch a species on a downturn with unusual (for it) environmental conditions and it leaves the scene as has 99% of all species that have ever existed. Life in the wild for species as for individuals is nasty, brutish and short. If we place polar bears, steller sea lions, sea otters etc. etc. on endangered lists for natural downturns, soon we will be managing the whole biota preserving here, culling there, trying to impose an unnatural equilibrium. At worst we will be wasting time, treasure, and natural resources on fool’s errands, like sequestering CO₂ to save polar bears (one wonders how they survived past interglacials without the help of the U.N.)

The upside is that new species evolve. Look at the mammals, forced into the nooks and crannies of the dinosaur’s world for 180 million years and still having enough genetic plasticity to evolve into whales. So yes, we should do what we can to protect the environment, but lay off the guilt trip, it may raise money and pass laws, but like the Nine Times Rule of McClenney we are in the 88.9% if we put on the hair shirt. Actually there may be a silver lining, human birth rates are falling and not everyone wants to live in an Al Gore sized house. It would help if we would exploit the minerals we need where they occur (including ANWR) and not waste our energy and resources chasing rumors, even if they provide wealth, awards, and political power to a few. Then we may remain rich enough to continue to be environmentalists.

Joseph P. Riva
CPG-03548
1. Which of the following rocks would you expect to be formed by the very rapid cooling of molten “mafic” material?
   a) Tachylite
   b) Obsidian
   c) Diorite

2. Isolated hills on the pediment of an arid landscape, depicting erosional remnants, are known as:
   a) Monadnocks
   b) Bajirs
   c) Inselbergs

3. The “Salpausselkä Ridges” define this type of geological feature:
   a) Tilted fault blocks along the Caledonian Mountains of Scandinavia.
   b) Terminal moraines in southern Finland.
   c) “Nappes” along the European Alps.

4. An earth material is tested in the lab through a series of triaxial compression tests. The table below depicts the relationship between the shear stress at failure (τ) and the normal stress at failure (σ), as recorded in kilobars.

<table>
<thead>
<tr>
<th>σ (kb)</th>
<th>τ (kb)</th>
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<tbody>
<tr>
<td>1.00</td>
<td>0.50</td>
</tr>
<tr>
<td>2.00</td>
<td>0.60</td>
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<td>3.00</td>
<td>0.80</td>
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<td>4.00</td>
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<td>5.00</td>
<td>1.20</td>
</tr>
<tr>
<td>6.00</td>
<td>1.40</td>
</tr>
</tbody>
</table>

What is the “Coulomb-Mohr” equation of shear strength for this earth material?
   a) τ = 0.30 + 0.18σ
   b) τ = 0.50 + 0.21σ
   c) τ = 0.10 + 0.56σ

Answers on Page 28
Some days I think I should have my head examined for trying to take on the climate change debate. Or stated more correctly, I should have had my head examined for having a group of colleagues take on the climate change debate while I am President. I wish I could offer words of wisdom, condense the Intergovernmental Panel on Climate Change (IPCC) report to a few eloquent quips or present reproducible scientific experiments that have been peer reviewed to show you the answer, but I can’t. Unfortunately, I don’t think anyone can. I think the science is too multi-disciplinary and complicated to try to boil it down to one experiment or one set of experiments. After all, we are talking about earth processes and we cannot conduct controlled system-scale experiments incorporating the full complexity of interacting processes that might be ideally required to fully verify or falsify the climate change hypotheses. This means we are left with conducting experiments on single aspects of the global climate system to refine our body of knowledge and then try to apply these secular system understandings to a global climate system.

This is why the body of knowledge is fragmented and unfortunately in my opinion there is enough isolated data in the peer reviewed community to allow a person to pick and choose scientific papers to support either climate change position.

As the President of AIPG, I have been involved in a number of climate change discussions with leaders of sister societies and geologists from all over the world. It has offered me a slightly different perspective than most. At one discussion, it became relatively clear to me that there was a growing concern from the anti-anthropogenic effects group (if I can call them that), that if they continued to staunchly claim that there is no data to support that climate change is caused, in whole or part, by anthropogenic effects, then they will be dismissed by the scientific and political community. Even some in the American Association of Petroleum Geologists (AAPG) who could be interpreted to be in the anti-anthropogenic effects camp, believes this to be true.

One of my greatest concerns with the climate change debate is that we need to be open-minded on this subject. Far too many of my colleagues including many members of the AIPG seem to have formed solid positions with a superficial understanding of the current scientific research.

Unfortunately, I don’t think we will ever really know the definitive answer to whether the observed increase in CO₂ has or will cause climate change. But ultimately society will have to make a decision balancing the relative risks associated with increasing CO₂ concentrations against potential mitigation costs. This wouldn’t be the first time society had to make these types of risk based decisions without scientific consensus and it unfortunately won’t be the last.
A member once questioned the activities of the national Executive Committee, which the member perceived as an exclusive club that spent AIPG resources to travel to various U.S. destinations to merely enjoy a good time. This erroneous perception couldn't be further from the truth. The fact of the matter is that the AIPG Executive Committee consists of member practitioners from all disciplines, all sectors of the economy, and various regions of the country who volunteer time and resources to support AIPG and set its course. It is true that three times each year the sitting Executive Committee meets in various regions of the country to conduct AIPG business as required by AIPG Bylaws and to meet with section membership.

Meetings are usually weekend meetings (including the Annual Meeting) imposing no small inconvenience on the part of the committee members. These member volunteers, all of whom are involved in earning a living, are willing to sacrifice time and energy to forge an organization that is dedicated to improving the professional standing of all practitioners. There is no personal gain accruing to these geologists, but there is the satisfaction of knowing that some of the decisions made will benefit all AIPG members and in many cases, all practitioners.

Frequently a member will question a particular decision or policy made by the Executive Committee. I typically respond that each member of AIPG has the prerogative of influencing the direction taken by the organization as a whole by simply making an opinion known to the Executive Committee members, or by devoting a little time to AIPG at the section or national level. All AIPG members have the opportunity to contribute a voice in establishing AIPG policy. The members of section and national Executive Committees are, in actuality, you. If you want to effect a change, you are able to do so through active participation!

The main point to make here is that the individual members of executive committees at all levels are deserving of recognition for the time, energy, dedication, and resources each contributes. It's been written often, and is no less true because of it, that the progress made by AIPG as a supporter of education and advocate for the profession is due primarily to the efforts of its volunteers. Thank you to all AIPG members who volunteer their time, energy, and resources to supporting the AIPG mission.

VOTE! A final note to encourage those of you who have not voted for the 2009 Executive Committee officers to do so now. Ballots will be accepted at headquarters through August 15. The hard ballot was enclosed in the May/June TPG and the electronic ballot is found on the AIPG website (www.aipg.org).

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
Power Point slides with review and self assessment questions.
AIPG accredited 1 CEU (with exam) or 0.5 CEU (without exam).
Reference CD available
To order the course or for more information go to www.aipg.org.
Ethics Codes and/or Conduct Codes

I periodically review the ethics or conduct codes of other organizations. Comparing these codes with AIPG’s Code of Ethics is always interesting. What are the differences? Is something included that AIPG does not have; if “yes,” it this something AIPG should consider?

I recently reviewed the Project Management Institute’s (PMI) Code of Ethics and Professional Conduct (CEPC). The most striking thing about the PMI’s CEPC is its explicit recognition of the difference between aspirational statements and mandatory rules of conduct. Most codes of ethics, including AIPG’s, mix aspirational statements and mandatory rules of conduct without explicitly identifying which is which and the difference between the two (see “Ethical rules and ethical ideals: both are needed,” column 63, April 2001; “Professional conduct codes versus professional ethics codes,” column 65, June 2001). Codes of Conduct by contrast are intended to be mandatory, although sometimes the rules are more aspirational in character than is obvious at first glance.

The PMI’s CEPC’s chapter on honesty provides a good example of the differences between the aspirational statements and mandatory rules.

Chapter 5. Honesty

5.1 Description of Honesty. Honesty is our duty to understand the truth and act in a truthful manner both in our communications and in our conduct.

5.2 Honesty: Aspirational Standards. As practitioners in the global project management community:

5.2.1 We earnestly seek to understand the truth.

5.2.2 We are truthful in our communications and in our conduct.

5.2.3 We provide accurate information in a timely manner.

Comment: an implication of these provisions is that we take appropriate steps to ensure that the information we are basing our decisions upon or providing to others is accurate, reliable, and timely.

This includes having the courage to share bad news even when it may be poorly received. Also, when outcomes are negative, we avoid burying information or shifting blame to others. When outcomes are positive, we avoid taking credit for the achievements of others. These provisions reinforce our commitment to be both honest and responsible.

5.2.4 We make commitments and promises, implied or explicit, in good faith.

5.2.5 We strive to create an environment in which others feel safe to tell the truth.

5.3 Honesty: Mandatory Standards

As practitioners in the global project management community, we require the following of ourselves and our fellow practitioners:

5.3.1 We do not engage in or condone behavior that is designed to deceive others, including but not limited to, making misleading or false statements, stating half-truths, providing information out of context, or withholding information that, if known, would render our statements as misleading or incomplete.

5.3.2 We do not engage in dishonest behavior with the intention of personal gain or at the expense of another.

Comment: the aspirational standards exhort us to be truthful. Half-truths and non-disclosures intended to mislead stakeholders are as unprofessional as affirmatively making misrepresentations. We develop credibility by providing complete and accurate information.

The foregoing quotation includes another feature of the PMI CEPC, the comments that are used to illustrate the concepts expressed in the various standards.

As noted above, AIPG’s Code of Ethics, like many professional society ethics codes, mixes aspirational statements with conduct rules. Standard 5.1 provides an example, “Members should strive to improve their professional knowledge and skills.” We are all encouraged to participate in Continuing Professional Development, but no specific requirements are included. Thus, Standard 5.1 is an aspirational statement. However, Section 2.3.11 of AIPG’s Bylaws requires that those who initiated their CPG application process after July 1, 2006 are required to participate in AIPG’s CPD program. For these CPGs, a minimum amount of reported CPD is now a requirement of continued certification (see column 113, January/February 2008).

Unlike the AIPG Code of Ethics and many similar codes that are organized by the relationship of the member to other groups (the public, clients, fellow professionals, etc.), the PMI CEPC is organized around four primary values that the project management community views as particularly important. They are responsibility, respect, fairness, and honesty (hence “honesty” is a chapter heading in the Code).

Codes of ethics or conduct can be organized in several ways and still cover the same concepts. This is the first time I’ve seen a code organized by key values. Organization by key values is a means of reinforcing the issuing group’s principles. However, my wife, Sue, who is a project manager and is seeking project management certification from PMI, noted that much of project management involves establishing and maintaining good relationships with various groups (clients, colleagues, other parties involved in a project, etc.). She wonders if a relationship-based organization for the PMI’s CEPC would make more sense. The organizational choice for a code of ethics is one of those issues that can be endlessly debated with good arguments for each choice. Ultimately a choice is made. The concepts addressed in the code can be adapted to any choice.
The PMI’s CEPC can be viewed at www.pmi.org/PDF/ap_pmicodeofethics.pdf. If the foregoing discussion intrigued you, please look at the whole PMI CEPC; it’s fairly short.

Does Certification Require Membership in the Organization?

Another interesting aspect of the PMI’s PEPC is its listing of who is covered by the PEPC. In addition to PMI members, the PMI’s PEPC also covers non-members who (1) hold PMI’s project management certification, (2) non-members who have applied for PMI certification, and (3) non-members serving PMI in a volunteer capacity. The PMI and American Statistical Association have the only professional ethics codes I’ve encountered that explicitly cover non-members. This non-member coverage has some interesting consequences when one is considering the disciplinary actions that an organization can bring. Most professional organization’s disciplinary sanctions, such as AIPG, are ultimately limited to expelling members who are found to have acted unethically. How can you discipline someone who is not a member? In PMI’s case, they can presumably withdraw or not grant their certification to the first two non-member classes and they can stop the volunteers from further work.

The interesting implication of the first two PMI non-member classes is that PMI grants project manager certification to non-members, that membership is not required for obtaining or maintaining one’s certification. AIPG’s certification requires that one be or become a member when one applies for certification and that one must maintain one’s membership in order to maintain one’s certification and other membership privileges (AIPG Bylaws, section 2.7.4). Most organizations have similar provisions.

How Safe is Fieldwork? (columns 113 & 115, January/February and May/June 2008)

While surfing through the AAPG Bookstore’s website for something else, I ran across Field Safety in Uncontrolled Environments by Stephen R. Oliveri and Keven Bohacs, 2005. The product description on AAPG’s website states, “Field activities are normally safe, but accidents do happen and consequences are potentially so serious that measures should be taken to reduce the risks. The field safety program elaborated in this book is straightforward, widely applicable, and scaleable to the wide range of field activities, from short roadside stops to month-long backcountry expeditions. It applies to all field activities, identifying the roles and responsibilities that must be addressed in pre-trip preparations, field operations, and post-trip follow-up. This manual is both an overview of the field safety process and a template for creating individual programs. Included are digital versions of the checklists and forms for easy customization.” This 150-page book plus a CD containing a wide variety of forms for planning and organizing safe field trips is something those of us conducting field trips and most of the rest of the geoscience community should buy; it’s $22 plus shipping & handling. Go to www.aapg.org, click on “Bookstore” on the yellow ribbon near the top, and search on “safety” in the title.

Active volcanoes are inherently dangerous and fascinating places to work. The volcanic rock part of my undergraduate field geology course was a 3-week visit to active volcanoes in Guatemala and El Salvador. It was a fabulous experience generally and spending a couple of days at Santiago, an active felsic extrusion dome on the western flank of Volcan Santa Maria (similar to the currently active dome on Mount St. Helens) was a real thrill. Never mind the unstable rock slopes and steam vents containing a few percent HCl, which rusted my then new Estwing hammer—I still have it. We all wore hard hats and did delay people up and down particularly unstable slopes.

Victoria Bruce’s, 2001, No Apparent Danger, the true story of volcanic disaster at Galeras and Nevado del Ruiz: HarperCollins Publishers, 239 p., describes two volcanic disasters, the sub-ice eruption and resulting mudflows from Nevada del Ruiz in November 1985 that buried a number of towns killing over 23,000 people and the minor eruption on Galeras in January 1993 that killed 9 and critically injured several others. Bruce describes the geoscientists at both events and the steps they took that either contributed to or helped mitigate subsequent events.

In particular, the discussion of the January 1993 on Galeras provides another example of a field safety event. The field trip leader and a number of other volcanologists on the trip laughed at the fellow from Los Alamos who had a hard hat, a gas mask, and fire-retardant coveralls. The field trip leader also ignored seismic events indicating an apparent eruption. He studied volcanic gases and the gas measurements didn’t indicate an imminent eruption. A number of other safety precautions employed at Galeras a few years before by USGS volcanologists were not employed. During the
eruption, the safety equipment worn by the fellow from Los Alamos didn’t prevent all injuries, but they did prevent some. The field trip leader suffered severe head injuries. The Galeras story relates a number of safety practices followed and not followed when working in a dangerous environment. One of the striking differences was between the Los Alamos team, who came from a very safety-oriented institutional culture and the academic professors who did not. No Apparent Danger is a worthwhile read for a variety of reasons; get a copy and enjoy Bruce’s good writing and consider the field safety issues she presents.

Ethics Question #1: Switching Sides

I’m starting a new section of this column, an “Ethics Question.” The “Question” will be a case history along with some relevant questions. Please contribute your answers, observations, opinions, etc. about the “Question.” These will be included in the subsequent issue. Remember, your published response will provide evidence that you spent some time studying professional ethics, as required by some CPD programs.

The question for this issue: 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?
I was struggling to come up with a topic which is why I missed writing an article for the last issue and was worried about coming up with something for this one. But I was saved by a contract that I was asked to review on behalf of an insured. This contract was from a major financial services company that was looking for engineering services from my insured. The main body of the contract was 45 pages which is not a good sign. The first section of the contract contained a preamble entitled “Commitment to Project Goals”. The engineer is being expected to commit to the listed goals as well as any that may be amended by the Owner during the course of the project. The wording does not say whether or not the engineer has the right to refuse or negotiate the owner’s amending the project goals. This could be problematic if the owner decides to amend the goals with something like “the engineer shall provide design documents with zero defects”. I’m taking the point to the extreme but it is something to think about. There are no design documents that are completely error free.

Now let’s look at some of the goals that have been written into the contract:

“To provide complete engineering services for the Project in conformity with the design team here. The Owner has the final decision on what type of building they wish to have designed and constructed. They can either go for the Cold War-era Trabant or go for the first-rate state of the art facility.”

This clause puts responsibility on the design team to accomplish the business objectives of the Owner. The engineer is there to design the project to the agreed upon scope of work. This may or may not be in agreement with the business objectives. This seems to be a nebulous area and could cause some problems down the road.

“To fully utilize all available Project resources to as to maximize the usages and benefits obtainable by the Owner”

There may be situations where the maximal usage and benefits by the Owner contradict building and/or life safety codes. This sentence as it stands does not appear to allow for that possibility.

“To meet all schedule and milestone constraints established by the Owner”

This would seem to require strict compliance with the schedule and milestones. Does this allow for delays due to unforeseen conditions such as weather, materiel or labor shortages, etc?

“To incorporate the Owner’s marketing strategies and initiatives into those elements of the Project that must complement and assist such strategies and initiatives”

What marketing strategies have to do with the engineering is beyond me. This would seem to be something that the Owner would take into consideration as part of their decision making during the design process. Seems like the Owner is really trying to push responsibility on to the design team here.

“To provide complete engineering services for the Project in conformity with the Project Budget established by the Owner”

The usage of the word “complete” potentially raises the standard of care. I would take the word “complete” to be the equivalent of “perfect” or “error free”. As I discussed above, there are no error free design documents.

“To provide complete engineering services for the Project such that it will result in an enthusiastic response from each of the different user groups who will occupy the Project”

Huh?!? Enthusiastic response?!? How do you measure this? Especially if one of the user groups are accountants or actuaries? When was the last time you saw an enthusiastic accountant? All joking aside, the engineer is being asked to achieve an undefined and possibly indefinable goal.

Scope of Services

In the scope of basic services the Owner included the following:

“The Engineer is aware of the nature and scope of the Project and acknowledges that the design is contemplated by the Owner requires the Engineer to provide complete and coordinated engineering Drawings and Specifications consistent with a first-rate, state of the art facility.”

I’ve already discussed the issue with the word complete. The biggest problem with this section is what is a “first rate, state of the art facility”? The Owner is actually expanding the standard of care here. The Owner has the final decision on what type of building they wish to have designed and constructed. They can either go for the Cold War-era Trabant or go for the first rate state of the art Ferrari. The engineer and the rest of the design team are expected to design either choice to the standard of practice in existence at the time and location of the project. With this wording above the Owner could actually attempt to claim that the Trabant-equivalent that they requested wasn’t first-rate and state of the art. Again the Owner is trying to shift responsibility to the design team.
Construction Documents

“The engineer shall ensure that the Construction Documents are 100% complete, fully dimensioned…”

No engineer can ensure that anything they do is 100% complete or correct. Yet another example of how this contract is redefining the standard of care for the engineer.

Value Engineering Items

“The Engineers shall, as part of its Basic Services, be responsible for the review, approval and incorporation into the Construction Documents of all value engineering items proposed and/or incorporated in the Project.”

This clause taken by itself does not seem to allow the engineer to reject value engineering items that might not be good engineering practice. The Owner continues to dictate engineering practices through the contract language.

Coordination

“The Engineer shall coordinate the Engineer’s Services with the services of the members of the Project Team so that the Drawings and Specifications and other documents prepared by or on behalf of the Engineer and the members of the Project Team, collectively and as a whole, comprise a complete, accurate, coordinated and fully integrated set of Drawings and Specifications that provides complete, clear and consistent data and information.”

Looks like the engineer is going to be responsible for having the project team play nicely in the sandbox. Not only that they have to make sure that the systems that the various members use will coordinate effectively. This might not be possible given different software packages and/or versions of software that might not talk to each other well. Combine that with words like complete, accurate, fully integrated, and clear and you have a recipe for trouble.

“The Engineer shall ensure that the Drawings and Specifications and other documents prepared by the Engineer and the members of the Project Team are complete, include all items customary or desirable for a building of the type and nature of the Project, and contain all information necessary to complete construction in a high quality manner.”

Where do I begin with this clause? Any time you see the word “ensure” in a contract, warning bells should go off. The client is requiring the engineer not only to make sure that their deliverables are “complete” but also those of the other members of the design team. The engineer is not in a position to properly evaluate the completeness of the architect’s deliverables or even other engineers providing services outside of their area of expertise. The engineer or the other designers on this project have no direct control over whether the construction can be completed in a high quality manner. The construction means and methods are the responsibility of the contractor. A professional liability policy does not provide coverage for construction defects.

Send comments to: Martin Andrejko, CPG-08512, Assistant Vice President, XL Design Professional, 520 Eaglevieu Blvd., Exton, PA 19341, (610) 321-9227, Fax (610) 458-8667, e-mail: martin.andrejko@xlgroup.com

National Executive Committee Votes to Increase Membership Dues

The Executive Committee met on May 17, 2008, and discussed the 2008 budget. Executive Director Bill Siok presented to the committee the projected shortfall in the budget because of additional unexpected expenses in IT consulting, in needed upgrades to the network, software upgrade purchases, replacement of the 20 year old telephone system, and general higher expenses on all services related to the escalating energy costs. The members of the committee did not want to eliminate any membership services to reduce expenses. After much pro and con discussion a measure passed to increase dues by $5.00 for CPG and Members as well as $10.00 for Non-Practicing Members for Fiscal Year 2009 and beyond. Associate and Student Adjuncts dues are not changed.

Submitted By Treasurer
Ron Wallace, CPG-08153

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Duane A. Carey, CPG-10305

C’mon, admit it. At some point in your career you’ve hung up the phone and muttered “My clients are just plain stupid!” Granted, you over-reacted and didn’t mean to use such strong language, but you had clearly told them several times “that’s not how we do it here”, and you even gave them detailed explanations as to why. But they kept expecting something else, hence your very negative judgment of their cognitive capacity.

Of course, they’re probably not stupid, are they? But they are self-centered. Clients, like all people, are concerned with their own wants and needs, and tend to fit the information you provide into their own precast mold. The specific information that does not fit their concept of how things should be is simply discarded. This is why it’s so tough to have rational conversations about politics or religion (or global warming) with someone opposing views: they won’t let the facts get in the way of their pre-conception.

This is why otherwise intelligent people can hear something 14 times, yet still not seem to absorb it. They’re always operating from their own point of view and in their own interest. This is natural behavior. If you react badly to this behavior, you will lose your client. If you go into situations expecting this behavior and have a plan to handle it, you can gain a client for life.

Disney Does It Right

In his book Secret Service, John DiJulius recounts a great story about the Disney Corporation, which is a true leader in customer service. DiJulius had been waiting in line at Disney World for about an hour with his six-year-old son, who was very excited to ride a roller coaster. When they reached the front of the line, the teenaged attendant empathetically explained that the boy was not tall enough to go on the ride, pointing out the measuring-stick signs that were posted all along the waiting line, and emphasizing the focus on safety. The father had obviously seen these signs, but the message didn’t sink in – he just wanted his son to have his much-anticipated roller coaster ride.

So how did the teenager respond to the father who didn’t read the signs? Did he say “Dude, read the signs, your kid’s too short”? After all, can you image how many times a day this happens. The attendant must hate dealing with these “stupid” people who don’t read the signs, right? Nope. Not at Disney, because they’ve been properly trained to anticipate such situations. The teenager bent down and asked the boy, who was on the verge of tears, for his name. He then said: “Jobi, I’m going to give you a certificate with your name on it. This certificate says that the next time you come to Disney World you will be tall enough to get on Twilight Zone, and you won’t have to wait in line. All you’ll have to do is walk right up to the front of the line, show this certificate, and you’ll go on the ride without waiting.”

The boy’s mood changed from sadness and frustration, to joy and anticipation. He felt like a VIP: no waiting in an hour-long line for him, he could march right up to the front and get on his ride. Disney handled this brilliantly and all parties involved were winners. The boy won because he has something wonderful to look forward to. The father won because he could now walk around the amusement park for the next several hours without a sobbing or whining child, upset because of foolish mistake of the father. Disney wins in many ways. First, it gains the gratitude of both the father and the son for handling things so well. Second, it has just created perhaps the best marketing opportunity possible: every day for the next two years, the boy will walk up to the refrigerator, gaze at his VIP certificate and ask “Daddy, am I big enough to go on my ride yet?”. Rest assured, as soon as he is, the family will be back at Disney World.

What are the recurring misunderstandings in your business? What is it that clients just don’t “get” about the way you do things? What do they complain about most? Even if you know you’re right and they’re wrong, how could you change these things to make your clients happier?
Plan for Good Client Service

Intuitively, you probably know how aspects of the service you provide are annoying to your customers. But have you ever placed yourself in their shoes and walked through the entire process? Do so, with a completely open mind, and you’ll gain a lot of understanding about how to keep clients for life.

Set aside a couple hours in a quiet office and map out a client retention plan. I think an outline format works well for this. Start at the first contact your client or prospective client has with your company. The first “contact” might actually be an ad in a trade journal, a referral, or a chance meeting at a conference, but for this exercise let’s assume that the client has been acquired and is now ready to start working with you. From the start, how is he treated? Does the receptionist greet him by name and welcome him as a new client? What about your contracts – are they overly oppressive or unreasonable so that he feels like he needs a law degree just to work with you? At the first meeting, do you do more talking or listening? Do you remember to thank your clients for their business?

Whatever the issues, get introspective and walk through all the typical client interactions. Identify at least five things clients most often dislike. Identify at least five things they wish you offered. Look at all the clients who no longer do business with you and objectively ask yourself why they left. For the long-term, happy clients, objectively ask yourself why they’re happy. Once you’ve looked at the existing interactions, next look at the things you could do to be proactive. Can you alert your clients to impending legislative issues that might affect them? Can you contact them in advance of certain regulatory deadlines with a friendly reminder?

The planning exercise itself will force you to look at the little things, the little interactions with your clients that can make or break long-term, mutually-beneficial relationships. Don’t put this off - do it this weekend. You’ll be surprised by what you find.

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

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Why are you taking this Introductory Geology Course?

At the start of every new semester, faculty teaching introductory courses ask their students for personal information to get a better idea of the demographics of the class. They ask about previous geology classes the students may have taken, in order to get a better understanding of how familiar the students are with geological concepts. Similar questions also typically inquire into the student’s educational background in math, chemistry, and/or physics. Since geology is an interdisciplinary science, it is nice to know how much of the basics will need to be covered during the semester. There may be student specific questions about alternative contact information or required disability accommodations that should be known at the start of a class. Then, sometimes tacked on at the end, there is the question, “Why did you choose to take this course?”

Believe it or not, “Why did you choose to take this course?” can be a very powerful question, particularly for an introductory geology course. Answers like, “to fulfill a requirement!” or “because I needed a lab science” are typical. As the instructor in that course, these answers tell you that you may be faced with quite a number of people that may or may not be interested in what you will be teaching all semester. Some students give a little more detailed information in their responses, like “to fulfill a requirement and because geology seemed interesting” or “because I needed a lab class and I don’t like chemistry or physics”. These answers show the professor that although the student had to take the class because of a requirement, he or she chose geology over all of the other options.

So, “Why geology?” Maybe the student just likes rocks or maybe he or she just wanted to learn more about the mountains that he or she regularly hikes in. These types of students have always populated introductory geology courses. They know what geology is about and they are interested in learning more. Yet, not all of the interested students are rock hounds and geology buffs. This once again brings us back to the question of “Why geology?”

Some of the more detailed responses I have been receiving from students provide more than just insight into the personality of the introductory student, they reflect current events and societal trends. Here are some examples of the more interesting responses I have received. See if you can identify the unifying theme.

- “I want to know more about it (the environment) not only because I find it intriguing but also because I think it’s my responsibility to know more about what goes on around me.”
- “I have seen many changes in the environment in the short time I have been here. I am looking to have a deeper understanding of what happens in our world on an environmental level, and why it is so.”
- “I was interested in taking this course because of all the recent controversy about global warming and I’m hoping to get a better understanding of the issue.”
- “I am taking (this course) primarily to get a better understanding of global warming and learning why the Earth is changing so drastically. Global warming seems to be a big topic of conversation these days and I would like to finally have the opportunity to give my opinion on it.”

Other responses I have received express a desire to share what was learned in the class about global warming with others and even inquired about ways to be “eco-friendly”.

The public discussion over global climate change seems to have had an additional, unintended effect on the geoscience community, that of increasing interest in geology as a subject. The public has been barraged by the news media over the past couple of years regarding global warming/global climate change. The whole controversy of whether or not global climate change is really happening and if it is anthropogenic (a discussion which will not be addressed here) has forced the public to think about the world in a different way. The issue is not going away and I get the feeling that in general people want to know more about the science behind the controversy, either to form their own opinions on the issue or to form a feeling of stewardship about the planet and the environment around them. What better place to go to learn more about the way the Earth works than an introductory geology course? That means more butts in the seats and perhaps over time an increase in geology majors.

There is, however, a fairly large disconnect between an interest in geology because of global climate change and a command of geological concepts. The average layperson has no concept of the structure, composition, and internal workings of the Earth below the surface that they walk on and no concept of the scale of geologic time. Some students walking into the introductory courses truly believe that the internal heat struc-
ture of the Earth is being profoundly affected by a few degrees change in the average global temperature at the surface. They view any global climate change as catastrophic and do not have an appreciation for the variety of climatic conditions that are thought to have existed on the Earth in the distant past. The tone of the media and the limited time frame in which climate change is presented has lead to this skewed view of the current state of the Earth. Although global climate change will be a challenge for the human race to face, it is not going to lead to the complete destruction of the Earth itself. Misconceptions aside, however, once a student is in the class, that student will be gaining a better appreciation for the Earth and learning a lot more about what is going on below his or her feet. He or she becomes one more informed member of the public that can (hopefully) better critically evaluate the popular media.

So, once the class ends is that the end of the student's foray in to the study of geology? How does one take a simple interest in global warming and develop it into a desire to be a professional geologist (hydrologist, consulting geologist, petroleum geologist, mineral exploration geologist, etc.) without just creating another climate change researcher? I can't really say that I have a good answer for that question. Acknowledging a student's interest in the health of the Earth is a start. If he or she is interested in global climate change, it may not be that far of a leap to think that he or she may also be interested in pressing environmental issues, such as water resource management, which is a current problem related to the effects of climate change. The root cause of why we become geologists could expand from a love of the outdoors and a love of rocks to a desire to address geological effects related to global climate change. It's all a matter of taking advantage of current events and having the right perspective when recruiting students.

Controversy and discussion is good for science, but I think it is time to realize that regardless of whether or not we (as geologists) present a united opinion, we have the spotlight of public attention. While we may argue about the science, we should also notice that we are getting the attention of today's student. Today's student could very easily become tomorrow's geologist. Today's student may also be tomorrow's public policy maker, public school teacher, and even future customer of our consulting services. Now is the time to educate the public and get them interested in more than just the controversy. After all, geology is cool, geology is exciting, and geology can help you make sense of the changing world around you. So, come on in and learn! We won't mind if you get comfortable and stay a while.

If you have any ideas, questions, or comments about this article or any other issues, please feel free to contact me via email at: nancyaprice@yahoo.com.
1. The answer is “a” or “tachylite”.
   “Tachylite is the glassy counterpart of basalt, sometimes found in the rapidly-chilled borders of mafic intrusions and in the crust of mafic volcanic flows. “Tachylite” glass is nearly anhydrous, while “palagonite” glass is a hydrous version formed when the molten material is discharged into water or under ice (such as the ones found in Iceland).

   In contrast, “obsidian” glass ranges in composition from “granitic” to “tonalitic”. Although usually black with conchoidal fracture, dispersed hematite can give “obsidian” a red or brown color. Some “obsidians” exhibit phenocrysts of feldspars or quartz.

   “Diorite” is the plutonic counterpart of “andesite” and constitutes a quartz-poor, sodium plagioclase-rich intermediate igneous rock.

2. The answer is “c” or “inselbergs”.
   “Inselbergs” are erosional remnants or isolated hills on the pediment of an arid landscape, characteristic of the late stages of the erosional cycle in arid climates.

   In contrast, “monadnocks” are the erosional remnants rising above the pediment of stream-eroded landscapes. “Monadnocks” are characteristic of the late stages of the erosional cycle occurring in regions with temperate climates.

   “Bajirs” refer to lakes or ponds found in desert areas on the flat bottoms of basins separating sand dunes or hills.

3. The answer is “b” or “terminal moraines in southern Finland”.

   “Salpausselkä” is an extensive ridge system left by the ice age in Southern Finland. The ridges constitute terminal moraines formed during the “Younger Dryas” period, approximately 12,700 to 11,500 years ago.

4. The answer is “a” or “τ = 0.30 + 0.18σ”.
   Plotting the points from the table allows us to determine the line of best fit and, thus, the linear “Mohr envelope” that defines the strength of this material under these conditions. The “y intercept” on the graph defines the cohesive strength or “cohesion” (c) and the angle between the “Mohr envelope” and the horizontal depicts the “angle of internal friction” (Ø) for the material. The coefficient of friction is defined as the tangent of the angle Ø. In this example, “c” is found to be about 0.30 and Ø about 10 degrees, so that tan Ø is 0.18. Thus:
   \[ \tau = c + \sigma \tan \Theta \]
   \[ \tau = 0.30 + 0.18 \sigma \]

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*As defined by the American Geological Institute, a geological science is any of the subdisciplinary specialties that are part of the science of geology, e.g., geophysics, geochemistry, paleontology, petrology, etc.
2008 RM-URISA Scholarships

Rocky Mountain URISA is proud to announce three scholarships for 2008: $1,000, $500, and $250. Applicants must fulfill the following qualifications to be considered:

1) Must include a project, paper or visual presentation (such as a map) which makes effective use of GIS and focuses on the purpose of RM/URISA. The Urban and Regional Information Systems Association (URISA) is an interdisciplinary society of professionals dedicated to stimulating and encouraging the effective application of information technology and integration of urban and regional information for decision making.

2) Complete an application (available at www.rm-urisa.org).

3) Be a current RM/URISA member

4) Currently enrolled student in a GIS (or closely affiliated) program at an accredited institution

5) The applicant must either live in Colorado, New Mexico, Utah or Wyoming or be enrolled in a qualified program within those four states.

Please send any questions to scholarships@rm-urisa.org. Deadline for submission is Sunday, August 31, 2008. Look for this and other announcements at http://www.rm-urisa.org/news.html

National Ground Water Research and Educational Foundation Awards $7,000 in Scholarships

The National Ground Water Research and Educational Foundation (NGWREF) awarded a total of $7,000 to five students from its Len Assante Scholarship Fund, Foundation President Scott Fowler, CWD/PI, announced today.

Jennifer Teeple of Toledo, Ohio, won the Past President’s Award—the top scholarship presented to the most qualified of the applicants. Teeple, who is attending the University of Toledo to study environmental science and geology, received $2,000 toward her education.

The other recipients are:

* Jeanne Eckhart of Bandera, Texas: $2,000 for the Ora Lyons Scholarship named in honor of a former distinguished National Ground Water Association (NGWA) member. Eckhart attends Texas A&M University and is studying environmental science and geology.

* Guleed Ahmed Hussein Ali of Tucson, Arizona: $1,000. Ali attends the University of Arizona, studying geology.

* Jonathan Love of Petersburg, Illinois: $1,000. Love attends Western Illinois University to study geology with a focus on hydrogeology. He is minoring in natural resources and conservation.

* Elliot Matthews of Easton, Kansas: $1,000. Matthews attends the Colorado School of Mines, studying geological engineering.

AGI Releases Geoscience Enrollment Data

Alexandria, VA - The American Geological Institute (AGI) Workforce Program has announced the 2007 enrollment and degrees granted in the geosciences statistics in the latest Geoscience Currents. Enrollment rates have remained steady for 2003 and 2004. AGI has compiled enrollment data since 1955 and tracked the number of geoscience degrees granted since 1973. You can view the complete data set at http://www.agiweb.org/workforce/.

Geoscience Currents provides data snapshots and short reports to shed light into the issue of the overall health of the geoscience profession. From scholarships to employment opportunities, the effect of retirements, to university enrollment trends, Geoscience Currents provides up-to-the-minute glimpses into all areas of the geosciences, from academia, government, and industry to educational opportunities and university demographics.

To subscribe to this free service go to http://www.agiweb.org/workforce/ and click “Register.” Also on the website are previous Geoscience Currents issues and other reports completed by the Workforce Program, as well as other resources pertaining to geoscience careers.

The American Geological Institute is a non-profit federation of 44 geoscientific and professional associations that represents more than 120,000 geologists, geophysicists and other earth scientists. Founded in 1948, AGI provides information services to geoscientists, serves as a voice of shared interests in the profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in society’s use of resources, resiliency to natural hazards, and interaction with the environment.

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For more information, contact rfonf@geosciencedm.com, sbishop@geosciencedm.com, or visit our website at: www.geodm.com or www.aipg.org. Robert Font, Ph.D., CPG, PG, EurGeol - Author

“The need for bright young people in the ground water professions has never been greater than today. The demand for safe drinking water and protection of our precious ground water resources is at an all-time high and increasing,” Fowler said. “Our scholarship recipients represent great hope for our industry and for those who rely on ground water.”

Under the NGWREF scholarship program:

* Scholarships are granted for full-time undergraduate study (available to high school graduates and students in four-year programs and well drilling two-year associate degree programs)

* The applicant must be entering a field of study that serves, supports, or promotes the ground water industry

* A 2.5 GPA is mandatory for high school or college students

* Previous scholarship recipients are ineligible.

Established in 1994, NGWREF is operated by NGWA as a 501(c)(3) public foundation and is focused on conducting educational, research, and other charitable activities related to a broader public understanding of ground water. The Foundation is an arm of NGWA that is focused on activities related to a broader understanding of ground water. For further information, contact Cliff Treyens at (800) 551-7379, (614) 898-7791, ext. 554, or ctreyens@ngwa.org.
Is it just me, or does the international clamor to fight climate change by turning plants into fuel set off Defcon 4 warning lights for anyone else? To follow up on my May-June discussion of climate change and the good, the bad, and the ugly of efforts to avert global catastrophe, I’d like to point out what I think is the most uninformed issue we now face. As a result of misinformation and shortsighted perspective through which the public has been shown climate change, a severely misguided effort has been implemented, with plenty of backing.

This effort is not just misguided. It’s more like treating a headache with a lobotomy. The biofuel movement literally threatens to starve us all out before the piña-coladas and sunblock even start flowing. Most importantly, THIS is a prime opportunity for us, as geoscience professionals, to really step up and advocate for the betterment of humanity.

Since climate change has reached the pinnacle of the international issue pantheon, biofuel has emerged as the frontrunner in the race to replace fossil fuels. People everywhere are hooked on the concept of growing our fuel, from Presidents to grandmothers. The mentality is apparently “what could be more renewable than plants?” But the reality is a whole lot of things, actually, when you can see beyond the facade of semi-truths that have been used to propagate this hoax.

As I said in the last issue, I am all for sustainable development and renewable energy, for a host of reasons. There are fewer bigger fans of the concept than myself. By rushing, however, into something as drastic as replacing the fuel on which Earth’s economy operates without considering all the consequences, and not so hidden costs we see at the grocery store, we are doing more harm than good. Biofuel is the poster-child here.

Biofuel is really nothing new. Biofuel has been around since before Henry Ford and George Washington Carver were toying with the possibility. As a result there are countless sources of biofuel today; made from corn, soy, sugarcane or basically anything organic. Some forms of biofuel are reasonable, such as those made from waste products, though ultimately “recycling” plant waste by converting it to fuel is robbing the Earth of what it would have recycled on its own anyway. Research is progressing at a break neck pace now to find more effective and efficient biofuel sources, and some concepts, such as utilizing algae and closed loop systems are actually very promising.

What is most concerning is the overarching trend to meet demand now by turning perfectly good crops into fuel sources producing that fuel. While biofuel has been produced and consumed in other nations for years, it has always been a fringe product in the US, used as little more than a fuel additive. Its promotion here began to grow considerably within the past 20 years thanks in large part to heavy lobbying by the massive agri-businesses who are profiting from subsidies as more and more emphasis is placed on biofuels.

One of the most glaring faults in using food sources for fuel is that this removes food sources for a growing population, a population that the UN claims will need at least 50% more food production by 2050. I’m not going out recording any hit singles to fight famine in Africa, but common sense still screams to me that putting corn into a gas tank instead of a hungry stomach is a little ridiculous. You can put gas into a gas tank, but you can’t put gas on the dinner table. On principle alone, that should set off some warning lights. Beyond diverting plants from consumption to combustion, it further keeps food from many by lowering the supply and raising the price of crops that are actually for eating. Global food prices have spiked and in some cases doubled in just the past few years since interest in crops as fuel has grown. This trend will continue with staple foods like corn filling two roles as primary commodities traded, and with appropriately astronomical prices.

The more those prices go up, the more valuable fallow land is that could be growing these crops. So while the point of expanding biofuel use in the first place was supposedly to combat carbon emissions, farmers across the developing world are clear cutting and burning forests, which were huge sinks for that carbon, to grow their new cash crops. Effectively this not only releases tons of carbon in the deforestation process, but likewise destroys the trees earth uses to recycle carbon on its own.

Forget about the climate and the carbon for a minute though. The biggest piece of the puzzle that most are missing here is that it’s not just sun and water needed to make these plants. Every field planted and crop burned off as fuel is equivalent to burning off a little pile of soil. And that’s not taking into account the real loss, coming from the increased plowing and working of fields. David Montgomery, in his October 2007 GSA Today article “Is agriculture eroding civilization’s foundation?”, highlights the serious levels of erosion we currently create with modern industrial farming.
techniques. Especially responsible is large scale monoculture, which not only leads to soil erosion but degradation as key components are lost depending on what crops are habitually planted. With farmers planting extra fields to cash in on the high prices they’ll garner, it’s nearly certain they will continue to forego crop diversity in favor of the higher payday. This is all leading to the conversion of more forests into farmland, and exponentially more soil erosion. Montgomery hints to biofuels having an effect on erosion at the end of his article, but the impact is shaping up to be huge rather than a side note.

Montgomery also discusses the critical role of viable soil to civilization. As a double major in history at school, I’m frequently studying the ebb and flow of civilizations throughout time. Jared Diamond’s Guns, Germs and Steel says it best, with great examples to correlate a civilization losing the ability to grow its own food with the subsequent collapse of that civilization. Sure, the argument can be made that in today’s globalized economy and with modern, reliable methods of transportation we can hypothetically import any food we needed. But we have a tough enough time begging OPEC to be reasonable with oil, never mind food. Dinner is a heck of a bargaining chip for somebody to hold over your head, and I for one would prefer to stay out of that mess.

Thankfully, some are getting the point. Recently, articles and studies have run in many publications, including National Geographic, Science, and countless newspapers, calling this fad for the boondoggle it is. Even Rolling Stone published a particularly to-the-point piece on what a load of manure this agribusiness is. The vast majority of these articles, however, have concentrated on just the carbon-emission realities of biofuels, which by all means should be enough to convince any rational person of how ludicrous this whole thing is. But the piece everybody still seems to be missing is the fact that growing fuel is not ultimately renewable! Soil is the second most valuable resource to organisms, period, never-mind humans. All of this abuse will result in the need for large scale commercial fertilization of soils to maintain their fertility, and the significant additional cost of acquiring and processing those fertilizers, all one of the hidden costs of such intense monoculture. So until somebody invents a giant bedrock mulching machine that churns out farm ready loam, we need to do all we can to ensure that we use our existing quality soil and land in the most effective way for the long haul.

Even with this backlash, it’s not enough. The US senate passed legislation mandating a steep increase in biofuel production by 2022, while maintaining the subsidies that pave the way in fields of gold to get there. If you caught any of the buildup to January’s Iowa Caucuses, like me you probably sat bewildered as each of the presidential candidates praised corn farmers and ethanol as the messiahs of the energy crisis. This continues still now, despite previous comments from both John McCain and Hillary Clinton criticizing ethanol. Assuming all politicians would do what’s right if they knew the facts, our elected leaders are clearly lacking one of two things: any common sense, or the things we all know and which cause us to be so frustrated reading this paragraph.

So this is where we come in. We as geoscientists are in a unique position as the ones who perhaps understand the potential pitfalls of this trend better than anyone. We can’t sit back while this ill-conceived use of our tax dollars funds an absurdly detrimental endeavor. Let’s get out and fight this scam before it gets any worse. Large scale, let’s work with AGI and our lobbying power to get the facts out there in Washington. Maybe we need an organizational position statement on this as well, or to coordinate again with AGI for press releases to the media. On an individual level, write to your congressmen and senators to tell them what you think about this mess. Maybe pass on a study or two highlighting the key points. Then, just take the time to set the record straight with the people you meet on an everyday basis. A grassroots campaign of professional geologists informing the cookout at your relatives’ house or the people you overhear in the grocery store can go a long way.

We are the professionals, and the ones who work every day with the knowledge and the sense needed to set the record straight. Taking action here and sharing our expertise with others is exactly the type of thing we can do to get ourselves out there and show people what we do, while also doing a solid service for society. In the end, this will only serve to increase our professional recognition and strengthen our licenses, as people realize how important our work is. And I hope it will fill any of you who take me up on this with the same peace of mind that writing this rant has provided me.

Yes, there are a few sources of biofuel with potential, and on a small scale they are being and should be utilized. Just too much of the money and energy going into biofuel right now is landing squarely on the exaggerated benefits of ethanol and the like. While we may not all be able to agree on the finer points of climate change yet, I hope we can all agree that it’s a heck of a gamble to be wagering our food sources on the hope of keeping the thermostat down a few degrees. With some work and some luck, hopefully we can help trash this non-recyclable idea.
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Organized Outreach - An Aid to Survival for the Geosciences

James F. Howard, CPG-02536

"Outreach - An effort by an organization or group to connect its ideas or practices to the efforts of other organizations, groups, specific audiences or the general public" (Wikipedia). Richard Powers, in his presentation at the Traverse City meeting provided data from an American Geological Institute (AGI) study that indicates the Geosciences are approaching crisis levels in many areas (Powers, 2007). Crises were identified in numbers of graduating Geosciences practitioners, decreasing numbers of working professionals due to retirement, public perception of the profession and poor representation in appropriate public policy decision-making.

These perceived crises have been generated by a lack of effective Outreach between practicing professionals and the public in its various forms, e.g. lay public, legislators, regulatory officials, local planning groups, pre-college educators and generally anyone not directly within the Geosciences community. Most geoscientists tend to restrict their communication to those within the boundaries of the profession, commonly even minimizing their contacts even more narrowly, e.g. environmental geologists, petroleum geologists, geophysicists, igneous petrologists, geochemists, with minimum contact across other sub-disciplines, much less outside the Geosciences community as a whole.

This lack of Outreach is not universally true within the profession. There are many highly motivated individuals within the profession that spend a great deal of individual effort in effective Outreach. Their individual efforts help modify some of the negative public perception and lack of understanding of the role that Geosciences should play in problems faced by modern society. Ivan Gilmore, honored during the recent AIPG meeting in Traverse City for his Outreach activities, is an excellent example of the many successful individual efforts spread throughout the Geosciences. Many others should receive recognition, but prefer to operate quietly and behind the scenes in Outreach.

A main problem with our present approach to Outreach is inefficiency. The talents and resources of the professionals involved are primarily mobilized on a local basis. To be effective in promoting the proper role of the Geosciences in general society, I feel we must increase the level of organization in our efforts Most of us, unfortunately, tend to reinvent the wheel each time we begin an effort to expose the public to information on Geosciences affecting potential solutions to problems we face today.

Since there is apparently no organized compilation of ongoing efforts in Geosciences Outreach Programs, a logical first requirement will be to identify and compile ongoing efforts. We can then identify the appropriate methods to use for the various target groups by reviewing successful existing efforts and use the results of that review to develop organized plans to achieve our goals.

To start off the effort, I would like to describe the Kentucky Section’s recent efforts as one example of developing an organized Outreach Program, some of the problems we encountered and the solutions we developed. In starting an effective Outreach Program, it must be recognized that the success of any outreach program is dependent upon the desire of the individuals involved. Therefore, the first requirement is to find an individual or individuals interested in spearheading the process. The initial setup and implementation will require the efforts of an individual dedicated to the concept of outreach and willing to push to get the program going. Once the initial framework is completed, then the effort becomes a more broadly based effort.

The process of developing an organized Outreach Program in Kentucky involved several tasks including defining objectives, delineating target groups and their characteristics and identifying the technical and support resources available within the organization(s). Once the objectives and target groups were defined, the resources and the target group characteristics were integrated to develop programs appropriate to each group. Specific responsibilities were then assigned within the Outreach Committee and the programs were implemented. Program modifications were accomplished as feedback dictated.

Our first task involved defining the objectives of the Outreach Program. General objectives provide a framework for the effort but specific objectives are necessary to implement the program with efficiency. The objectives selected for the Kentucky program are:

a. **General Objective**: To provide an interface for increasing public awareness of the role of Geosciences in assessing and solving modern environmental and societal problems.

b. **Specific Objectives**

1. Increase public awareness and competence to evaluate media information on perceived problems.
2. Increase the numbers and quality of students entering the Geosciences as a career field.
3. Improve the capabilities of practicing professionals and increase participation in professional organizations in Kentucky.
4. Expand the role of professional geoscientists in public policy development and implementation in Kentucky.
5. Improve the public image of Geoscience professionals in Kentucky.

Defining target groups and their interests is complicated since the objectives outlined above involve target groups with very disparate characteristics and organizational modes. In general, the following groups were identified as discrete target elements in the overall program strategy:
General Public: Service Groups (Rotary, Kiwanis, Lions, Chamber of Commerce, Elderly Retirement Groups, Church Congregations). These groups are interested mainly in issues with High Media Emphasis, e.g., Global Warming, Earthquake/Disaster Preparedness, Energy “Crisis” and Ramifications, Disaster Scenarios involving Geosciences components, Alternative Energy Possibilities and Feasibilities and Mixed Topics with Geosciences Elements (Anasazi History and Climate Change Impacts, Little Ice Age, Karst Influences on Mayan Water Supply, Glaciations and Man in North America, for example).

National and Local Legislators: (Regulatory Plans, Planning Commissions, City Councils, County Commissions, Regional Development Agencies, Emergency Response Agencies at all levels). These groups are interested in anything that will help them get re-elected, e.g., Increasing Industrial Development, Energy Resources and Future Crises, Natural Resource Policy and Ramifications, Environmental Pollution and Short-term/Long-term Costs.

University Students and Faculty: Interested in Big Picture Topics, e.g., Sea-level Change and Impact on Mankind, Climate Change History and Future, Plate Tectonics and Impact on Evolution, Petroleum Development in ANWR, Decertification and Causes, Future of Geosciences and Job Opportunities. Where possible, we use topics and visits to enhance visibility of the Geosciences departments on campus with other disciplines.

Teachers and Students at pre-college level: (State Curriculum Development Groups, Ongoing Education Programs at State and Federal Level, Career Counselors, Science Classes at high school levels, City and county school administrators, State Continuing Education Superintendents and University Teaching Departments). These groups are interested in ongoing education and teacher upgrades for in-service degree programs.

Business Audiences: (Industrial Development groups, Regional Planning Commissions, Neighborhood Redevelopment Groups).

These groups are interested in Environmental Planning, Water Resources, Brownfields, Water Quality Controls, Earthquake and Disaster Preparedness, Zoning and Flood Control, Climate Control and Future of Energy Resources.

Practicing Professionals: (State Agencies, Private Industry and Consulting Companies). These groups are interested in skills development and upgrades in professional capabilities. Forums, field demonstrations and short courses in new technology or interpretive skills are appropriate.

In our program, we based the Outreach Program structure both on the characteristics of the target groups and the character of our own volunteers within the Geosciences organizations involved. Some volunteers are comfortable in a big lecture format; some prefer small informal or one-on-one settings or field demonstration programs with other professionals. Others are good at contact and support work but are uncomfortable in up-front roles for large group presentations. To accommodate those differences, we developed a structure that allowed each volunteer to effectively select his own role and define the limits under which he was willing to operate, either in a time sense, geographic travel or specific professional involvement level.

Using that philosophy and to enhance program flexibility, three separate but overlapping areas of activity were developed for the Kentucky Outreach program.

A Speaker’s Bureau was formed to allow access to individuals who are comfortable with the presentation mode of outreach. Each volunteer completes a form available on the AIPG-Kentucky website that allows him to define his own comfort zone, e.g. 50 mile travel radius, high school student audiences; statewide, general public audiences; statewide university audiences; 50 mile travel service club audiences; interaction with municipal or state boards/commissions; or any combination of the above. A database of PowerPoint presentations is being developed as a support system for the speakers. These presentations involve 20 minute to one-hour PowerPoint slide groups on various topics. Eighteen lectures have already been prepared with another 500 Megabytes of additional images and numerous web site links for those who wish to construct their own formats or modify the others.

Academic Enrichment: All university geoscience-oriented academic programs in Kentucky are now represented on the Outreach Committee. Interaction with the departments include student mentoring, career guidance, presentations on subjects of interest, departmental review groups where requested, and support in developing projects to enhance visibility of the department on their own campuses, where desired. This program will expand with feedback from the departmental personnel with time.

Professional Enrichment: The Outreach Committee is developing educational forums, field trips and special training programs to upgrade professional capabilities and enhance the performance of both existing and future professionals and public agency employees in their career development.

In assessing the resources available, it was quickly obvious that no one organization at the state level has the available manpower to cover the areas above. Since we viewed this effort as directed toward the profession as a whole, not just as a political effort for AIPG, we joined forces with the Kentucky Society of Professional Geologists (KSPG) thereby expanding our resources from 92 geologists to over 400. Although the program lead is AIPG, the committee co-chair is a KSPG member ensuring optimum cooperation between the groups. Invitations have been extended to other professional groups in Kentucky and southern Indiana to further expand the assets available.

Using our combined assets, programs were specifically designed for each target group. For example, entry to the service clubs uses the local chamber of commerce and their files with follow up personal visits to the program coordinators; each academic department head was personally contacted; press releases were sent to each major newspaper, radio and television media outlet in Kentucky; personal contacts were used where available to the support members of the committee; old friends were sometimes shamelessly used to provide entries to the target audiences.

Components of the program were assigned to committee members to ensure
responsibility for contact work, database compilation, and a central clearinghouse to handle requests for services and maintain operational efficiency of the program is in place. Where published articles are involved, a peer review group provides oversight of manuscripts.

Implementation of the program formally began on August 1, 2007, although some oral presentations preceded the formal Press Release sent out on that date. A key element of the program will be an ongoing stream of press releases and media contacts. Publicity is the lifeblood of an ongoing program and, if properly conducted, will provide the momentum for an ongoing and successful overall outreach effort.

As of November 1, 2007, the Kentucky Outreach Program is officially three months old and includes thirty members from two different professional organizations, five academic institutions and several independents. Results of this program to date include:

1. Six presentations to the Lexington Environmental Commission, Kentucky Geological Survey, two service clubs, a church group (75 attendees), and a county detention facility. Three more are scheduled by December 1, 2007.

2. One Cable Television appearance and two one-hour radio talk show appearances on “Global Warming” and “Earthquake Hazards and Preparedness” have been conducted.

3. Three visits to academic institutions (Eastern Kentucky University and Murray State University as well as the Bluegrass Community College Campus in Lexington, Ky.) will be conducted in the next 30 days with presentations, student mentorship and recruiting.

4. A series of invited articles on eight different topics are in preparation for a business-oriented trade magazine serving 20,000 subscribers in the Lexington, Kentucky area.

5. Preliminary discussions on a series of symposia tentatively scheduled for summer of 2008 under the banner of AIPG as a Charter Member of the “Year of the Planet Earth” effort involving the Kentucky, Virginia, Tennessee and Pennsylvania sections of AIPG and our allied organizations are now underway.

6. Technical support for the Daviess County, Kentucky Emergency Management Agency in screening suitable local sites for backup communication facilities is now in progress with the help of Kentucky Geological Survey personnel.

Outreach can provide one approach to the present threats to our profession. However, we must increase the efficiency of Outreach and incorporate more people in the overall effort to attain the goal we all desire.

Efficient development of effective Outreach Programs requires learning from the efforts of others. I therefore invite all of you to submit descriptions of your efforts, your participants and an evaluation of your successes and failures to AIPG. These data will provide guidance for all of us involved in active Outreach in the years to come.

Submitted by Dr. James F. Howard, 2008 President, Kentucky Section of AIPG and Chairman of the Kentucky Outreach Committee, Advisory Board Delegate to AIPG Executive Committee for 2008.

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Groundwater Recharge and its Impacts on Non-Point Source Nitrate Contamination

Donald P. Hanson, R.G., MEM-0532

This paper was presented at the 11th Biennial Symposium on the Artificial Recharge of Groundwater, Tempe, Arizona, June 5-7, 2003.

ABSTRACT

The question of recharging in former agricultural areas is rapidly becoming a focal point for several municipalities that rely on recharge as a means of balancing supply and demand issues. Former agricultural sites across the Salt River Valley (SRV) have become the target for recharge via infiltration basins, vadose zone wells, and/or aquifer storage and recovery (ASR) wells. In many cases, subsurface soils and/or groundwater beneath these sites have been contaminated by nitrate. Mobilization of this residual contamination from subsurface soils into groundwater can increase observed nitrate levels.

Studies have shown that while mobilization of nitrate contamination may occur, it is tempered by mixing and dilution from the recharged water. This mixing and dilution results in nitrate impacts that are limited in both time and space within the aquifer. Whether nitrate impacts are already present in the aquifer or caused from leaching of soils with elevated nitrate contamination, nitrate impacted groundwater will eventually be improved through the recharge process.

This paper examines two different sites where municipalities are recharging treated effluent into aquifers that have been contaminated by nitrate. At both sites, groundwater quality improved significantly through the recharge process. In both cases, state agencies issued violations and/or required costly actions because they lacked a full understanding of groundwater movement and interactions that are responsible for the observed conditions. Through varied analyses at the two different sites, it was determined that recharging treated effluent had a net positive impact on groundwater quality within the aquifer.

Those who recharge and the entities that regulate them should be aware that although elevated nitrate concentrations may be detected in compliance wells during the early stages of the project, the groundwater quality will ultimately improve as recharge continues. Municipalities and private entities alike should develop a thorough understanding of the local hydrogeologic system with a particular emphasis on determining profiles of groundwater quality and gradients before initiating recharge.

INTRODUCTION

The hydrologic cycle, including components of infiltration and groundwater recharge, has been occurring over geologic time. From the late 19th and throughout the 20th centuries, a new form of groundwater recharge emerged: agriculture. Particularly in the arid southwest, the proliferation of flood-irrigated agriculture and its associated groundwater recharge has resulted in the development of large areas of groundwater polluted by various agricultural chemicals.

Within the East and West Salt River Valleys, the Arizona Department of Water Resources (ADWR, 2002) has estimated the volume of groundwater recharge solely from infiltration of excess applied irrigation water beginning in 1978 (Corkhill and others, 1993). As of 1998, date of the latest available information, the estimated volume of agricultural recharge in the Salt River Valley was 443,000 acre-feet per year (ac-ft/yr) or enough water to cover nearly 700 square miles of land with a foot of water (Jehnke, 2002). Even this large volume is considerably less than the estimated high of 726,000 ac-ft/yr, which occurred in 1981 just before implementation of Arizona’s Groundwater Management Act of 1980. Fertilizers, largely consisting of ammonium nitrate, have contributed huge masses of available nitrogen to the underlying soils and subsequently the local groundwater system. Concentrations of nitrate in groundwater beneath many portions of the valley can reach 60 milligrams per liter (mg/l) or higher while the current drinking water standard for nitrate is set by the US Environmental Protection Agency (EPA) at 10 mg/l. The result is widespread non-point source nitrate contamination in millions of acre-feet of groundwater.

As time progressed, yet another type of groundwater recharge emerged. Typically known as aquifer storage and recovery (ASR) projects, this new form of recharge has gained popularity as a cost-effective way to manage and reuse reclaimed water (treated effluent) to supplement potable groundwater resources. However, ASR is much more heavily regulated than agricultural recharge by both ADWR and, in many cases, the Arizona Department of Environmental Quality (ADEQ), even though the quality of water recharged is typically far superior to that of the excess applied irrigation water. Water used for recharge typically has low nitrate concentrations, with less than 2 milligrams per liter (mg/l) for Central Arizona Project water and in the 4 to 7 mg/l range for reclaimed water. While government agencies are responsible for the protection of the public, unnecessary burdens have been placed on entities that are actually improving groundwater quality through the recharge of reclaimed water.

GEOLGY AND HYDROGEOLOGY OF THE STUDY SITES

The two recharge sites examined in this study are the Tumbleweed Recharge and Recovery Site (Tumbleweed site) located at the intersection of Germann and McQueen Roads in Chandler, Arizona, and the Gilbert Riparian Preserve at...
Water Ranch (Water Ranch site) located at Guadalupe and Greenfield Roads in Gilbert, Arizona. At both sites, tertiary-treated reclaimed water is recharged in areas where groundwater has been polluted by the percolation of agricultural leachate from historical farming. However, these two sites are quite different in their design, method of recharge, and observed conditions.

**Tumbleweed Site**

Tumbleweed Park is a municipal park within the City of Chandler, which provides numerous recreational amenities. Covering more than 160 acres, the park offers an important element to the growth plans for the southern portion of the City. Prior to its development as a park, the site was farmed for many years. Groundwater recharge began at the site in late 1997 using a series of vadose zone injection wells. Due to clogging issues and a concurrent decline in injection capacity, the City began replacing the vadose zone wells with deeper ASR wells for direct recharge into the shallow aquifer. Currently, three ASR wells are in operation at the site, with two more planned for installation. When completed, the Tumbleweed site will have a permitted recharge capacity of 10 million gallons per day (MGD) for a period of 20 years.

ADWR has divided sediments in the SRV into three major units consisting of the Upper Alluvial Unit (UAU), the Middle Alluvial Unit (MAU), and the Lower Alluvial Unit (LAU) (Corell and Corkhill, 1994). The UAU is typically characterized as unconsolidated sand, gravel, and cobbles with varying degrees of clay and silt, while the MAU generally consists of semi-consolidated fine-grained deposits of clay, silt, mudstone and gypsiferous mudstone with occasional sand and minor gravel units. The LAU consists of conglomerate and gravel near basin margins, and grades to mudstone and anhydrite in the central basin areas.

Beneath the Tumbleweed site are several sequences of sand, gravel and cobbles beginning near 100 feet below land surface (bls) and extending more than 400 feet bls (Figure 1). These coarse-grained deposits form a productive shallow aquifer beneath the site where the measured depth to water is approximately 105 feet. Laney and Hahn (1986) indicate that this area falls within the bounds of the ancestral Salt River channel, which is characterized by highly permeable coarse-grained deposits. Aquifer testing of the newly installed ASR wells confirmed the aquifer's productivity. For the three new wells, the average hydraulic conductivity was 178 feet per day (ft/d) or 1,334 gallons per day per foot squared (gpd/ft²) (Clear Creek Associates, 2001).

Although significant groundwater supplies could be realized from this highly permeable aquifer, prior to operating the recharge site, groundwater quality testing in nearby irrigation wells revealed nitrate concentrations above 15 mg/l in the early 1990’s (ADEQ, 2003). These concentrations were confirmed after installation of monitoring wells at the recharge facility in 1998 (Brown and Caldwell, 2001).

**Water Ranch Site**

The Water Ranch site was completed in 1999. Designed as a groundwater recharge and passive recreation park, the site allows people to experience wildlife and the natural water cycle in an urban setting. The 120-acre preserve contains seven percolation ponds, each measuring approximately 10 acres that are capable of recharging up to 4 MGD of tertiary treated effluent and Colorado River water. The vegetation component of the Water Ranch site was designed to reflect the valuable riparian and wetland habitats once abundant throughout the Sonoran Desert. Fourteen distinct habitat zones, nine of which are riparian, range from marshlands to uplands and mimic the native vegetation found in the respective zones. Each of the ponds contains a permanently wetted survival zone with a marsh area as well as mudflats and shallows, making the basins ideal habitat for shorebirds. As with the Tumbleweed site, this area was irrigated agricultural land for many years prior to its development as a recharge site.

The Water Ranch site is located more than eight miles northeast of the Tumbleweed site, but is also within the bounds of the ancestral Salt River channel. Not surprisingly, the underlying geology and hydrogeology of the two sites are generally similar. Exploratory borings drilled during the planning stages of the project indicated a high percentage of sand, gravel, and cobbles in the UAU from about 100 feet bls to at least 250 feet bls. According to ADWR, the UAU/MAU contact in the vicinity of the Water Ranch site is 270 feet bls.

In July 1998, dual-purpose monitoring and recovery wells were completed.
to a depth of 230 feet bgs. After installation, the depth to water beneath the site was measured at 160 feet bgs. Initial groundwater quality samples contained nitrate concentrations of 25 to 30 mg/l, attributable to historical agricultural leachate.

**METHODOLOGY**

To evaluate the impacts of treated effluent recharged into contaminated groundwater, the following factors were considered:

- Depth to groundwater;
- Vadose zone and aquifer characteristics;
- Distance between monitoring wells and recharge sources;
- Pre-recharge nitrate concentrations in groundwater;
- Volume of recharge water; and,
- Concentrations of nitrate, nitrite, and total kjeldahl nitrogen (TKN) in the recharge water.

At the Tumbleweed site, groundwater modeling was also performed. The model code selected to simulate groundwater flow was Visual MODFLOW (Guiger and Franz, 1995), which combines the U. S. Geological Survey MODFLOW-96 (Harbaugh and McDonal, 1996) with a graphical interface. Initially, a three-dimensional groundwater flow model was developed. The model was based on ADWR's SRV model with several enhancements. In addition to incorporating site-specific aquifer parameters and unit boundaries, a low hydraulic conductivity layer was incorporated into the upper portion of the MAU. This modeled layer enabled us to simulate the actual layers of alternating coarse- and fine-grained material in the area that create downward vertical gradients of nearly 100 feet at some locations. The UAU was also divided into two layers to better simulate observed nitrate concentration gradients. The results predicted by the model were compared to actual site data. At the Water Ranch site, measured groundwater concentrations were simply plotted with respect to time, without numerical modeling, and compared with measured concentrations in the treated effluent.

**RESULTS**

The characteristics at the two sites are different in many respects, including depth to groundwater, hydraulic properties of the underlying aquifer, initial groundwater concentrations, and volumes and methods of recharge. However, the results were essentially identical, with both sites showing a significant decrease in groundwater nitrate concentrations after a period of time.

**Tumbleweed Site**

Two observation wells were constructed in the UAU at different times during the project. As shown by the observed concentrations (Figure 2), the shallow well (OBS-3Shallow) rapidly experienced the effects of recharge from the vadose zone wells, showing a spike in nitrate levels after six to eight months of operation. This spike was followed by a sharp decline over the next six months. In contrast, the deeper well (OBS-3Deep) was not affected by the recharge until nearly three years after measurements began (Figure 2). The increase in nitrate levels was more subdued than in OBS-3Shallow; however, concentrations did exceed the ADEQ alert level of 8 mg/l and eventually, the MCL of 10 mg/l.

More recently (2002 to 2003), concentrations have declined significantly and are now below pre-recharge levels, reflecting improved water quality from the recharge project.

Using observed concentrations, the groundwater model predicted a decline in nitrate concentration at the deeper well after a period of about four years after initiation of recharge. The model simulations included recharge via vadose zone wells, and then via ASR wells as the vadose zone wells were phased out. These results are consistent with the measured concentrations in the existing downgradient monitor well. Running the groundwater model further into the future indicates that concentrations at monitor well OBS-3Deep will ultimately decline to that of the recharge water, which is averaging about 4 mg/l of total nitrogen (which includes nitrite, nitrate, and TKN).

**Water Ranch Site**

Groundwater nitrate concentrations at the two monitoring wells at this site (L-1 and L-2) were in the range of 25 to 30 mg/l prior to the initiation of recharge (Figure 3). Total nitrogen levels in effluent used as recharge water averaged about 5 mg/l.

Nitrate levels in groundwater sampled from the two wells experienced a similar response, with a short-term spike in nitrate concentration followed by a long-term decline. The monitoring well closest to the recharge basins (L-2)
exhibited a spike relatively early, while in L-1, further downstream, there was a six-month delay. Also, the magnitude of the spike at L-1 is less than at L-2. As this site utilizes the basin recharge method, the spike is probably related to flushing of nitrates from the vadose zone by the recharge water.

In both wells, the spikes are rapidly attenuated and observed nitrate concentrations continue to decline with continued recharge. While nitrate concentrations in monitor well L-2 are still above the MCL of 10 mg/l, they are significantly lower than the pre-recharge concentration of 27 mg/l.

**SUMMARY**

Some may speculate that the groundwater recharge has simply created a "bubble" of cleaner water rather than actually improving groundwater quality. However, the pre-existing nitrate pollution was created by recharge of excess applied irrigation water, which does not typically occur as a bubble effect. Regardless of opinion, continued recharge of water with lower overall nitrogen levels will not only flush residual nitrates from soils beneath previously irrigated agricultural lands, but will also improve groundwater quality through induced and natural groundwater flow within the aquifer system. As observed at the two sites discussed above, and at other sites within the Salt River Valley, these improvements take time and concerned parties should understand that there may be short-term time periods of groundwater degradation. According to the results from the Tumbleweed and Water Ranch sites, as long as the quality of the water being recharged is better than existing groundwater quality, a short-term decline in groundwater quality is predictably followed by long-term improvement.

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Smith’s Other Debt: John Strachey, William Smith and the Strata of England 1719-1801

Dr. John Fuller

William Smith’s first surveying in Somerset took place mainly in the parishes of Stowey and High Littleton, within the NE Somerset coalfield. The Stowey estate where Smith began work in 1791 adjoined lands belonging to the Strachey family of Sutton Court (in the adjoining parish of Chew Magna). Smith was then about 22 years old, and while working in the district he is known to have had in his possession an engraved geological cross-section made by John Strachey of Sutton Court, illustrating parts of the coalfield (Figure 1).

Strachey’s work set out notions of regularity among the strata, their angles of dip, faulting and angular discordance; and uniquely identified a particular coal-seam by its associated fossils. A copy of this section was found among Smith’s papers after his death. It had been torn from an edition of the Royal Society’s Philosophical Transactions, and bore pencil annotations in Smith’s handwriting. ‘There is evidence’ said L R Cox, his biographer in 1942, “that he was acquainted with Strachey’s papers by the end of 1796’.

Much of William Smith’s early geology so closely resembled John Strachey’s as to leave scant doubt that he found in Strachey’s work both text and template for his future geological insights.

This account might have been subtitled “The truth behind the story of William Smith’ The story begins with the indenture of a lease drawn up in 1719, entitling William Jones of Stowey to dig for coal on land belonging to John Strachey of Sutton Court in the parish of Chew Magna, adjacent to Stowey. Smith acquired his early geological understanding and experience on exactly the same stretch of ground as Strachey - and took his first inspiration directly from Strachey’s work.

John Strachey, William Smith, and John Phillips

John Strachey (1671-1743) was a Somerset squire and antiquary of Sutton Court (Figure 2). In 1719 he made a pictorial cross-section of the geology under his estate, drawing profiles of underground strata seen in nearby coal works, and projecting them according to their measured thicknesses and attitudes into unknown areas between the coal workings. His purpose seems to have been to illustrate his grant of a coal-lease on parts of the Sutton estate, drawn up in that year. “To this day,’ said Sir Edward Bailey, Director and historian of the Geological Survey, “it conveys as clear a picture as could be desired of a semi-concealed coalfield’. Strachey’s stratigraphical cross-sections, of which he published several, are the earliest known in scientific literature.

Some years later, William Smith (1769-1839) working in the same part of this coalfield, also took an interest in the relationships among strata underground. He introduced a new form of map, tracing emergent edges of subterranean strata at the surface of the ground; and even more importantly, he established uniquely and for the first time that among broken or remote tracts of strata, identities among detached parts could be proved by identities among fossils contained within them. It is a historical fact that all present-day stratigraphic practice has an ancestry linked to these events in Somerset.
Smith's School Days

He was born in March 1769, the son of a blacksmith in the Oxfordshire village of Churchill. Among the rural poor of that time only a small proportion of school-aged children received any organized education. The luckiest event that could befall them was to be placed in the apprentice-house of an enlightened employer. William Smith became one such lucky individual.

By singular good fortune Smith's intelligence and industry were noticed by a sharp-eyed land surveyor, Edward Webb of Stow-on-the-Wold, not far from Churchill, who took him in as an assistant. Smith lived with the Webb family for nearly five years, training himself in the disciplines of surveying, measuring, casting numbers, making agricultural valuations, managing improvements to farmland drainage, and assisting with surveys of lands scheduled for enclosure.

It does no disservice to Smith's achievements to say that he possessed particular qualities of persistence and stubbornness, and that he began his adult years equipped with hardly more than an ability to read, a serviceable longhand, and the bare elements of scripture.

Chew Magna and Stowey
1719-1727

On 18 April 1719, John Strachey granted a 21-year lease on several tracts of his Sutton estate to William Jones. The indenture allowed J ones "to Search for open dig or Sink any pit or pits for Coal". Strachey had studied the coal workings at Bishop Sutton, about half a mile southwest of Sutton Court, and at Stanton Drew, about a mile to the north. He had learned from colliers that the same seams as at Sutton were being worked in pits toward Farrington Gurney, about four miles away to the southeast of Sutton Court. Strachey's land at Sutton lay between these two known productive areas, and to demonstrate its potential value as a prospect he made a cross-sectional diagram showing his predicted subterranean arrangement of the coal seams, their individual thicknesses and depths.

John Strachey wrote a letter explaining the geology of the local coal industry and the nature of the overlying strata to his friend Robert Welsted MD, a Fellow of the Royal Society. Welsted communicated Strachey's letter to the Society at its meeting on 7 May 1719, and arrangements were made for the letter to be published together with the cross-section. Strachey was 48 and later, at the November 5 meeting of the Society was elected FRS.

In his second paper for the Royal Society (1725), and in a booklet independently published two years later, Strachey emphasized his conception of the strata as a body or group of layered earths and minerals extending across England north-eastward from the coast of Wessex to Yorkshire and the farther coast of Northumberland. The Strata as he then understood them were potentially of global extent:

"All these different Strata, as found in any of those Places I have observed myself, or met with from others, I have at one View represented in a globular Projection of the terraqueous Globe."

The Strata, thus defined, consisted of several discrete entities, as follows: at the top Chalk (Upper Cretaceous), followed downward by Freestone (Upper & Middle Jurassic), Liias and Marl (Lower Jurassic), Red Earth (Triassic), Clives and Coal (Upper Carboniferous), and Limestone with Lead (Lower Carboniferous). This sequence was expanded to 12 units or component parts by the addition of other earths, ochres, and metals, so that the Strata became a duodecimally-layered fabric covering the whole globe. Strachey visualized the rotating Earth as consisting of 24 individual layers, 12 of which were exposed to the passing day, at the rate of one per hour, and a further 12 duplicating exactly the same sequence at night (Figure 3).

Easterly Dip and Creation's Fourth Day

Why did John Strachey, who was known to be a careful scholar, augment his straightforward account of coal-mining in Somerset with an abstract fancy visualizing a universal and globally distributed sequence of rock-units, duodecimally-arranged, which by rotation of the Earth passed an observer at a rate of one per hour by day, repeating identically at night? And why did the apparent prevalence of easterly dip among stratified rocks, particularly of coal-measures, become so prominent in both John Strachey's and William Smith's geology?

A single answer to these questions resides in something learned in the past by every reluctant schoolboy in England, and remembered also by every comprehend-ing adult; namely that Earth's lands and seas had been separated from one another on the Third Day of the Creator's work, and that on the Fourth Day the newly formed terraqueous globe was set into its rotational motion, turning from west to east, making one full revolution in 24 hours. Inertial forces at the commencement of Earth's rotation caused the unconsolidated and still waterlogged strata to bend away from verticality, overwarping to the west so that their exposed basset edges came to face westward, while the main stratified...
masses concomitantly acquired easterly dips.

To understand the geological language used by Strachey and Smith concerning Earth's structure and historical development, it is crucially important to appreciate that both of them turned to the highest authority offered by their schooling, namely Biblical narratives, from which they were able to deduce that the Strata had been formed en masse, not singly; that the order in which they had been formed was the natural order of Creation (certainly not an order of procession); and that this had been put into effect before Earth's rotation had commenced.

Reading Smith's early notes, and the incomplete Preface of 1801 to his intended book, one feels that Strachey's model of the Strata was never far away from his thinking. One could cite, for example, the emphasis placed by both Strachey and Smith on southeasterly dip; their exposition of "regularity" among the strata; their belief in hemispherical west-facing bassets, their visions of strata extending from pole to pole; and their wonderfully inspired notion that all the strata ultimately spiralled down to the Earth's centre "like the rolled up leaves of a book." This last idea certainly appealed to Smith, for in 1798 he wrote a memorandum describing Strachey's conception of the twenty-four rotating strata as "our theory".

**Hybrid Growth of Stratigraphy 1791-1801**

Through the first decade of the new geology, 1791 - 1801, its seedling shoot became a tree - tandem fit circulus arbor - growing with hybrid vigour from the works of John Strachey and William Smith's preface to his proposed book Natural Order of Strata, together with an assortment of Smith's hand-written notes. Examples in Smith's early writings revealing phrases and observations also found in John Strachey's papers. The main argument that Smith's early geology evolved from Strachey's work was, and still is, that Smith had evidently absorbed Strachey's published ideas, whether by way of Benjamin Richardson of Farleigh, or through the late Mary Jones's estate. Commonalities between the writings of Strachey and Smith are too numerous for apologetic coincidence.

Of all the original observations made by Smith, the one most celebrated was his observation of a diagnostic relationship among particular strata and their contained fossils. This principle appears in many forms, usually associated with words like "identity' and "identification'.

Another manuscript fragment, undated, records substantially the same sentiment, though it substitutes "Creator' in place of "Nature.' This note is headed Fossils:

"Many men to gratify mere Curiosity & to no other end have been at infinite pains to collect choice Specimens from the numerous Fossil Tribe without so much as dreaming of that Systematic arrangement to which they are the best of all Indices - or paying the least attention to that regularity with which the Creator has disposed of these singular productions & assigned to each Class its peculiar Stratum."

This shows that Smith did mean as he said, and that the Stratum really did define the fossils. This principle so stated was exactly the reverse of what he, and others after him, actually put into practice. The point is not trivial – perhaps Smith did mean exactly what he wrote, and that he was being guided, as elsewhere, by something he found in Strachey's papers. For example, on the copy of Strachey's 1721 cross-section which Smith possessed, the lettering above the bed of coal named Peacock or Peaw Veyn reads – "Cockle shells and Fern branches" (Figure 4). The text (p.260–63), also known to Smith, reveals that for Strachey and colliers alike the fossils and the coal-seam accompanied and identified one another:

"The Cliff [shale] also over this Vein is variegated with Cockle-shells and Fern-Branches, and this is always an Indication of this Vein."

The shells and ferns were indeed assigned to their peculiar stratum, as Smith rightly observed. Other geological notes, mainly from 1796 and 1798, reveal contemplative explanations that seem to depend upon Scriptural realism, yet they also question it. Two examples – Fossil Shells and Effects of the Deluge - offer strong evidence that by 1800 Smith's geological concepts were beginning to move away from literal exegesis:

"These[s] were not deposited there at the time of the Deluge for it is not at all consistent with the Wisdom and dig-
time they must not be mistaken for or confounded with Fossils.”

“Whether they were deposited in those Beds by the deluge or at the Creation are enquiries which will be better made when their properties and positions are better understood.”

Passages like these, glowing vividly among his preliminary notes, reveal Smith’s brilliant mind struggling to overcome its want of early instruction.

More than two centuries have gone by since Smith set out to map the strata of England. Leading figures among scientists at that time belittled him, though his observations were self-evidently correct. Later admirers, particularly geologists, began to envelop Smith in a transfiguring cloud of scholarly reverence, giving him central place in a very British story that told of a young orphan-boy from nowhere, who defeated adversity through self-help, who succeeded magnificently, unaided and alone in a huge personal enterprise, who confounded his critics, and was proved during his lifetime to have made a great scientific discovery. Yet in the end was openly cheated by a parcel of scheming gentry.

That story is celebrated among geologists everywhere, surviving even the discovery at Oxford in 1938 of a packing-case filled with Smith’s writings, left apparently by his nephew, John Phillips. Until that day in 1938, the Memoirs that John Phillips had written after his uncle’s death, had been the only biographical source readily available. For nearly a hundred years most things said about Smith and his early geological achievements had relied more or less obviously on what his nephew had written.

Given the class-structure of educated society in 1844 when the Memoirs was published, and the proprieties then observed for biographical writing, one may ask whether Phillips would have considered writing anything that seemed to diminish his own or his uncle’s scientific respectability. In the expanding flux of English society during the 1840s, social standing and respectability meant everything to the new professionals, particularly to Phillips, who was then enjoying the academic privileges of Oxford.

Acknowledgements

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Medical Geology – Threat or Opportunity?

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Key Words: Medical geology; environmental health; career opportunity

Abstract

Every day of our lives we eat, drink, and breathe minerals and trace elements. For most of us this interaction with natural materials is harmless, perhaps even beneficial, supplying us with some essential nutrients. However, for some, the interaction with the minerals and trace elements can have devastating, even fatal effects. Does this fact present a threat to geoscientists by providing more ammunition to those who advocate closure of mines and cessation of coal combustion or does it present an opportunity for geoscientists? In the U.S. and around the world geoscientists are playing increasingly important roles in addressing a wide range of environmental health problems. Examples include: helping to find the source of arsenic in drinking water which is affecting the health of more than 100 million people worldwide; determining the health benefits of geologic materials; assessing the health impacts of volcanic emissions; determining the cause of black lung disease; and determining whether radiation from fly ash presents a health threat to children. In these and other situations there are opportunities for geoscientists to work with medical researchers and public health officials to mitigate health problems and add a highly visible dimension to our societal contributions.

Introduction

Medical geology, defined as the study of the impacts of geologic materials and geologic processes on animal and human health (Finkelman et al., 2001), has been experiencing a recent renaissance. Newly formed organizations such as the International Medical Geology Association (www.medicalgeology.org) and the Geological Society of America’s Geology and Health Division (http://rock.geosociety.org/GeoHealth/index.html) have enjoyed rapid growth. Several books on the subject have appeared recently including Geology and Health (Skinner and Berger, 2003), Essentials of Medical Geology (Selinus et al., 2005), and Medical Mineralogy and Geochemistry (Sahai and Schoonen, 2006). Essentials of Medical Geology has received several awards recognizing its contributions to both geoscience and public health. Technical sessions, symposia, short courses, and accredited courses at colleges and universities are popping up all over the world. The Ellison Miles Geotechnology Institute at Brookhaven College, Dallas, Texas will offer a short course on medical geology to satisfy educational requirements for professional geoscientists and earth science teachers. The U.S. Geological Survey has recognized human health research as part of their strategic plan (see the Survey’s health web pages: http://health.usgs.gov/ and http://energy.er.usgs.gov/health_environment/medical_geology/medical_geology_usgs.htm). The National Research Council has recently released a report entitled “Earth Materials and Health – Research Priorities for Earth Sciences and Public Health” (Skinner et al., 2007). The report describes the present state of knowledge in the emerging field of medical geology, evaluates the need for financial support for medical geology research, and identifies the basic research that is needed in bioscience and geoscience to support medical geology research. On the global scene, “Earth and Health” is one of ten geoscience themes that comprise the United Nation’s “Year of Planet Earth” (http://www.esfs.org/).

The primary focus of most of these activities, books, journal articles, symposia, etc. is the health problems caused by natural materials such as trace elements, minerals, and geologic processes. Do we really need to be reminded again of problems caused by geologic processes and by materials mobilized by the extractive industries? It seems that every day there are reports on TV and the newspapers about health implications of global warming, coal use, arsenic, mercury, lead, and other chemical elements in our environment as well as respiratory problems caused by asbestos, quartz, and ambient dust. True, these issues may be exaggerated in the media and some reports may use hyperbole or even alarmist rhetoric in describing these situations but the fact is most of these environmental health problems are real. Denying that geologic materials and geologic processes can have adverse impacts on health makes us appear to be oblivious to the obvious or, worse, to be part of a conspiracy to cover up the facts.

In fact, many geoscientists are taking a proactive approach to these societal issues and are playing increasingly important roles in helping to address a wide range of environmental health issues in the U.S. and around the globe. The following examples illustrate some of the significant contributions that geoscientists are making in the emerging field of medical geology.

Examples of Medical Geologists at Work

A medical geologist is simply someone with geologic expertise working with the biomedical/public health community to address environmental health problems caused by natural materials or processes. Perhaps their most important responsibility of a medical geologist is to provide the critical earth science information that will allow public health officials to mitigate existing environmental health problems and prevent similar problems from occurring elsewhere.

A well-established area of geoscientific investigation is the study of health threats from volcanic eruptions. Geologists, including volcanologists and geochemists have joined with epidemiologists, toxicologists, public and health and physical chemists to determine the health effects of volcanic emissions. They have formed the International Volcanic Health Hazard Network (IVHHN) in 2003.
involving experts from 25 international institutions and over 130 corresponding members. The IVHHN promotes the expansion of the newly emerging field of volcanic health hazard research, develops new collaborative links between the multidisciplinary international partner organizations, produces widely disseminated protocols and volcanic health hazard information to volcano observatories, scientists, governments, emergency managers, health practitioners and the general public and encourages collection of geologic and medical data to evaluate health hazards (http://www.ivhhn.org).

Throughout Bangladesh and West Bengal, India, high levels of arsenic have been found in tube wells relied upon by rural people for drinking water. This has been described as the ‘greatest mass poisoning in history,’ and affects the health of millions of people in the region. Geoscientists (hydrologists, sedimentologists, geochemists, etc.) from the U.S., Bangladesh, Great Britain, India, and elsewhere have been trying to determine the source of this arsenic.

The U.S. is not immune to this problem. Arsenic levels that exceed the current recommended safe level of 10 μg/L occur in just about every state (Figure 1) and in a collaborative study between the U.S. Geological Survey and the National Cancer Institute (Ayotte et al., 2006) has shown that naturally occurring arsenic in New England groundwater may be a causative factor in the high levels of bladder cancer in this region.

An important role of the medical geologist is to help reassure the public if an environmental health concern is unwarranted. For example, periodically there have been reports in the scientific and public literature about the threat of radioactivity from coal and coal combustion products (Gabbard, 1993). One of the more serious accusations was that young boys playing near disposal sites of coal combustion by-products would be sterilized by the radiation. A report (Zielinski and Finkelman, 1997) based on data from the U.S. Geological Survey’s CoalQual database (Bragg et al., 1997) demonstrated that the levels of radionuclides in coal and coal combustion by-products are generally low to modest, commonly in the same range as many surficial rocks and soils. They also note that the uranium in the fly ash was dispersed uniformly throughout the fly ash particle rather than being concentrated as a leachable phase on the surface. Based on this and other information the court declined to issue an injunction against the creation of a disposal site for coal combustion by-products.

Geoscientists working with biomedical researchers are spreading new light on some old environmental health problems. Although the incidence of Coal Worker’s Pneumoconiosis (CWP: Black Lung Disease), a progressive, debilitating respiratory problem caused by inhalation of coal dust, has decreased dramatically in the U.S. it still takes a heavy toll on coal miners in developing countries. For example, an estimated 600,000 Chinese coal miners are suffering from CWP. For more than 100 years it has been assumed that black lung disease was caused by the inhalation of the black pulverized particles of coal. Recent research (Huang et al., 2004), however, has shown that CWP may be initiated not by the coal particles but by inhalation of pulverized pyrite, a common coal mineral (Fig. 2). The pyrite dissolves in the lung fluids releasing strong acids and iron radicals that irritate the lung tissues. Particles (coal dust, quartz, clay, pyrite, etc.) that then contact the irritated tissues will initiate the fibrosis leading to decreased oxygen exchange capacity. Thus, knowledge of the mineral composition of the coal may be a key parameter in anticipating the incidence of CWP. Information on the mineralogy of the coal being mined may provide essential data needed to protect the health of the miners in cost effective ways thus reducing the enormous financial burden of health care and lost productivity.

It is true that most medical geology research has been focused on the health problems caused by excess or deficiency of trace elements, exposure to ambient dust, and on other geologically related health problems or health problems for which geoscience tools, techniques, or databases could be applied. Nevertheless, there are important health benefits that medical geologists are working to bring
to the public’s attention (Finkelman and Limpertlaw, 2006). Some of the earliest known medicines were derived from rocks and minerals. For thousands of years various days have been used as an antidote for poisons. Some of these remedies are still in use today. Many trace elements, rocks, and minerals are used today in a wide variety of pharmaceuticals and health care products. There is also a segment of society that believes in the curative and preventative properties of crystals (talisman and amulets). Metals and trace elements such as Au, Pt, Bi, Li, Ga, and Gd, derived from our mineral resources, are being used in some of today’s most sophisticated medical applications. Other recent examples of beneficial effects of geologic materials and processes include epidemiological studies in Japan that have identified a wide range of health problems (such as muscle and joint pain, hemorrhoids, burns, gout, etc.) that may be treated by one or more of nine chemically distinct types of hot springs. Perhaps one of the most unusual examples of the health benefits of geologic materials is a report by Wang and others (2004) on the occurrence of Iodine Deficiency Disorders (IDD, severe congenital problems) in Guizhou Province, China. They describe communities that use coal as the principal source of residential fuel have a low incidence of IDD whereas communities that primarily rely on wood have a far greater incidence of IDD. Chemical analyses of the fuels indicate that the coal is markedly enriched in iodine. Thus, burning the coal in the home to dry crops mobilizes the iodine and may provide a significant health benefit in preventing IDD. This story illustrates why we should keep open minds about the impacts of geologic materials on human health.

Another important role of the medical geologist is to bring to the attention of the public health community potential areas of environmental health concern based on sound geologic information. Although many of the more dramatic medical geology issues occur in developing countries the experienced gained there by geoscientists can be useful in recognizing similar health problems in the U.S. that have more subtle clinical manifestations. A good example of translating medical geology experience from a foreign country to the U.S. is the work of Bunnell et al. (2006). Because of their experience studying a degenerative kidney disease with associated renal pelvis cancers that affect thousands of people in the Balkans (Orem, et al., 2007), Bunnell and his colleagues have recognized that a similar situation exists in the U.S. Gulf Coast. They found that hydrocarbons and microbes with known or suspected links to kidney disease and renal pelvis cancer exist in greater concentration in ground water derived from lignite aquifers of the Wilcox group than in water from other sources.

Mining-related environmental and human health concerns have been the subject of several international medical geology studies. In 1996 during mining of porphyry copper ores on the Island of Marinduque, The Philippines, an accidental large-scale release of tailings into the island’s largest watershed created social, environmental and health impacts among the inhabitants of this island (Plumlee et al., 2001). Although alleged cases of human poisoning from lead, arsenic and cadmium had been attributed to the components of these tailings, a collaboration between biomedical, epidemiological and geological scientists, concluded that health assessment studies were critically needed to better understand the health impacts. The complexity of these types of studies underscores the need for interdisciplinary environmental health assessments, and highlights many scientific, logistical, political and cultural challenges such assessment must overcome.

A second example of medical geology research and mining related human health impacts is the worldwide concerns associated with mercury exposure from small scale gold mining. Mercury exposure presents a significant threat to human health. Effects on the nervous system are well-documented. Cardiovascular and renal effects have also been reported. The increase in small-scale gold mining practices is particularly a concern in South America and Africa. Environmental geochemists from the University of Campinas and the Brazilian Geological Survey are actively collaborating with public health scientists to evaluate the health effects of mercury in populations chronically exposed to it.

Finally, medical geologist can use their geoscience skills, tools, and databases to address environmental health issues outside the traditional geoscience realm. For example, Plumlee et al. (2005) used traditional geochemical and mineralogical procedures to characterize the dust generated by the collapse of the World Trade Center, producing important insights into the makeup and reactivity of the dust. This type of information is essential for the protection of first responders, clean-up crews and the public.

Conclusions

Threat or opportunity? There is no question that medical geology presents us with an opportunity to demonstrate that the geoscience community has the ability to make significant contributions to a range of environmental health problems.

Medical geology seeks to educate the public about these issues and about the role of geoscientists in helping to address these problems. The message that medical geology sends is that we - the geoscience community - are not part of these problems; we are an essential part of the solutions to these problems. To address them the geoscience community must work in concert with the public health community and others to find the causes and to help seek practical solutions.

Perhaps in the near future geoscientists could provide a valuable service to public health communities. Geoscientists working in remote areas and having appropriate training in public health issues could serve as “medical scouts” recognizing possible health problems in areas lacking medical facilities and reporting their observations to the local public health authorities.

Yes, assessment of the potential human health impacts of the extraction or use of earth materials could result in decisions to close down mining or mineral processing operations because the costs for treatment or prevention of health problems would render the projects uneconomic. However, these situations will be more than counterbalanced by generating information that will allow the projects to “do the job right,” resulting in lower clean-up costs, healthier, more productive workforce, fewer lawsuits, and better relations with the neighboring communities. These benefits could ultimately lead to more opportunities for geoscientists.

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Reviewed by AIPG Associate Editors: John Berry, CPG-04032 and Doug Perisutti, CPG-10055.
Rainbow Colors and Grade Control: A Perception Issue

Bart Stone, CPG-11114

Introduction

Recently, on a drive along I-15 in San Bernardino County, California, I noticed a strong bright orange-yellow-colored mountain several miles to the north of the Interstate. The mountain was unique in its bright colors and different from the other mountains radiating outwards in all directions surrounding the target mountain. Then I saw the sign: Calico Ghost Town 5 miles. Calico was discovered in March 1881, produced around 50 million ounces of silver and was abandoned in 1907 when silver prices had fallen to half their 1881 value. The amazing color anomaly in the Calico Mountains is a result of sulfide oxidation and the chances are high that it was the color that attracted the original prospectors.

Pincock Allen and Holt (PAH) clients use portable spectrometers, scintillometers, magnetic susceptibility meters and a myriad of other technical and electronic gadgetry to enhance alteration and grade control parameters. How many mineral deposits have been found by associated color patterns? If color is important, why aren’t companies using it effectively by adding it as a discrimination parameter in reserve modeling? After all, we do use the Munsell Color Order System in a lot of geologic descriptions.

This Perspective seeks to address the issue of color and how it might be better used in identifying critical characteristics of ore patterns and alteration assemblages associated with mineral deposits.

What is the Nature of Color and Individual Perceptions of Colors?

Electromagnetic radiation is characterized by its wavelength (or frequency) and its intensity. When the wavelength is within the visible spectrum (the range of wavelengths humans can perceive (typically from 380 to 740 nanometers), it is known as “visible light.” All of us are familiar with the complete range of the visible spectrum when we observe a rainbow. The lowest end at 380 to 400 nm is the color violet and the upper end is red, with a wavelength of 625 to 740 nm. Most light sources emit light at many different wavelengths. A light source’s spectrum is a distribution giving its intensity at each wavelength. My example of the rainbow has its source in the light from the sun.

The spectrum of light arriving from a given direction determines the color sensation in that direction, but there are many more possible spectral combinations than color sensations. A color may be formally defined as the class of spectra that give rise to the same color sensation; however, such classes would vary widely among different species and to a lesser extent among individuals among the same species. Herein lays a clue to why color has not been very successfully applied in the evaluation of mineral resources.

Color is the visual perceptual property corresponding in humans to the categories called red, yellow, white, green, etc. Color derives from the spectrum of light interacting in the eye with the spectral sensitivities of the light receptors. Color categories and physical specifications of color are also associated with objects, materials, light sources, rock types, soils, ore grades, etc., based on their physical properties such as light absorption, reflection, or emission spectra.

Typically, only features of the composition of light that are detectable by humans are included, which then objectively relates the psychological phenomenon of color to its physical specification. The perception of color stems from the varying sensitivity of different types of cone cells in the retina to different parts of the spectrum, such that colors may be defined and quantified by the degree to which they stimulate these cells.

The normal human retina contains two kinds of light sensitive cells: the rod cells (active in low light) and the cone cells (active in normal daylight). Normally, there are three kinds of cones, each containing a different pigment. These cones are activated when the pigments absorb light. The absorption spectra of the pigments differ: one is maximally sensitive to short wavelengths, one to medium wavelengths, and the third to long wavelengths. The absorption spectra of all three systems cover much of the visible spectrum and the sensitivity of normal color vision actually depends on the overlap between the absorption spectra of the three systems: different colors are recognized when the different types of cone are stimulated to different extents. Red light, as an example, stimulates the long wavelength cones much more than either of the others, and reducing wavelength causes the other two cones systems to become increasingly stimulated as well, causing a gradual change in hue.
The previous discussion relates to the "normal human retina" which leads to the question of what about the "abnormal human retina" and how does that impact the perception of color? Color blindness, or color deficiency in humans, is the inability to perceive differences between some or all colors that other people can distinguish. It is most often of genetic nature, but may also occur because of eye, nerve, or brain damage, or due to exposure to certain chemicals. The list of types of color blindness and specific color deficiencies is well documented but such discussions are outside of the considerations of this Perspective. Medically, the evidence indicates that most color deficiencies are related to defects in the X chromosome. Since men have only one, but women have two X chromosomes, color deficiencies are much more common in men than in women. The ratio in the United States is that approximately 8 percent of the male population but only 0.4 percent of the female population suffer from color blindness defects and of these 90 percent are for the red-green spectrum of colors. Individuals with this vision deficiency either cannot distinguish red from green, or see red and green differently. A considerable number of rock alteration assemblages associated with porphyry copper deposits and massive sulfide deposits are characterized by clay alteration assemblages in the green and light-green spectra. Extending the known statistics on color blindness to the on-site evaluation team, approximately one in every ten geologists will not be able to correctly identify the colors of alteration associated with the mineralization. PAH observations suggest that most projects with more than three drill rigs running on reserve delineation will have geologic teams in excess of ten individuals recording geologic, geotechnical and alteration/mineralization parameters and at least one will have suspect color observations. Perhaps this consideration is intuitively known by the evaluation team and the result is a very low reliance on color as a significant parameter.

History has demonstrated that color has been a very useful guide to ore and the delineation of mineable deposits. Theophrastus, Dioscorides, and Pliny had recognized the distinction between blue and green copper minerals. Pliny (23 – 79AD), also known as Pliny the Elder, was a distinguished Roman citizen and naturalist whose encyclopedic Naturalis Historia was basically a summation of the then known human knowledge covering most subjects in ancient Rome. Pliny observed the eruption of Vesuvius in 79AD and, according to his nephew Pliny the Younger, died as a result of the inhalation of toxic fumes. As an aside, in modern volcanology, the term plinian refers to a very violent eruption of a volcano marked by a column of smoke and ash extending high into the stratosphere.

Agricola in his famous work, De Re Metallica, (1556) summarized mankind's mining and metallurgical knowledge in Europe and parts of Asia. He makes note of the observation that chrysocolla, or azure, or verdigris, or orpiment, or realgar, when they are found, are counted among the good indications of metal content. All of these are intensely colored indicator minerals. In modern times, orpiment at the Jerritt Canyon operations in Eiko County, Nevada was a very favorable indicator of gold mineralization, while at Getchell, in Humbolt County, the bright orange-red colors of realgar have always been associated with good grade gold mineralization. Some of the important ore minerals are named after their unique color, i.e., azurite, the blue hydrated copper carbonate is derived from the Latin word "azure" meaning sky blue and has been in use for thousands of years as an indicator of copper mineralization. Pyrrhotite (Fe₇S₈), a common associate of massive sulfide nickel deposits derives its name from the Greek word "pyrrhos" meaning the color of fire. Hematite, the principal ore mineral of iron deposits derives its name from the Greek word meaning sanguine, the color of human blood.

An informal poll taken within the mining staff at the PAH office in Denver indicated that everyone had worked on at least one significant deposit where color was or had been an important part of grade control, exploration or delineation. The question is how can the concept of using color be quantified and digitized for use in block models and resource studies.

The Munsell Color Order System

The answer can be found in the pioneering work of Munsell in the early 20th century. Albert H. Munsell (1858 to 1918) was both an American artist of distinction and a gifted teacher of art. He developed the first widely-accepted color order system to make the description accurate and convenient and to aid in the teaching of color. The Munsell color order system has gained international acceptance and has served as the foundation for other color order systems, although Munsell is the now the most widely used in the world. He wrote two books about it: A Color Notation in 1905 and Atlas of the Munsell Color System in 1915.

The system of color notation developed by Munsell identifies color in terms of three attributes: HUE, VALUE AND CHROMA. The HUE (H) notation
COLORS AND GRADE CONTROL: A PERCEPTION ISSUE

indicates its relation to a visually equally-spaced scale of 100 hues. There are five principal and five intermediate positions in this scale. The hue notation in general use is based on the ten major hue names: Red (5R), Yellow-Red (5YR), Yellow (5Y), Green-Yellow (5GY), Green (5G), Blue-Green (5BG), Blue (5B), Purple Blue (5PB), Purple (5P) and Red-Purple (5RP).

The VALUE (V) notation indicates the lightness or darkness of a color in relation to a neutral grey scale, which extends from absolute black (value symbol 0) to absolute white (value symbol 10). The symbol 5/ is used for the middle grey and for all chromatic colors that appear half-way in value between absolute black and absolute white.

The CHROMA (C) notation indicates the degree of divergence of a given hue from a neutral grey of the same value. The scale of chroma extends from 0 for a neutral grey to /0, /2, /4 or farther, depending upon the strength (saturation) of the sample evaluated.

In writing the Munsell notation, the order is hue, value, chroma with a space between the hue letter and the succeeding value number, and a diagonal between the two numbers for value and chroma. If expression beyond the whole number is desired, decimals are always used, never fractions. Thus the notation for a color of hue 5YR, value 5, chroma 6 is 5YR 5/6, a yellowish red. The notation for a color midway between the 5YR 5/6 and 5YR 6/6 is 5YR 5.5/6; one midway between 2.5YR 5/6 and 5YR 6/8, it is 3.75YR 5.5/7. The colors and notation come in the form of a small field binder with waterproof paper and oval openings adjacent to each color so that the oval can be placed on the rock/sample/drill core, etc., and directly compared. There are no issues with colorblindness because each individual is comparing the sample with the color chart directly, and each will see the same color notation regardless of what color is perceived by the brain. With universal usage and no language barriers to complicate communications, every geologist looking at a dark red rock with Munsell notation 7.5R 3/8 will identify a dark hematite material, typical of lateritic iron ores and lateritic nickel deposits.

In the mid 1950’s uranium boom, the Shirley Basin in Wyoming became a major hotbed of activity and very quickly it was discovered that the optimum ore guide was the contact between light yellow green alteration and a darker brown which marked the roll-front boundary between oxidation and reduction. The author’s examination of a roll-front deposit in the Dakota Sandstone in Colorado showed that the oxidized sandstone had a Munsell notation of 2.5Y 8/3 while the reduced sandstone was a very pale brown with notation 10YR 8/2. Uranium mineralization was at the contact between the two but could be approached from either direction very closely using the colors. The favorable clay horizon mined over a number of generations within the town of Golden, Colorado is part of a black horizon of argillite with a color designation 2.5Y 6/3. In a similar fashion, formation tops and bottoms can be color specific. On the I-70 geologic cross-cut just west of Denver, the top of the Morrison Formation is a maroon siltstone 7.5R 5/4 while the bottom of the Dakota Group is a siltstone with designation 10YR 7/3.

Mineralization, alteration and sulfide types can also be categorized with Munsell color notation. With mining operations and their geologists logging color as a significant attribute, we may find someday that the evidence suggests that economic hypogene porphyry mineralization has a characteristic 5Y 8/2 notation. As the situation currently exists, we don’t know this, but then we really haven’t tried to apply it, except in a few rare cases. Munsell Color charts are available from your favorite geology supply stores. PAH would recommend that you buy one for each core logging facility and get started logging colors. In five or ten years there may be enough data from enough projects that we can develop a new mine modeling tool.

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Munsell colors: http://www.acs.appstate.edu/~kms/classes/psy3203/Color/munsell.htm

Bart Stone, CPG-11114, graduated from Regent University with an MBA and from Dalhousie University with a B.S. in Geology. He has managed exploration groups in North and South America, Australia, and Africa seeking both base and precious metals. He has also applied new technology creatively which led to the discovery of new metal deposits in copper and gold and reopened a large silver deposit.
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