TPG

Volume 48, Number 5

THE PROFESSIONAL GEOLOGIST

SEPT/OCT 2011

A Publication of the
American Institute of Professional Geologists

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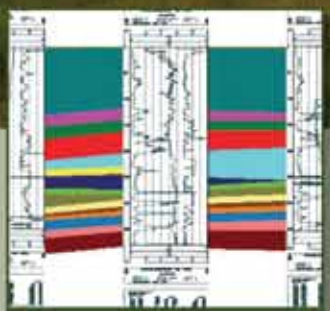

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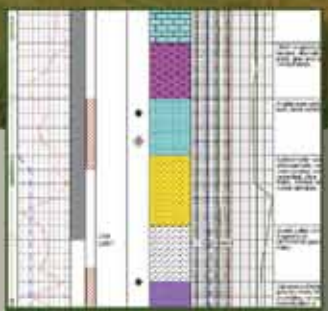

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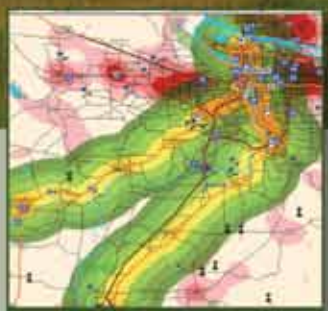

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Volume 48, Number 5 SEPT/OCT 2011

Inside This Issue

ON THE COVER-Council Overhang, at Starved Rock State Park in Illinois. Photos by Kathy Casstevens-Jasiek/Starved Rock Lodge.

DEPARTMENTS

AIPG Publication Policy, October 4, 2010. AIPG encourages submission of articles and editorials for publication in *TPG* on topics related to the science and profession of geology. Submittals shall be of interest to the members of AIPG, other professional geologists, and others interested in the earth sciences. Articles and editorials may be noted as follows at the discretion of the Editor, "The opinions, positions and conclusions presented herein are those of the author and do not necessarily reflect the opinions, positions or conclusions of the American Institute of Professional Geologists." All materials submitted for publication, including author opinions contained therein, shall include accurate and appropriate references. The Editor has the authority to solicit, edit, accept, or reject articles and editorials and other written material for publication. The Executive Committee has the authority if it so chooses to act on any particular case to support or overrule actions of the Editor regarding the solicitation, editing, acceptance, or rejection of any particular article, editorial, or other written material for publication.

American Institute of Professional Geologists (AIPG) is the only national organization that certifies the competence and ethical conduct of geological scientists in all branches of the science. It adheres to the principles of professional responsibility and public service, and is the ombudsman for the geological profession. It was founded in 1963 to promote the profession of geology and to provide certification for geologists to establish a standard of excellence for the profession. Since then, more than 10,000 individuals have demonstrated their commitment to the highest levels of competence and ethical conduct and been certified by AIPG.

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

The Professional Geologist (USPS 590-810 and ISSN 0279-0521) is published bi-monthly by the American Institute of Professional Geologists,12000 Washington St., Suite 285, Thornton, CO 80241-3134. Periodicals Postage Paid at Denver, Colorado and additional mailing offices.

POSTMASTER: Send address changes to The Professional Geologist, AIPG, 12000 Washington St., Suite 285, Thornton, CO 80241

Subscriptions for all Members and Adjuncts in good standing are included in annual membership dues. Subscription prices are $20.00 a year for Members' additional subscriptions and $30.00 a year for non-members for 6 issues (for postage outside of the U.S. add $10.00). Single copy price is $4.00 for Members and $6.00 for non-members. Claims for nonreceipt or for damaged copies are honored for three months.

Printed in U.S.A. by Modern Litho-Print Company in Jefferson City, Missouri.

For AIPG news and activities go to www.aipg.org.

AIPG National Officer Election Results

2012 President-Elect (2013 President)

Ronald J. Wallace
CPG-08153
Roswell, Georgia

Statement of purpose or goals you have for AIPG: To continue to show value to our members and to all professionals. To support the continued growth in educational training by conferences, workshops, and field trips. To reach out to the universities and students and show them the opportunities they will have as professional geologists and how AIPG can help them reach their goal.

2012 Vice President

E. Thomas Cavanaugh
CPG-10493
Arvada, Colorado

Statement of purpose or goals you have for AIPG:To enhance the communication with all of the state sections, increasing the sharing of ideas between all sections and with the National Executive Committee to stimulate growth and development of sections while working with the current VP to make a transitional change and continue his efforts. My goals include assisting the president in affecting her agenda, the AIPG strategic plan, strengthening the stature of CPG, and promoting the National Conferences.

2012-2013 Secretary

J. Foster Sawyer
CPG-10000
Rapid City, South Dakota

Statement of purpose or goals you have for AIPG: To promote the role of geologists as decision makers, providers of critical information, and public educators regarding our natural resources. To stimulate growth and development within struggling and inactive State Sections. To increase student participation in AIPG through student participation in meetings and field trips, and through increased interaction between AIPG and geoscience departments across the nation.

2012-2013 Editor

Virginia T. McLemore
CPG-07438
Socorro, New Mexico

Statement of purpose or goals you have for AIPG: My goals as your Editor are to 1) continue the efforts of past editors to improve and expand the scope of the Institute's publications, 2) to broaden the understanding of geologic concepts to the public, especially secondary students and their teachers, 3) continue to encourage student participation in AIPG and TPG, and 4) to continue to provide a forum for controversial issues facing our profession, such as water, environmental, climate change, mining, the need for minerals for green technologies, among others.

Arizona Section

Arizona Section Judges, Awards Prizes, At Arizona Science And Engineering Fair-The Arizona Science and Engineering Fair (AZSEF) was held April 10-12 in the Phoenix Convention Center. Arizona Section members Pam Wilkinson, Bill Greenslade, and John Ward spent a day as volunteer judges for the fair on behalf of AZ-AIPG. Once we had completed our AZSEF assigned individual judging tasks, we joined forces and revisited approximately 40 displayed projects that touched on the broad field of earth science. Our intent was to award three cash prizes, one in each age group (elementary, middle, and high school), to the best projects in the earth sciences. After considerable deliberation we were unanimous in our selection of the prize winners. Pam Wilkinson attended the awards ceremony and presented the AIPG prizes to the recipients, as described below.

Bridget, a student at La Joya Community High School in Avondale was our senior high school division prize winner. Her project was entitled "Comparative Crater Morphology of the Leading and Trailing Hemispheres of Saturn's Inner Moons". She was awarded a check for $300. (Bridget also took second place in the Earth and Planetary Science Category.)

Henry, a student at Veritas Preparatory Academy in Phoenix was our elementary school division prize winner, with a project entitled "Salinity of Central Arizona Waters". He was awarded a check for $50.

Aamirah, a student at Paragon Science Academy in Chandler was our middle school division prize winner. Her project was entitled "The Science Behind Tsunamis". She was awarded a check for $150. (Aamirah also received recognition from the Association for Women Geoscientists.)

From the letters accompanying each prize: *The Arizona Section of the American Institute of Professional Geologists (AIPG) is pleased to inform you that your Arizona Science and Engineering Fair project ... has been selected for special recognition. The science of geology covers many areas of study including the water, mineral resources, atmosphere, history, past life forms, formation and processes of change that affect the earth and other celestial bodies. Understanding the processes that control the formation and development of the earth and the solar system is key to the well-being and survival of humans, animals and plants.*

Your project demonstrates a curiosity about geology and an aptitude for science that the AIPG wishes to recognize. AIPG represents more than 5,500 practicing professional geologists in the United States and abroad and encourages you to consider a career in one of the many interesting areas of study within the science of geology. Please accept the enclosed check .... in recognition of your research and interest in geology.

I congratulate our winners and offer special thanks to Bill and Pam for devoting their time to this effort, and also thanks to our section for your encouragement and support to award $500 from our treasury for these prizes.

John Ward, CPG-06729
Section President

Our winners are, from left to right: Bridget Russell, Henry Gorton, and Aamirah Chisti.

Arizona Section Spring 2011 Field Trip Snowflake-Holbrook-Winslow Area Saturday – Sunday, May 21st – 22nd. The AIPG Arizona Section spring field trip was led by Paul Lindberg, CPG-6344. As many of you know, Paul has led several excellent field trips for us in the past so we really appreciated his offer to lead another geology field trip for us. The trip to see some of the geology of the Holbrook – Winslow area began early on Saturday, May 21st in Snowflake. The first stop on the field trip included a hiking tour of "The Sinks" (a large number of sinkholes where the surface Coconino Sandstone is collapsing into subsurface salt solution cavities). Then, onto the Holbrook anticline (the "anticline" is caused by the one-sided solution collapse of subsurface salt on the otherwise gently north-dipping rock surface) with a nice stop for lunch, through the new wind generation complex, and then another hike into an area of giant earth cracks caused by subsurface salt solution. The area also includes the extensive potash and related minerals deposits of the Holbrook Basin.

The Saturday portion of the field trip ended in Winslow where we had a very enjoyable dinner at the historic La Posada Hotel. It also gave many of us a chance to "stand on the corner in Winslow, Arizona", one of the other highlights of Winslow.

The field trip resumed on Sunday morning when we met in Holbrook at the core shed from drilling of the potash deposit by one of the development companies. It was a very interesting visit and we enjoyed reviewing the core and discussing the geology of the Holbrook basin.

The field trip was very informative and included some spectacular scenery. Thank you to Paul Lindberg for leading such a great trip. (And, thank you, Phyllis for assisting with the field trip also).

Barbara Murphy, CPG-6203
Section Secretary

Michigan Section

***IN-SITU* Advance Tools Workshop held on June 22 and 23-**The Michigan Department of Environmental Quality and the AIPG Michigan Section co-sponsored a workshop that showcased advancements with *in-situ* remediation methods on June 22 and 23 at the Ralph A. MacMullan (RAM) Conference Center on the north Shore of Higgins Lake. Kevin Lund and Sara Pearson co-chaired the event which was attended by approximately 100 people. Attendees included regulators, consultants, contractors and private industry.

The first day included presentations that reviewed microbiological processes, innovative laboratory tools, presentations on isotope analysis in biodegradation, and microbiological sampling equipment. A new topic for most attendees was using stable isotope analysis to understanding the origination of TCE sources; another line of evidence to demonstrate monitored natural attenuation, using microcosm studies to screen remedial alternatives; or, answering that age old question, "Will the addition of oxygen promote the growth of bacteria capable of aerobic degradation of BTEX?"

The second day included a review of Public Act 451, Part 22 regulatory compliance process, discussions regarding *in-situ* failures and why these applications failed, a concept that it is cheaper to map a plume than to remediate a plume, and a presentation that a successful in-situ remedy deployment requires site specific theory/design, execution and definition of achievable endpoints. Several case studies presented examples of successful in-situ techniques applied in Michigan and other parts of the Midwest.

Speakers for both days included academicians, regulators and consultants. The workshop benefited from generous participation from Advanced Tools for In-situ Green Remediation, Mateco Drilling, Cemcor Environmental Services, Orin Remediation Technologies, In Ventures Technologies, Chemviron Midwest, Catskill, EOS Remediation, LLC, Regenesis and Adventus.

Workshop participants were enthusiastic about this learning and networking opportunity.

Some comments from attendees included:

"…an excellent outreach training of modern *in-situ* remediation technologies including the rules, successes and pitfalls. If these conferences and training seminars are continued they should help to improve the remediation toolbox for Michigan consultants…."

"…The workshop provided many quality presentations and discussion about technical issues in areas of investigation and remediation. Most importantly, it showed MDEQ's commitment to working with industry to develop a constructive problem solving dialogue. At several points during the discussion, MDEQ staffers reiterated the message that they were eager to work together to close sites…"

AIPG Michigan Section would like to continue fostering these types of activities through collaboration with the MDEQ. In order to continue and build on this success AIPG Michigan Section needs support from its membership through participation.

Our goal was to deliver a cost effective forum to share in-situ remediation experience and establish networks between the MDEQ, Consultants and Industry. Given the numerous positive comments we exceeded our expectations. This was achieved through the planning and hard work of Kevin and Sara.

Color slides from the presentations given during the two day workshop will be available on the AIPG Michigan Section's website. Be sure to check them out.

Outdoor presentations by vendors at the DEQ/ AIPG Michigan Section *IN-SITU* work shop. Photograph courtesy of Kevin Lund.

AIPG Michigan Section Education Grant-In December 2010 the Michigan Section awarded a grant to Kelloggsville Public Schools. Lynnea Roon of Kelloggsville Schools, who prepared the grant application, shared photographs and explained how the grant was used to enhance outdoor science lessons for third, fourth, and fifth graders. It was clear that the grant was put to good use.

Grant Awardee Lynnea Roon showing how the grant money was used. Photograph courtesy of Adam Heft.

Adam Heft, CPG-10265
Section Newsletter Editor

Kentucky Section

Nearly 1,000 people, many of them children, attended the Kentucky Section of the American Institute of Professional Geologists' third annual Darwin Lecture on February 10, 2011, to hear Dr. Jack Horner, curator of paleontology at the Museum of the Rockies, speak. The lecture, "How to Build a Dinosaur: Extinction Doesn't Have to Be Forever," was based upon Dr. Horner's book of the same name (Dutton Adult, 2009, $12.99). Horner is somewhat of a celebrity-scientist, having been the real-life inspiration for the paleontologist in the Jurassic Park books and movies (he says he was the one who didn't get eaten!).

Horner began the lecture with some comedic misdirection when he revealed his first slide: "Eliminating Dinosaurs and Making New Ones." By this he meant that there are "too many" dinosaurs species, and outlined how he was going to remedy the problem. He assumed that birds are modern-day dinosaurs and that bone structure and skull features of birds are different between juveniles,

subadults, and adults. He used the cassowary, a modern flightless bird with a colored bony crest from the tropical forests of New Guinea and Australia, as an example. He then showed the difference between bone structure and skull development in cross section in the various life stages of cassowaries. He noted that birds develop from juvenile to adult at a rapid rate, and surmised that if dinosaurs also matured at a rapid rate, these developmental differences could also apply to dinosaurs.

Horner noted that although cassowary skeletons are plentiful, dinosaur skeletons are not. He joked that he would go to various museums and ask if he could have their dinosaur bones to cut up, to which they politely replied, "NO!" Horner also observed that in the early days, museums displayed only the largest specimens. Later, when they began collecting smaller skeletons, they noticed similarities in a species type, which led to a new genus, without consideration of stage development. Giving developmental stages their own genus and species names has resulted in naming about twice as many dinosaurs as there probably were, he indicated.

Since no museums were going to give up their specimens, Horner decided to collect his own to test his theory. He knew Montana's Hell Creek Formation has fossils from 17 known dinosaur species, so he set about collecting as many different size specimens as he could, then grouping them into similar species. Next, he examined bone structure cross sections and skull development, and concluded that many of the so-called new species were really just variations in development of the same species. Through many years of collecting and examining, he managed to eliminate five of the 17 species found in the Hell Creek Formation. He used the common dome-shaped heads of pachycephalosaurs as examples. Based on the internal, bony head structure of three such dinosaurs, he suggested that Dracorex, Stygimoloch, and Pachycephalosaurus may actually be the juvenile, teen, and adult forms, respectively of the same dinosaur genus.

This, he said, "leaves an opening for my dinosaur, the Chickenosaurous." He would not use the Jurassic Park method of extracting dinosaur DNA from mosquitoes preserved in amber—so far only proteins have been retrieved using this method, so it seems DNA is not preserved during fossilization. Instead, he proposed manipulating certain genes in a bird embryo to create a dinosaur. He noted that in the embryonic developmental stages, a chicken has a long tail, which later is resorbed, and you can see three distinct segmented limbs at the end of the wing, which later became fused as one. Molecular biologists have already found the gene in the chicken that controls teeth growth and have managed to "turn that gene on." So, he figures that if molecular biologists can find the gene or genes that "turn off" the tail reabsorption and the fusing of the end limbs in the wing, that it would be possible to hatch a different-looking chicken: the Chickenosaurus.

Can we look forward to this new species any time soon? Horner says that although he continues to work with molecular biologists, progress is slow. But there has been surprisingly little objection from the scientific community. Unlike the scientists in Jurassic Park, Horner is not conducting his research in secrecy. He has discussed the work online, and of course wrote How to Build a Dinosaur.

After the talk, Horner fielded questions from enthusiastic kids of all ages, then signed autographs and spoke at length to all who were interested.

Richard Smath, MEM-0240
Section Newsletter Editor

Section News continued on page 50.

Is Your Profile Correct?

It is important to keep your address, phone numbers, and e-mail information up to date in our records. Please take the time to go to the AIPG National Website, ***www.aipg.org,*** login to the member portion of the site and make sure your information is correct. You can edit your record online. If you do not know your login and password you can e-mail National Headquarters at aipg@aipg.org or call (303) 412-6205.

Invitation from AIPG to Submit Articles

You are invited to submit an article, paper, or guest column based upon your geological experiences or activities to the American Institute of Professional Geologists to be included in "The Professional Geologist" *(TPG)* bi-monthly journal. The article can address a professional subject, be technical in nature, or comment on a state or national issue affecting the profession of geology.

Article submissions for *TPG* should be 800 to 3200 words in length (Word format). Photos, figures, tables, etc. are always welcome! Author instructions are available on the AIPG website at *www.aipg.org*.

Please contact AIPG headquarters if you have any questions. AIPG email is *aipg@aipg.org* or phone (303) 412-6205.

BUILD THE FUTURE OF GEOLOGY TODAY!

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The Foundation of the American Institute of Professional Geologists is building a strong platform of programs to promote the future of the geosciences among students, the public, and professionals.

The Foundation is soliciting your support to fulfill its mission. Your contributions, through either generous cash contributions or a deferred gifts program, are vital for the continuation and expansion of the Foundation's initiatives.

The goal of the Foundation is to establish a $2 million endowment which will be used to fund geologically-oriented programs.

The Foundation will support the dissemination of information concerning geologic issues affecting the public, AIPG section outreach activities, scholarships, and professional development programs.

Help the public interest, the geological profession, AIPG, and yourself in the following ways:

- Contribute to the Foundation
- Help raise funds for the Foundation
- Volunteer assistance in developing the Foundation's programs

For further information or if you have questions about donating to the Foundation, contact Raymond W. Talkington, PhD., Chairman of the Foundation at (603) 773-0075, ext. 11 or rtalkington@geospherenh.com.

AQUIFER MANAGEMENT IN THE MID-ATLANTIC STATES

(WATER DEMAND, PUMPING STRESS, SALINE INTRUSION, ASR, RESOURCE PLANNING etc.)

Hilton Hotel, Greenville, North Carolina
207 SW Greenville Blvd., Greenville, NC 27834, (252) 355-5000

October 3 & 4, 2011 (Optional field trips Oct 2nd & 5th)

Symposium organizers:

American Ground Water Trust

American Institute of Professional Geologists

In cooperation with:

East Carolina Institute Coastal Water Resources Center

East Carolina University

This two day water resources symposium will provide information exchange opportunities for civic leaders and water professionals in science, engineering, planning, management and regulation. The symposium focus will be on water resources issues (especially ground water) that are impacting the coastal Atlantic states from Maryland to Georgia. The invited presentations will provide insight to water related problems in the region and to the latest scientific findings and technology innovations that can provide solutions. It is anticipated that the symposium will assist state and local policy decision makers to optimize current and future water use to achieve economic and environmental sustainability. Earn CEU's!

The field trip on Sunday, October 2nd will travel to North Carolina's first Aquifer Storage and Recovery (ASR) Project that involves the storage of treated Tar River water in the Black Creek and Upper Cape Fear Aquifers. Cycle testing involving injection of water at approximately 550 gpm is currently underway. Participants will visit the Greenville Utilities Water Treatment Plant followed by a site visit to the ASR facility. The trip will depart from the Hilton Hotel at 2:30 pm and return approximately 6:30 pm.

Program:

- Sunday, October 2, 2011 - Field Trip-NC's First ASR Project
- Monday, October 3, 2011 - Symposium Presentations
- Monday, October 3, 2011 - Evening Reception
- Tuesday, October 4, 2011 - Symposium Presentations

Basic Ground-Water Hydrology
by Ralph C. Heath

Be one of the first 100 registrants to receive a free signed copy!

$325 - AGWT/AIPG Members Full Registration - $180 One-Day
$345 - Government Rate Full Registration - $190 One-Day
$395 - Non-Member Full Registration - $220 One-Day
$150 - Student Full Registration - $80 One-Day
$ 25 - Sunday Field Trip (2:30-6:30 pm - Departs and Returns to the Hilton Hotel)

Registration cost will include course materials, continental breakfasts, lunches, breaks, and the evening reception on October 3rd. Participation in the field trips is optional and will be priced separately.

* Be sure to mention the 'Water Conference' to receive the $99 room rate at the Hilton through 9/16/11

AQUIFER MANAGEMENT IN THE MID-ATLANTIC STATES

(WATER DEMAND, PUMPING STRESS, SALINE INTRUSION, ASR, RESOURCE PLANNING etc.)

American Ground Water Trust

Hilton Hotel, Greenville, North Carolina
207 SW Greenville Blvd, Greenville, NC 27834, (252) 355-5000

October 3 & 4, 2011 (Optional field trips Oct 2nd & 5th)

East Carolina Institute
Coastal Water Resources Center
East Carolina University

American Institute of Professional Geologists

Registration Form

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Address: _____

City/State/Zip: _____

Telephone: (_____) _____ E-mail: _____

First 100 registrants receive a free signed copy of Ralph C. Heath's book 'Basic Ground-Water Hydrology'

Registration Fees:
$325 - AGWT/AIPG Members Full Registration - $180 One-Day
$345 - Government Rate Full Registration - $190 One-Day
$395 - Non-Member Full Registration - $220 One-Day
$150 - Student Full Registration - $80 One-Day
$25 - Field Trip Sunday, Oct. 2nd, NC's First Aquifer Storage Recovery Project (2:30-6:30 pm) depart from the hotel

Mention 'Water Conference' to get the room rate of $99 at the Hilton through 9/16/11

(conference registration includes course materials, continental breakfast, lunches, breaks and evening reception)

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Cancellations received less than 21 days prior to the first day of the event will be charged a $75 processing fee. Cancellations received less than 7 days prior to the first day of the event will forfeit the entire registration fee. (All cancellations must be made in writing to the American Institute of Professional Geologists).

Register Today!

American Institute of Professional Geologists - 12000 N. Washington Street, Suite 285, Thornton, CO 80241
(303) 412-6205 Fax: (303) 253-9220 email: aig@aipg.org

James J. Geraghty – Environmental Pioneer

May 26, 2011 - James J. Geraghty, CPG-02038, one of the pioneers of the environmental movement in the U.S. and a founder of the noted groundwater consulting firm Geraghty & Miller, died in The Villages, FL earlier this month at the age of 90.

Entering the field of geology in the 1950's, a time when few schools offered groundwater courses and there were few if any programs in hydrogeology, Jim earned a master's degree in geology from the City College of New York. After a brief stint with a New York-based consulting firm, Jim spent seven years working for the U.S. Geological Survey. In 1957 he teamed with two other groundwater experts, David Miller and Gene Hickok, to form Geraghty, Miller & Hickok, one of the first U.S. consulting firms to specialize in this little understood but critical niche. A year later Hickok left the firm, which then became Geraghty & Miller (G&M).

Moving their office from New York City to Long Island in 1961, Jim worked overseas with the United Nations Development Program during the early 1960s, traveling to over 20 countries under a UN passport to consult with foreign governments on developing groundwater resources. After the creation of the U.S. Environmental Protection Agency in 1970, Jim consulted for this newly established agency. Jim's work focused on the impact of surface impoundments and other industrial sources on groundwater quality, building up an inventory of knowledge about groundwater contamination throughout the U.S. In fact, the firm's findings were incorporated into the original EPA guidelines on groundwater, many of which are still being used today.

G&M's work in the 1970's helped define environmental problems and contaminant sources relating to groundwater, resulting in a groundbreaking report to the U.S. Congress in 1977: Waste Disposal Practices and Their Effects on Groundwater. After the discovery of massive contamination at Love Canal, the firm's clientele shifted from municipal and federal agencies to industries, focusing on evaluating groundwater contamination problems at industrial sites. Through the late 1980's the firm was active almost exclusively on groundwater cleanup issues. Collaborating with the EPA on defining sound disposal practices, they were instrumental in the development of major Federal environmental regulations.

Photo of David Miller, (left) and Jim Geraghty take in 1996.

Over the years, Jim's creativity took many forms. It was his idea to form the Water Information Center, through which the firm sold subscriptions by direct mail for a newsletter on groundwater, which, according to David Miller, "kept us alive in the 50's." For nearly two decades, G&M held numerous seminars across the U.S., with thousands of attendees from industry and government coming to hear Jim's lectures on groundwater. Jim was a major mover in expanding the company from a regional New York firm to a national consultancy with two major regional offices in Annapolis, MD and Tampa, FL. The firm went public in 1988 and Jim became Board Chairman.

In the early 1990s, recognizing the attractive opportunities for growth in the European environmental market, G&M opened an office in the United Kingdom. They also participated in a joint venture focused on soil washing with Heidemij, a Dutch company. In 1993, G&M merged with Heidemij, which later changed its name to ARCADIS. Jim followed the company's growth from a distance, retiring soon after the merger to lead a quiet life in Florida at age 72, having reached his goal – almost all his former employees remained with ARCADIS where they found a satisfying working environment with global ambitions.

"Jim was a true scientist," says his former partner, David Miller. "He was one of only a handful of people in private industry that understood how groundwater works and was able to teach others by taking complex information and making it simple." He reported his conclusion that soil and groundwater at almost all existing and abandoned industrial sites were contaminated, generating national headlines in Time magazine and Business Week – when asked why, he replied, "Everything leaks."

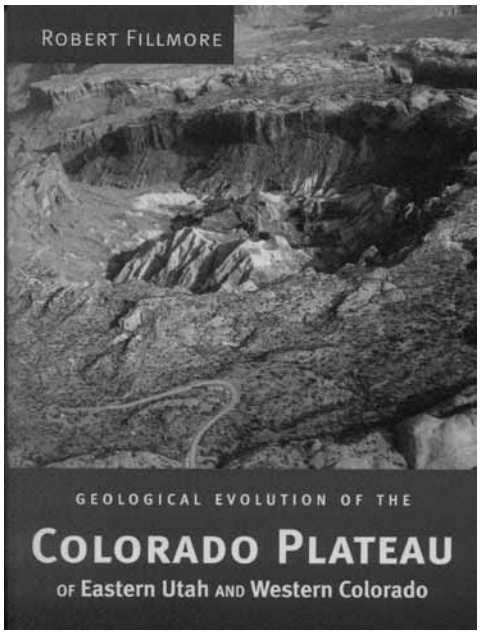
"Jim always thought outside the box!" said co-worker Vince Amy. "He enjoyed finding creative solutions to problems and was willing to entertain any concept – which he'd then run through a rigorous scientific process for feasibility." He believed that Science could lead the charge for change.

Another former G&M employee, Tom Tessier, commented, "he was definitely great at making you think – often playing the devil's advocate to spur debate and make you defend your position." Jim's legacy to the profession was in creating "the most innovative and effective solutions," said former co-worker Nick Valkenburg, "ensuring safe water supplies for generations to come all across the U.S."

"Jim was one of the 'grandfathers' of the environmental movement in the U.S., said Steve Blake, CEO of ARCADIS U.S., "his pioneering groundwater work shaped the industry and is still meaningful for environmental engineers and scientists today."

Geological Evolution of the Colorado Plateau of Eastern Utah and Western Colorado

By Robert Fillmore



Matthew Rhoades, CPG-07837

With this particular review, I do not want you, the reader, to miss the conclusion. Thus, in the second sentence, I want you to know that this is a fantastic book and you will be professionally remiss if you do not get your own copy and read it cover-to-cover. You do not need to have a particular interest in the Colorado Plateau to really benefit from absorbing this book. This book is bigger than the Colorado Plateau. There are so many concepts artfully explained in it that you will really benefit from giving this a thorough run-through.

Personally, I have a geology library bordering on the absurd. I can easily state that this is the best geology book I have read in the last two decades. When good technical discussion is woven into really good prose, it morphs into fine geologic literature. This book is excellent geologic literature. Dr. Fillmore has an excellent grasp of the English language and he paints many fine pictures in detailing technical fine-points.

The deep secrets of the Uncompaghre Uplift come unravelled as Fillmore recounts the investigative efforts of those who have toiled in the field for decades. The author is quick to give full credit to the brilliant geologists who have gone before him and he names hundreds of them in the telling. He gives many examples of how geologic thought progressed with continued, detailed investigations in the region. The reader will most likely recognize many of the names (besides John Wesley Powell). I really like the author's style of mentioning geologists or teams of geologists by both their first and last names and often mentioning their university, employer, or agency affiliation. He really gives credit where credit is due and, in the process, he established himself firmly in the hierarchy.

In the pages of this book, I can also guarantee you that you will read for the first time some of the little-known connections between the Colorado Plateau and the rest of North America. Specifically, these include; Appalachia, the Quachita Belt and the Marathon Mountains, the Ancestral Rockies, the Rio Grande Rift, the volcanics of Central Mexico, and the accreting terranes on the western continental margin.

Sequence stratigraphy, depositional systems, salt diapirism, uranium deposits, fold belts, evaporate sequences, potash deposition, Ar/Ar dating, sea level rise and fall, angiosperms and gymnosperms, plus a host of other topics are combined with tectonics to tell a compellingly rich and well-researched story of the evolution of the Colorado Plateau. This book could only be written by an individual with a deep, intimate understanding of the region. It is quite obvious (while reading between the lines) that Dr. Fillmore has scrambled-up many side canyons to get a first-hand understanding of the Colorado Plateau.

Like all fine geologic story-telling, this one starts in the Proterozoic. It progresses, in detail, all the way to a discussion of arrow heads and spear points. It is a very good read in-between.

Also included at the end of this book are several detailed road logs for field trips throughout the region. They are very well presented.

In addition to the great text in this book, it is also particularly well-illustrated with graphics and color photos. Many of these have been created by the author and can be found nowhere else. This book is also a great buy. At less than $30 and more than 300 pages, it is bound to become a hit amongst skin-flint geologists. The book has an extensive glossary and copious bibliography. It is obviously well-researched and has both the physical heft and the cerebral heft to support all of my claims above.

My advice is that you buy two of the large format, Gazetteer-like map books for both Colorado and Utah before delving too deeply into this tome. You will want to have a much better geographical understanding of the points made in this book. They will also help you find all the great National Parks that populate the region (for good reason). A bright highlighter will be handy for the text, too.

In my efforts to be an impartial reviewer, I almost feel obligated to mention something negative about this book. And, with that passing thought, I have assuaged any thought of lacking objectivity. Although I did not know it at the time, I now know that I had actually been waiting for this book for a long time. Buy this book, soak it in slowly, and you will be a much better geologist for the experience.

So there, I also presented the conclusion at the end.

AASG

Association of American State Geologists

July 21, 2011

Mr. William J. Siok
AIPG Executive Director
AIPG National Headquarters
12000 Washington St., Suite 285
Thornton, Colorado 80241-3134

Dear Mr. Siok:

During the 2011 Annual Meeting of the Association of American State Geologists, it was unanimously resolved by all attending members to present the American Institute of Professional Geologists with the enclosed appreciation. It is my pleasure as AASG President to present the resolution to AIPG.

The distinguished committee that AIPG assembled, and the research and evaluation they conducted to answer the question, "What is the importance and future role of state geologic surveys?" has produced an invaluable tool for AASG. We are most appreciative and humbled by the recognition and endorsement of our professional colleagues.

Since 1908 state geologists have formally convened as AASG to determine what the overarching geologic and natural resource issues are and to act upon those determinations at a state and national level. We remain dedicated to this mission and appreciate knowing that our efforts are useful to the geologic community-at-large.

Many regards,

Vicki S. McConnell
AASG President

Enclosure

AASG
Association of American State Geologists

Resolution to Thank the AIPG and Members of the Committee Who Participated in the White Paper "Importance and Future Roles for State Geological Surveys"

WHEREAS, the American Institute of Professional Geologists initiated a study of the value and importance of the state geological surveys; and

WHEREAS, the AIPG formed a distinguished committee of the following members:

Bob Blauvelt
GEI Consultants

Chuck Drake
Tetra Tech

Mimi Garstang
Kansas City, MO

Barbara Murphy
Clear Creek Associates

Dennis Pennington
Maple Glen, PA

Dorothy Richter
Hager-Richter Geoscience, Inc.

Dave Sadoff
AIG Consultants

Foster Sawyer
South Dakota School of Mines and Technology
Dept. of Geology and Geological Engineering

Bill Siok, Executive Director
AIPG National Headquarters

Ron Wallace
State of Georgia EPD

And **WHEREAS**, the AIPG committee conducted surveys and interviews with state geologists, and

WHEREAS, the AIPG committee wrote a white paper that was published in the *Professional Geologist* and disseminated widely; and

WHEREAS, this white paper eloquently described the value and importance of the state geological surveys,

NOW, THEREFORE BE IT RESOLVED: in official action on June 15, 2011 in Dubuque, Iowa, the Members, Honorary Members, and Associates of the Association express their sincere gratitude to the American Institute of Professional Geologists.

Webinar Spotlights Geosciences Careers for Women

(Westerville, OH — June 29, 2011) Female students considering career paths and professional women considering career changes can learn about opportunities in the geosciences during a October 13 Webinar hosted by the National Ground Water Association.

The half-hour Webinar, which begins at noon ET, takes place during Earth Science Week. Four women working in various areas of the geosciences will discuss their unique perspectives.

The Webinar will be presented at a level appropriate for all groundwater professionals — men, as well as women. The presentation will be informal and time will be allocated for questions.

Participating are:

- Rula A. Deeb, Ph.D., BCEEM, a vice president and technical director at ARCADIS in Emeryville, California, whose expertise includes groundwater and soil remediation with an emphasis on site closure strategies, in situ technologies, and the environmental fate, transport, and treatment of emerging contaminants
- Sandra Eberts, PHg, who has been with the U.S. Geological Survey for 25 years and currently is team leader of the USGS National Water-Quality Assessment Program Transport of Anthropogenic and Natural Contaminants to Supply Wells (TANC) topical study
- Michelle Whitman, an environmental scientist and manager of business development with BESST Inc., a California geotechnology firm
- Kathleen M. Wiseman, who works for Water Systems Engineering, a multitiered firm that specializes in groundwater and surface water applications.

Should I become a CPG?

Have a you been thinking about upgrading your membership to CPG? If the answer is yes, What are your waiting for? To find out if you have the qualifications go to Article 2.3.1 of the AIPG Bylaws. The AIPG Bylaws can be found on the AIPG website or the directory.

The CPG application can be found on the website under 'Membership'. Just follow the instructions. The basic paperwork includes the application, application fee, transcripts, geological experience verification and sponsors.

If you have any questions, you may contact Vickie Hill, Manager of Membership Services at aipg@aipg.org or call headquarters at 303-412-6205.

www.aipg.org

PROFESSIONAL MEMBER APPLICATION

American Institute of Professional Geologists
Professional Member Application
Sign up Online – www.aipg.org
12000 N. Washington Street, Suite 285, Thornton, CO 80241 – (303) 412-6205 - aipg@aipg.org

Professional Member Dues (Membership is activated upon receipt of dues.)

If you apply: Dec – Mar = $100; Apr – Jun = $75; Jul – Sep = $50; Oct – Nov = $25 **Payment: ☐ Enclosed ☐ Bill Me**

Last Name: First Name: MI: Suffix:

Employer Name: ☐Mr. ☐Ms. ☐Mrs. ☐Dr.

Preferred Mailing Address: ☐ Home ☐ Business Male ☐ Female ☐ Year of Birth:

Street:

City: State: Zip: Country:

Work Ph: Home Ph: Cell:

Email: Yr Highest Degree Awarded:

Geological Degree: ☐BA ☐BS ☐MA ☐MS ☐PhD University:

I am a State Licensed PG in the following State(s):

ATTESTATION: I attest that I meet the requirements for AIPG Professional Member (30 semester hours/45 quarter hours in geological sciences with a BA or higher degree) and agree to abide by AIPG Bylaws and Code of Ethics.

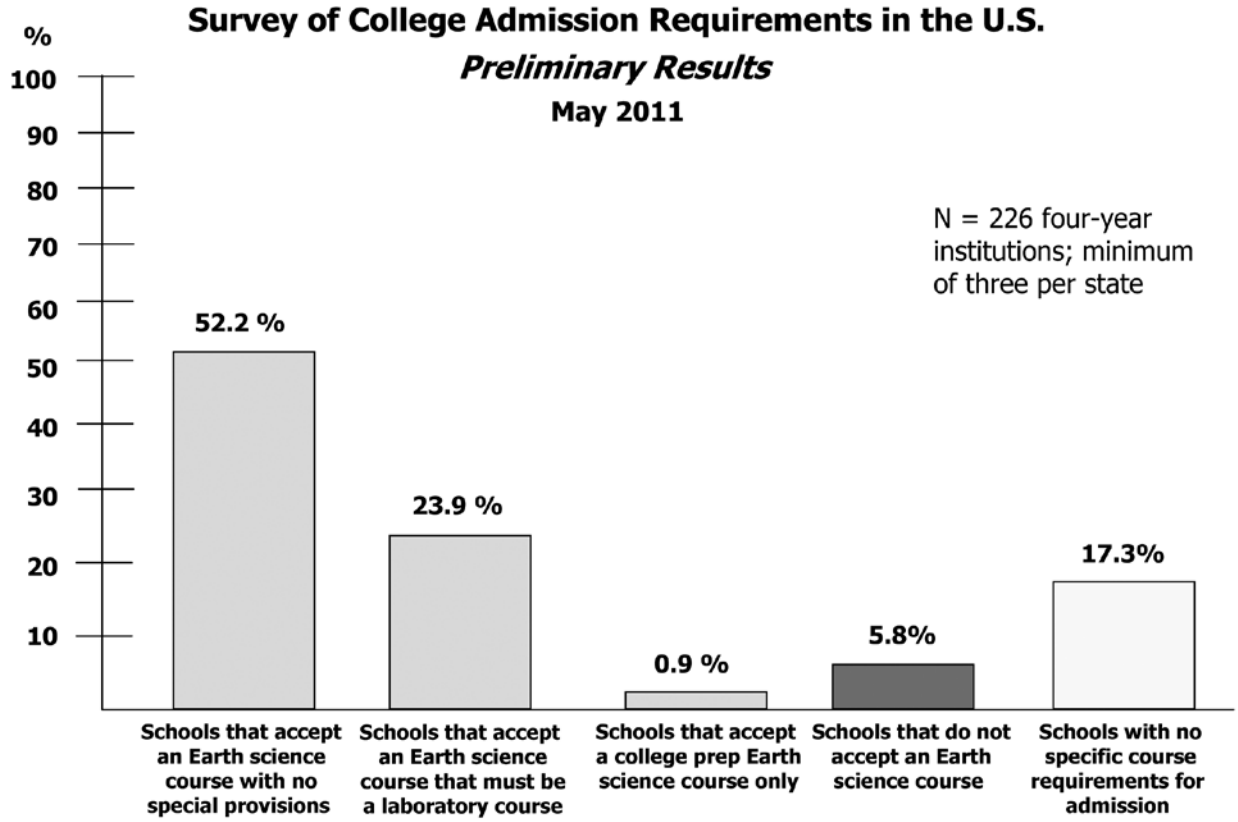
Applicant Signature: **Date:**

HEADQUARTERS USE ONLY Amt: Date Rcvd: Mbr #:

American Geological Institute
GEOSCIENCE CURRENTS
No. 44
20 May 2011

College Admissions Survey: Acceptance of High School Earth Science Courses

AGI contacted 262 four-year institutions of higher learning to determine whether or not they accept a high school Earth science course for admission. At least three schools were contacted per state (state schools as well as private institutions). As of May 8, 2011, 226 schools responded. (This study is ongoing.) The preliminary results indicate that 77.0% of the surveyed institutions accept high school Earth science courses, but there can be conditions on that acceptance. Almost 1/3 of those schools stating they accept an Earth science course for admission require that it must be "laboratory-based." To date, only 5.8 percent of schools responding to the survey do not accept an Earth science course for college admission.



American Geological Institute, 2011

Some reasons given by four-year institutions for not accepting high school Earth science courses included:

1. Earth science is not a laboratory course, according to the institutions' definitions of what a laboratory course must include.
2. There is no Earth science Advanced Placement examination.
3. Earth science is perceived as not being as "rigorous" as biology, chemistry, and physics.

- Ann Benbow
Education, Outreach and Development Director

www.agiweb.org/workforce/
SERVING THE GEOSCIENCES WORLDWIDE AGI THE AMERICAN GEOLOGICAL INSTITUTE
workforce@agiweb.org

A New Factor in Your Job Search – Social Media Background Checks

Robert A. Stewart, CPG-08332

Social media are a fact of life for many of us and the personal details people are willing to make public is astonishing. Since the advent of Facebook, YouTube, LinkedIn and many similar services, not to mention blogs and on-line forums of all types, I have counseled caution to geoscience students at local colleges and universities where I've had an opportunity to speak about employment and professional practice. It was obvious that social media rapidly became a source of curiosity by technical and human resources staff involved in the hiring process, and the last thing a prospective candidate needs while job-seeking are ill-considered remarks in a blog or an embarrassing photograph or video on YouTube. For baby-boomers, many photographs and other reminders of youthful exuberances during higher education are buried in the pages of old yearbooks, although subject to exhumation and on-line postings for those willing to dig far enough. I've seen a few examples of businesses engaged in re-publishing yearbooks exactly for the purpose of social networking, so we're not completely immune.

A recent[1] email newsletter I received from Debix, a commercial identity protection service, included an item about the internet startup business Social Intelligence[sm] (*www.socialintel.com*), which has commercialized the concept of social media background checks, and sells the data to potential employers.

According to Debix, the Federal Trade Commission (FTC) investigated Social Intelligence[sm], and found the company compliant with the Fair Credit Reporting Act (FCRA). Debix commented "In other words, the Internet is fair game. So that means when you put your private life out there publicly, it's there to be evaluated. All it takes is a Google search. And while employers can't legally make hiring decisions based on race, religion, marital status or disability, they can make decisions based on whether or not they like your attitude or your ethics."

Debix offers some common-sense tips for ensuring an employer-friendly profile on the Internet:

- Conduct a self-check of your on-line information. Remove anything that could be taken out of context.
- Be thorough. Without question, vet your Facebook posting, but don't ignore the other sites in common use such as LinkedIn, Craigslist and Foursquare. Check blogs, forums and wiki sites that you host, visit or include your postings.
- Do frequent checks of your privacy settings on social-media accounts.
- A more serious alternative to self-scrubbing your online profile is to hire an "online reputation management company" (ORM), such as Reputation.com or Unsubscribe.com, among others.

The Social Intelligence[sm] (SI) website includes links to dozens of recent news stories about the trend of social network screening by employers, even to the point of using Facebook profiles to gauge personality traits. SI notes that employers who fail to Google job candidates "are not making the best efforts to screen applicants and are vulnerable to risky hires." Furthermore, job candidates may not be "recognized for assets, achievements, and contributions." The latter point may be true; however, most news stories focus on background screening as a basis for rejecting candidates based on objectionable online materials. A survey by Microsoft[2] found that 70% of HR professionals in the United States had rejected a job applicant based on Internet profiles. According to the survey, the top online factors for rejecting a job applicant are unsuitable photos or videos, concerns about a candidate's lifestyle, and inappropriate comments written by the candidate.

Other potential future users for SI or copycat companies include the U.S. Armed Forces, to screen for traits favorable to, or disposed against "unit cohesion." Colleges and universities are also interested in the concept as part of the admissions process, as if that whole game wasn't weird enough already. As far as the positive aspects of an Internet background check, well, I can't see that side of the coin as the central purpose. So, leave nothing to chance. The profession of geology still relies on interviews and tangible demonstrations of competence. The science of geology boils down to understanding earth materials in three dimensions. Whether your work is 90% field mapping or 90% computer modeling, the latter pursuit starts with basic skills at field work, so we all have something in common for an interview at any level.

As for me, a social background check would be dull. I don't subscribe to social networks (yet), mainly out of inertia. At the moment, email, IM and cell phone suit me. The rest of the family is well-connected via social network accounts.

1. August 15, 2011, which I can forward to interested readers upon request.
2. Mathew Ingram, *Yes, Virginia, HR Execs Check Your Facebook Page*. Gigaom.com, January 27, 2010.

Answers on Page 28

Robert G. Font, CPG-03953

1. Which of the following silicic, extrusive igneous rocks would be expected to have an abundance of plagioclase over potassium-rich feldspars and constitutes the volcanic counterpart to the plutonic "granodiorite"?

   a) trachyte
   b) latite
   c) dacite

2. Which of the following statements is generally correct based on our knowledge of rock mechanics?

   a) Rock strength is directly proportional to confining pressure and inversely proportional to temperature and pore pressure.
   b) Rock strength is inversely proportional to confining pressure and directly proportional temperature and water content.
   c) Strain rate may affect ductility, as a high strain rate favors ductile behavior.

3. Consider a clay-rich layer for which its remolded strength is much lower than its undisturbed strength value. What term below ***best*** describes this material?

   a) "Sensitive clay" or "quick clay".
   b) "Thixotropic clay".
   c) "'Flocculated-fabric clay".

4. Consider a tsunami with wave length (L) 0f 100 kilometers and where the water depth (d) is 1,500 meters. To a first approximation, what are the theoretical limits of maximum wave velocity ("V" in miles per hour or mph) for both deep-water and shallow-water conditions?

   a) V = 1,328 and 761 mph
   b) V = 1,104 and 516 mph
   c) V = 881 and 270 mph

Failures of Common Sense

Samuel W. Gowan, CPG-07284

Seven Italian geologists are scheduled to go on trial September 20th of this year for manslaughter for failing to alert the residents of the City of L'Aquila of an impending earthquake[1]. The seven geologists allegedly were explicit in their reassurance of the City and its residents that there was no risk of a devastating quake; therefore, there was no need for the residents to leave their homes. The reassurance was provided in a statement on March 31, 2009 and an earthquake occurred on April 6, 2009 that resulted in the deaths of 308 citizens. The seven geologists are accused of giving the citizens a false sense of security that the judge says "thwarted the activities designed to protect the public".

It is hard for us to understand the nuances and realities of the Italian case from a distance or from the media, which is notorious for biased and non-factual accounts. Regardless, it takes a lack of common sense on any account to perceive that science makes it possible for geologists to predict the timing and size of an earthquake or to conclude that a significant earthquake will not occur within a prescribed recurrence interval along an active fault zone. Even if we agree with the possibility that the geologists inappropriately reassured the public, the judge's view indicates either a complete lack of understanding of science, or worse, a "witch hunt" orchestrated to divert attention away from failed public policy and leadership. Keep in mind, that the death toll would very likely have been similar, even the same, regardless of the tone of the geologists' statement. After all, the real role of the geologist is to identify the fault zones and assess the potential magnitudes and recurrence intervals. This is critical information that the policy makers need in order to establish building codes necessary to minimize loss of life and property.

We like to think that modern humanity makes rational decisions based on science without being prone to "witch hunts" predicated on superstition, or worse, the human weakness of not accepting responsibility for poor leadership. I think it is fair to say that we have essentially the same intellectual capacity today as we had during the Salem Witch Trials in 1692; however, our science has given us the knowledge necessary to dismiss superstition and make rational decisions. I have a particular interest in the witch trials since my great, great….grandparents (on my mother's side), Samuel and Priscilla Marsh, testified as to the good character of John and Elizabeth Proctor during the witch trials. Unfortunately, the Proctors were convicted and executed in 1692. I have no doubt that our human nature would allow us to slip back into the mindset of the 1600s if scientific knowledge is lost or subverted.

The subjugation of science is a serious threat to our society today, throughout the world, and poses a threat that will cause many egregious failures of common sense. Some of these attacks are even coming from sources in the environmental movement, which has an allure to which we are all susceptible due to our desire for a clean environment. One of the most recent examples of this occurred in New York State when the State Geologist, Taury Smith Jr., expressed views on hydrofracturing. Mr. Smith expressed a scientifically supported opinion that hydrofracturing in the Marcellus Shale has a proven safety record and can be done safely[2]. Mr. Smith was promptly castigated by Ms. Stephanie Low, "who works as a manager of a classical musician" and "a Sierra Club Atlantic Chapter "National Hydrofracking Team" member"[3]. Although Ms. Low's scientific credentials are not provided, her opinion was given more credence than the State Geologist on a geologic/scientific issue. Mr. Smith was immediately censored, told not to speak in public, and an attempt was made by his supervisor in the State Education Department to have him fired from his job. This is a very dangerous situation for our society.

The Marcellus Shale and associated technique of hydrofracturing has created many opportunities for failures of common sense that are arising between science-based knowledge and ignorance spawned by non science-based advocacy. I will leave you with one more example. In November of 2009, several of us representing AIPG and other geology based groups, participated in a New York State roundtable convened by the Chair of the Senate Environmental Committee, State Senator Antoine Thompson. The roundtable also included VIPs from many groups from all sides of the issue such as the NYS Department of Environmental Conservation, the League of Women Voters, Scenic Hudson, Greenpeace, The Adirondack Mountain Club, Audubon New York , New York City Department of Environmental Protection, Chesapeake Energy Corporation, Fortuna Energy, and many more. The discussion was heated and often non science-based. For example, one individual claimed that the

1. See - *http://www.homelandsecuritynewswire.com/scientists-charged-manslaughter-not-issuing-earthquake-alert*
2. Times Union, 2011, see - *www.timesuntion.com/local/article/Scientist-says-the-spin-is-on-1116437.php*
3. Times Union, 2011, see - *www.timesunion.com/local/article/A-controversy-for-state-s-geologist-1310032.php*

gas company will cut down the forests "and we all know that the trees will never grow back". Unfortunately, I am old enough to recall walking in a New York cornfield that is now overgrown with a naturally propagated mixture of trees that are more than a foot in diameter. Although many of us were not given the opportunity to speak, I wrote a follow-up letter to Senator Thompson exhorting him to first consider the credentials of those offering opinions before making an informed decision. That was ignored and Senator Thompson actively sought anecdotal information from non-professionals that he and his colleagues used to promote legislation to prohibit energy development in New York.

The battle to prevent failures of common sense will be never ending in the geosciences, but we can always make progress. We are actively developing programs through the AIPG National Executive Committee that we believe will provide us a stronger, more unified voice to advocate the consideration of geoscience in state based issues as well as those issues affecting our nation and the world. We are working towards enacting some of these before the end of this year.

AIPG Student Chapters

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Founded in 2003
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NGWA Lauds Senator Tester for Geothermal Heat Pump Technology Bill

(Westerville, OH — July 19, 2011) The National Ground Water Association strongly supports a bill sponsored by U.S. Senator Jon Tester (D-Montana) that among other things would establish a geothermal heat pump (GHP) technology research and development program.

Senate Bill 1142 seeks to amend the Energy Independence and Security Act of 2007. It is co-sponsored by Senate Majority Leader Harry Reid (D-Nevada) and Senator Lisa Murkowski (R-Alaska), ranking member of the Senate Energy and Natural Resources Committee, which held a hearing on the bill July 12.

GHP systems provide heating and cooling by exchanging heat to and from the ground or surface water.

"We applaud your efforts and those of Senators Murkowski and Reid to ensure the United States maintains a leadership position in geothermal heat pump technology," said NGWA Executive Director Kevin B. McCray, CAE. "Thanks for recognizing that geothermal heat pump technology is smart, a great value, and outstanding stewardship of our natural resources."

The bill would direct the U.S. Secretary of Energy to establish a program of research, development, demonstration, and commercial application for GHP technology. The program would award project grants to state and local governments, higher education institutions, nonprofit organizations, utilities, and for-profit companies, including manufacturers.

"This farsighted bill's focus on enhancing research, development, demonstration, and commercial application of geothermal heat pumps — while maintaining environmental protections — will help address the nation's energy needs in a sustainable manner," McCray said.

More specifically, the bill seeks to advance GHP technology in areas including:

- Heat pumps
- Heat transfer fluids
- Thermal grouts
- Drilling methods
- Geothermal ground loop installation
- GHP system design
- Large-scale applications (districts, neighborhoods, communities, large commercial or public buildings, and industrial and manufacturing facilities).

The bill would authorize appropriations for fiscal years 2012 through 2016 and require the Energy Secretary to solicit grant applications 180 days after enactment.

S. 1142 also would establish a loan program to support exploratory deep drilling for geothermal energy emanating from the Earth's core.

National Ground Water Association Files Brief in New Mexico "Bounds" Water Rights Case

(Westerville, OH—August 1) The National Ground Water Association (NGWA) filed a brief on Friday (July 29) with the New Mexico Supreme Court arguing that the state's current laws and regulations regarding domestic water wells adequately protect water rights.

In so doing, NGWA supports a Court of Appeals ruling that overturned a July 8, 2008, decision by the Grant County District Court in the case of Bounds versus D'Antonio. The District Court decision declared that New Mexico's domestic well statute unconstitutionally violated the due process rights of water right owners.

The District Court also ordered the state engineer to process applications for domestic wells in the same manner as other applications, such as commercial applications, which could result in significant costs and delays to persons seeking a domestic well. The lead plaintiff, Horace Bounds Jr., argued that his surface water rights were affected by groundwater withdrawals by domestic wells.

While not a direct party to the case, NGWA filed a "friend of the court" brief as an association with expertise and experience in groundwater science.

NGWA's brief states:

- The plaintiffs failed to provide scientifically supportable evidence to justify overturning the state's laws and regulations governing water rights
- New Mexico's current laws and regulations adequately protect water rights.

NGWA noted in its brief that even the district court which ruled in favor of the plaintiff found that Bounds "provided absolutely no evidence of monetary damages, and Bounds provided no substantial evidence of impairment from domestic wells."

Moreover, said NGWA, "There are many other tools available to the State and to the State Engineer that could be effective in protecting water rights, and these tools could be implemented within the framework of the current system," the brief states.

In summary, NGWA concludes, "This case brings to mind the age-old maxim that bad facts make bad law; decades of precedent and water planning policy should not be tossed aside without a sufficient scientific basis."

Webinar to Focus on Use of Nitrogen-15 and Carbon-13 As Tracers in Groundwater

(Westerville, OH — August 2, 2011) A Webinar on the use of nitrogen-15 and carbon-13 to trace NO3- and NH4+ contamination and attenuation in groundwater will be hosted by the National Ground Water Association September 27 at 11 a.m. ET.

It will address:

- Recharge and pathways of groundwater and nutrients in agricultural watersheds
- Redox geochemistry and the nitrogen cycle
- Nitrogen-15 in NO3- and NH4+ from agricultural, domestic, and industrial sources
- Sampling and analysis of nitrogen species for isotope analysis.

The Webinar will be presented at a level appropriate for all groundwater professionals including environmental consultants, consulting engineers and geologists, and water supply engineers. University-level chemistry and/or geochemistry is desirable.

The presenter is Ian Clark, Ph.D., professor of isotope hydrology, University of Ottawa, Canada.

To learn more about this Webinar, as well as the many other NGWA educational programs, click on the "Events-Education" menu on the NGWA website, *www.ngwa.org*

Professional Employment and Ethics

William J. Siok, CPG-04773

Some time ago, a member sent an inquiry to Ethics Committee Chairman David Abbott, CPG-04570 about the implications of advertising professional geology position openings in the respective section newsletter. The question specifically asked whether a breach of ethics occurs when an AIPG vehicle (i.e. newsletter) includes job opening listings. The underlying implication of the question is whether by advertising position openings AIPG pits one member against another by encouraging employees to "defect" by seeking to accept a position with a different employer than the current.

Interesting question and one which will elicit varying perspectives. As to the ethics of it all, I'll leave that discussion to David Abbott. I wish instead to bring your attention to the AIPG objective of improving professional situations for members by providing as much information as possible about the marketplace, including current job openings.

AIPG and the Executive Committee have always supported the use of AIPG's resources to provide all members with access to as much useful information about career opportunities and job openings as possible.

JobTarget for example has been effective both for geologists seeking employment and for employers seeking geologists. The benefit costs nothing for those wishing to post resumes and a small fee for companies recruiting new staff. If there is a negative aspect to the JobTarget benefit, it's the difficulty in advertising its availability to a sufficiently broad audience.

The question of ethical breach alluded to in the first paragraph seems to be moot. After all, what's the point in professional networking if not to stay abreast of your profession? Staying up-to-date implies staying current not only with respect to technology, but also with respect to what your colleagues are doing, what corporations are doing (or not doing), and generally keeping an eye on market conditions, including job opportunities. Wouldn't AIPG be more than a little delinquent if it didn't provide as much information to its members as it is able to provide?

Inasmuch as AIPG can be of service to all its members by advertising job openings, it doesn't imply that AIPG is attempting to entice anyone to abandon a present employer. AIPG has the obligation of informing its membership. AIPG is expected to facilitate job seeking on behalf of interested members.

Maybe the question about advertising professional jobs is worth discussing, perhaps not. Open exchange of opportunity announcements as they are available surely cannot be a negative for AIPG. Members are welcome to use the information provided through AIPG, or not.

IN MEMORY

David E. Houghton
CPG-11110
Member Since 2007
July 7, 2011
Santa Cruz, California

**Compiled by David M. Abbott, Jr., CPG-04570,
2266 Forest Street, Denver, CO 80207-3831,
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Topical Index-Table of Contents to the Professional Ethics and Practices Columns

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

The Slippery Slope Leading to Un-ethical Practices

Several discussions with AIPG members and other colleagues about consulting assignments prompt this topic. Those of us who are consultants are dependent on being retained by clients to earn a living. There have been times during my career when announcing that one was a "consulting geologist" was a euphemism for "unemployed." While I have always known those who've made a living as consultants and have been doing so myself for 15 years now, I'm aware that there are good times and bad times, that sometimes a stretch of time with no billable hours leaves one wondering how the bills are going to be paid this month and next month.

Clients who don't like the results stated in your reports are likely to refuse to pay. Unhappy clients won't refer their associates to you for further work. Conversely happy clients will pay and refer you to others. This can lead to undertaking assignments and writing reports that approach or even cross over the line into unethical practice. Word does get around. Those hyping mining properties with little or no potential seem to find one of a more or less known group of assayers who are known to provide encouraging results, results that cannot be duplicated using proper QA/QC techniques and verification assays. Similarly, geologists who appear to be more willing to write more encouraging reports are retained by others promoting similar deals.

But how do you know when a client isn't legitimate? Answering this question can be tricky. I've been retained by those who were particularly admiring of my experience as an investigator of mining frauds and wanted my opinion that their venture was legitimate compared to other, similar ventures that were not. In one particular case, the company president was an apparently successful businessman who was working with the property owner who had mining experience. The company was happy to show me the property and to have me observe their sample collection and processing methods. They provided me with copies of articles that purportedly supported their depositional model concepts. The problem was that they were not following accepted practices. They "knew" that generally recognized assayers couldn't duplicate their results because of alleged "bias," lack of knowledge or application of the "required" techniques, etc. My highlighting of these problems in my report was not appreciated.

Another assignment involved retention to oversee the sample collection, physical control of the samples with strict chain of custody protocols, and detailed oversight of all analytical and processing steps. Every effort was made to ensure that all reagents were sampled prior to use and that nothing was done without oversight examination. The problem was that the claimed results weren't obtained and the economics of the proposed processing method appeared irrelevant to those touting the property. This was a job in which the fee was paid in advance into an escrow account that required only an itemized bill for payment.

Another slide on the slippery slope involves the unexplored exploration concept, for example, the application of a new deposit model to an old district. Using new exploration concepts in old territory is an accepted way of exploring. The problems arise when the promoters, the money raisers, get excited and start putting out press releases or private placement memoranda that give full vent to unwarranted optimism. As Herbert H. Hoover put it in his 1909 *Principles of Mining,* "the old terms 'ore in sight' or 'profit in sight' have been of late years subject to much malediction on the part of engineers because these expressions have been so badly abused by the charlatans of mining in attempts to cover the flights of their imaginations. In fact, the substitutes for these terms are becoming abused as much as the originals ever were. All convincing expressions will be misused by somebody."[1]

The use of what I've for many years referred to as the "Big Lie" is another means of misleading and deceiving potential investors and the general public.[2] This involves use of estimates

1. Hoover follows this statement with the original definitions of "proven ore," "probable ore," and "prospective [possible] ore, ore which cannot be included in the above classes, nor definitely known or stated in any terms of tonnage." Hoover gets to the point a lot faster than the modern JORC Code or NI 43-101 definitions, which eventually get around to agreeing with Hoover, albeit with more descriptions of the types of required data.
2. I've been using the term "the Big Lie" since at least 1999; a slide on this was included in my short course on mineral definitions, etc. given at the 1999 AIPG annual meeting.

of in-place, *in-situ*, or gross value. The calculation is simple and is:

estimated tons × grade × metal or product price = value

The problem with such estimates results from:

- frequent lack of a good basis for the estimated tons and/or grade
- the costs of further exploration and property development required prior to commencement of extraction or the on-going development and other capital costs incurred during extraction
- failure to include the costs of extraction, recovery, permit compliance, etc.
- failure to discount for the inevitable losses in extraction and recovery

The mining industry really started appreciating the enormity of this lie when then Interior Secretary Bruce Babbitt used it to calculate the amount the public was purportedly being robbed by the granting of patents—fee simple titles—on mining claims on which a legitimate discovery had been made for the price of $2.50 per acre. The recently adopted revisions to Canadian National Instrument 43-101 expressly prohibit the use of such estimates because of their inherently deceptive character.

Related to the "Big Lie" is the use of historical production data and unverified assays as the basis for estimation of remaining tons and grade. As Hugh McKinstry observed, "A prospect is a potential ore producer which is still in its early stages of development; not until there is enough ore to support a substantial output does the property achieve the dignified status of 'mine.' A prospect may be merely an untouched ledge of outcropping vein-matter, or it may be a former mine that has produced thousands of tons, reduced again to the status of prospect by removal of all its developed ore. These and other types of prospects have in common the fact that the ore reserves consist chiefly of hopes." McKinstry goes on to state, "The very fact that a prospect is inactive is a sign that something is wrong with it. No doubt other engineers have been there before you and have turned it down for good reasons of their own" and "Remember that the record of past production is a measure, not of what is left, but of what is not left."[3] As Agricola observed in 1556, "Shafts and tunnels should not be reopened unless we are quite certain of the reasons why the miners have abandoned them, because we ought not to believe that our ancestors were so indolent and spiritless as to desert mines that could have been carried on with profit. Indeed, in our own days, not a few miners, persuaded by old women's tales, have reopened deserted shafts and lost their time and trouble."[4]

The fact that metal prices have recently increased does not overcome the fact that previous production extracted the highest grades and most readily processed mineralization. Nor do these price increases necessarily make up for the increased costs of operations, including modern environmental and safety requirements that did not exist during most previous operations. Failure to point these facts out in reports touting old properties constitutes omission of material facts needed to prevent misleading or deceiving potential investors and constitute violation of both AIPG's Code of Ethics (Standard 2.2 and Rules 2.2.1 and 2.2.3 thereunder) and securities laws.

Sometimes legitimately done technical reports are misused by clients or business associates, a situation that can bring the geoscientist into fraud investigations and related litigation. There are two variations of this misuse. In the first, the client or business associate alters the technical report in some way, for example, by adding a reserve estimation section that the geoscientist did not write. Sometimes the geoscientist learns of the report's alteration prior to being contacted by fraud investigators but sometimes not. If the geoscientist learns of the alteration first, contacting the appropriate regulatory authorities about the alteration can assist in bringing the altered report's misuse to an end. If the fraud investigators are the ones informing the geoscientist of the problem, production of the original report and active assistance in the investigation help to both maintain the geoscientist's professional standing and to prosecute the perpetrators of the fraud.

In the second variation, the technical report is not altered but the client/business associate hypes the results and potential of the property reported on well beyond the level of enthusiasm warranted by the report's conclusions. As in the first variation, alerting the appropriate regulatory authorities to the problem is important in maintaining one's professional credibility and standing. In both cases, creating, sending, and keeping copies of documents clearly setting out the problems, either a report's alteration or its misuse, are important pieces of evidence needed to convince the regulatory authorities that the geoscientist is not an active participant in the fraud.

Old and/or Historical Professional Literature

In the immediately preceding discussion I cited three old and historical books, Herbert Hoover's 1909 *Principles of Mining*, Agricola's 1556 *De Re Metallica* translated by Herbert Hoover and his wife, Lou Henry Hoover, and Hugh McKinstry's 1948 *Mining Geology*. Anyone interested in any aspect of mining should read these books. Unfortunately, only *De Re Metallica* is still in print, complete with all the original woodcuts. A check on amazon.com as I write this lists 3 used copies of *Mining Geology* for sale and *Principles of Mining* is available as a text-only edition, which is unfortunate because the illustrations are important. That these three books are still available reflects their historical importance.

In addition, these books are really well-written, serving as examples of technical literature that is fun to read—for once, not an oxymoron. I've provided examples from each book above and will add one more from *Principles of Mining* on the subject valuing a mine, or any other mineral property. "Any value assessed must be a matter of professional judgment based on geological evidence. Geology is not a mathematical science, and to attach a money equivalence to forecasts based on such evidence is the most difficult task set for the mining engineer. It is here that his view of geology must differ from that of his financially more irresponsible brother is science." While there is more mathematics used in the geosciences today that there was 110 years ago, Hoover's basic point remains entirely valid. The "Big Lie" discussed above is mathematically correct and financially irresponsible.

3. Hugh E. McKinstry, 1948, *Mining Geology*: Prentice Hall, p. 428 & p. 432.
4. Agricola, Georgius, 1556, *De Re Metallica*, trans. H.C. Hoover and L.H. Hoover, 1909: Dover Publications, 1910, p. 217-218. Ben F. Dickerson, III, who quoted this passage in his "Rock in the Box" column in *Mining Engineering*, February 1984, p. 181, noted that "'old women' were undoubtedly like those of today, i.e. little old males."

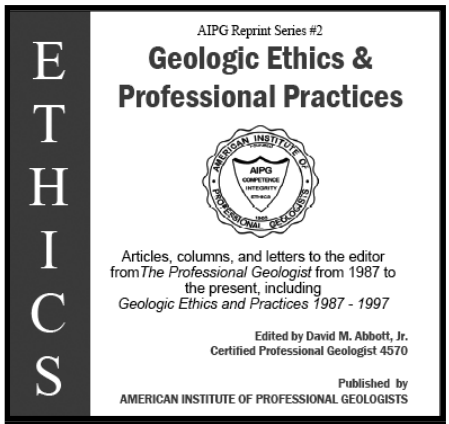
But does anyone ever read works that were historic when I was an undergraduate? Most basic economic geology and even some physical geology textbooks include (or did) one of the woodcut illustrations from *De Re Metallica*. But the other two books are not as well known. I discovered *Mining Geology* on the shelf of the old Jeffco Blueprints, which served as the bookstore for the Colorado School of Mines for many years and which also stocked a lot of related interest books. *Mining Geology* was written for the recent graduate who had a job in mining and was wondering what the job really was all about—there's a lot about practicing the geoscience profession that you don't learn in school. Willam Peters' *Exploration and Mining Geology* is an update of McKinstry, though Peters isn't the writer McKinstry was. I didn't discover the *Principles of Mining* until I was working for the US Securities and Exchange Commission (SEC) as a geologist and was looking through old legal decisions on mining cases and learned that the SEC's original definitions of *ore, proven ore*, and *probable ore* were taken from Hoover's book. I looked for a copy in the library and eventually purchased a used copy for myself. So even when I was an undergraduate, my reading and citation of professional literature focused on fairly current work.

I asked **Nancy Price**, SA-0382 and **Stephanie Jarvis**, SA-1495 our past and present Student's Voice, columnists, for their experience with old and historic professional literature and received the following replies. Nancy Price wrote, "Let's see…honest answer to your question: no, most students don't follow the reference trail to the origins of an idea unless they are forced to. One reason for this is accessibility. Interlibrary loan (ILL) is only so good at finding references. If the book is old and/or rare, the chances of ILL finding it are low. Most students will stop looking if ILL falls short. They may cite a classic reference, but that doesn't mean they have read it or even have a copy of it in their possession. They just cite the classic reference because they are expected to—and very few people will question them on the details of it. The other reason is just trust and a lack of time. Students are swamped. The strategy is to find a review paper and cite that, trusting that the review paper did a good job of presenting the background of an issue and that it isn't biased. They just don't have the time to look up classic or old papers. Citing a review paper produces the same result for less time. Unless they are told to do it, as a student there are no bonuses (no positive reinforcement) for using your time to do THAT thorough of a literature search. Finally, there is an attitude that old research is outdated. Really important classic papers are considered important and they get attention. Papers that haven't gotten the notice of the scientific community are doomed to die in obscurity, particularly if they are not searchable via google scholar, etc. I don't agree with this, but it is reality. So, the reliance on review papers and the bias to newer papers has us at times reinventing the wheel. I am just as guilty of it as everyone else. It is the reality of the academic system—everyone is just so busy creating quantity not quality.

"As far as classes, I have seen professors use classic literature to teach a topic. I like this approach and will likely use it when I teach structure this fall. So, there is some exposure to older papers depending on the professor. I'm not so sure how widespread it is."

Stephanie Jarvis' reply came as she just returned from an extensive field camp in Montana. She wrote, "I can't recall any references to really early publications, but I don't see why they wouldn't be useful. I think it would be really interesting to see that kind of historical perspective. Then again, I don't think I've really done much referencing of the professional literature, so I'm not sure how helpful my thoughts are."

So I guess that reading older literature is primarily done by those who have graduated and who love to read anyway—the folks with overflowing bookshelves whose books cover a variety of topics. If you would like to dip into a great collection of old and historic papers, get ahold of a copy of Preston Cloud, 1970, ed., *Adventures in Earth History: being a volume of significant writings from original sources on cosmology, geology, climatology, oceanography, organic evolution, and related topics of interest to students of Earth history:* W.H. Freeman; there were 14 copies on Amazon for as little as $0.04 on the day I wrote this.



Geologic Ethics & Professional Practices is now available on CD

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

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

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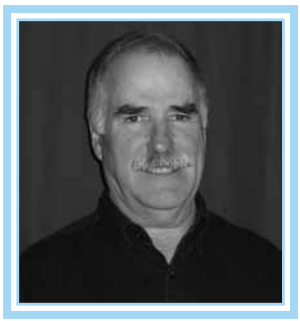

It's The Seasons, Stupid

William J. Stone

The source of ground-water contamination is usually found by determining the local flow direction and looking up-gradient. Flow direction may be readily determined from a water-table map. Also it may be sensed from topography, since flow is from higher elevations to lower elevations.

While working at a state geological survey in the Rio Grande valley, I got a call from a woman saying her well water was contaminated. "Stinky, black gunk" was now coming out of the kitchen tap. A hydrology grad student she knew from the local university had looked into it, apparently only briefly, and together they concluded the small battery-recycling operation across the interstate was responsible. This decision was made easier because she seemed to have other beefs with the battery place which operated mainly at night (for example, excessive noise and light). Admittedly the facility was up-slope and up-gradient in terms of ground-water flow. However, I had done some work for the recycling operation, unconvincingly proposed as a Superfund site for lead contamination by EPA, and knew it was not discharging anything.

A careful review of the regional setting suggested the cause was more likely a seasonal reversal of ground-water flow on the floodplain. Normally, flow is from the higher valley margins toward the Rio Grande, the regional discharge area. However, over the years, because of the construction of levees and normal channel deposition, the river bed was higher than the adjacent farmland on the floodplain. The river is fullest, during the spring (when snowmelt in the northern mountains runs off) and in the summer (not only the rainy season, but when water is released from dams for irrigation). At such high water times, ground-water flow is temporarily reversed, that is, from the channel toward the floodplain.

The woman's place was outside the city limits and, like the other rural properties in the valley, it was on a septic tank. This seasonal flow reversal could have caused flushing of stagnant ground water, "stinky and black" due to the reducing conditions associated with septic-tank effluent back towards area wells. This flow reversal presumably happens annually, but apparently that year the reversal was more pronounced or more far-reaching. Tip: Don't rule out seasonal ground-water flow reversal when searching for the source of contamination.

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

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Free Student Membership

This is a reminder to let all students know that as long as they are a student they can be a member of AIPG for free. As a student member you will receive an electronic copy by email of our bi-monthly magazine "The Professional Geologist". You will be given access to our web site to search for other members, post your resume for free, and search for employment. You will also receive discounts on any of the products AIPG offers. As a student member you will receive information on upcoming conferences and news from the sections on meetings and field trips. These meetings are a good way to meet professional geologists, to learn from them, and to network for future employment. AIPG also offers scholarships at the National level and a number of the sections have scholarships for their student members.

AIPG also has Facebook and LinkedIn sites. Facebook is more of a fun site to post pictures from meetings and field trips. LinkedIn is a professional site to discuss common questions such as licensing and to provide another avenue for posting job opportunities.

AIPG Student Outreach Committee

Notes From the Field

Stephanie Jarvis, SA-1495,
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As I sit on a cabin porch looking down on the town of Red Lodge, MT, preparing for another great sunset with a growler from the local brewery at hand, I am happy to finally be able to add my own perspective to the recent discussions on the importance of field camp to today's young geologists. The short version: It is sweet!!! I mean, what gets better than a two-day cross-country road trip to spend all day every day for 6 weeks thinking about, looking at, discussing, and learning about rocks? (OK, so my field notebook may have some notes jotted down on a few wildflowers, too…) Maybe I lucked out, but only a week and a half into it I feel like it's one of the best things I've ever done. Though there's been some frustrating moments, I've learned so much already, and I couldn't ask for a cooler group of people to spend my summer with (the music selection is amazing!).

I just finished my first mapping project (Elk Basin Oil Field), and feel pretty good about it. It's one thing to color a map with all the data given to you and draw nice cross-sections in structure class, but to actually get out in the field and determine for yourself where contacts are and what the beds are doing, make your own map, color it (the best part!), draw out cross-sections based on the data you collected, and watch it all unfold is a completely different experience. Through our projects and side trips, we're learning the story of this area, which is about the neatest thing ever. To be able to think on such a scale is nearly mind-blowing, and not something I would have been able to do well from the classroom.

The people taking this course come from a wide spread of schools. It is through Southern Illinois University, so there are some students from there, but there are also students from Nevada, Oregon, South Carolina, Ohio, Georgia, and Montana. Most are going into their senior year of undergraduate. For several, though, this is the last thing they need before they can graduate. I was surprised by that, as my undergraduate school didn't require a field camp credit and I didn't realize it was often a graduation requirement at schools that don't run their own camps. I understand the reasoning of my department: undergrad was costly enough and, it can be argued, the usefulness of field camp for a particular student depends on what that student plans on doing with their degree. However, I've already gotten the sense that this is exactly what I needed to fill in some gaps in my geologic knowledge and to really solidify my understanding of the concepts I spent the last four years learning. While I have had plenty of field experience through classes, field trips, and projects, none of it quite compares to the full immersion inherent to field camp.

The discussion of whether or not field camp is still relevant should, in my opinion, turn into a discussion on how to make it more affordable to students. There is no question about the benefits to an aspiring geologist that field camp has to offer. It is the monetary cost that really needs to be addressed. While it may be worth it in the long run, at the immediate time the price tag for field camp, plus lost work time, can be quite daunting. Talking to other students, it seems that some were able to get some financial aid through their schools (because, I assume, it was a requirement). Since I am attending SIU in the fall for grad school, they were able to help me out a little. I know that there are several scholarships and programs sponsored by professional organizations and corporations. These are things all students should look into, but there needs to be more. More options for students in terms of timing (I've heard of a few, for instance, that are run during winter break), length, and focus would probably ease the burden on many students. I don't have these answers, but getting them to students will require the cooperation of both the academic and professional worlds of geology. In the meantime, it's dark, the wind is getting a little chilly, and my David Grisman Quintet album is almost over. Time to get some rest before another day in the field!

A thrust-propagation fold at the mouth of Clarks Fork Canyon, WY.

The Elk Basin Oil Field (WY).

Answers:

1. The answer is choice "c" or "dacite". Dacite is typified by plagioclase over potassium-rich feldspar and accessory minerals such as biotite, hornblende and pyroxene. Quartz may occur as part of the groundmass and as phenocrysts. Dacite may exhibit a porphyro-aphanitic texture. The intrusive or plutonic, phaneritic-textured counterpart of dacite is granodiorite.

   Latite may exhibit a porphyro-aphanitic texture and may contain about equal amounts of plagioclase versus alkali feldspar. Biotite, pyroxene and amphibole are accessory minerals with quartz being either scarce or basically absent. Latite is the volcanic counterpart of the phaneritic-textured, plutonic monzonite.

   Trachyte is characterized by a porphyro-aphanitic texture and an abundance of alkali over plagioclase feldspar. Relatively minor amounts of quartz or feldspathoids may be present, with common accessory minerals being pyroxene and biotite. The phaneritic-textured, plutonic counterpart of trachyte is syenite.

2. The answer is choice "a" above, or "rock strength is directly proportional to confining pressure and inversely proportional to temperature and pore pressure."

   As confining pressure increases, so does rock strength. Rock strength tends to decrease with increasing temperature. Rock strength also decreases as pore pressure increases (recall that effective stress is total stress less pore fluid pressure). An increase in water content may turn competent shales into wet clays, leading to mass wasting and other geotechnical problems (such as the lowering of bearing capacity, etc). The effects of time on rock strength can be studied by modifying the strain rate. Very high strain rates favor brittle behavior and very low strain rates are conducive to ductile behavior.

   Choice "a" is correct for answering our question. Choices "b" and "c" are not appropriate.

3. The ***best*** answer is choice "a" or "sensitive clay" or "quick clay".

   By definition, the "sensitivity" of any given clay is the ratio of its undisturbed strength to its remolded strength at the same water content.

   Some clays regain strength after being remolded and allowed to stand at constant water content. This behavior defines "thixotropy" and is related to the reorientation of clay particles from a more "dispersed" or parallel fabric to a more "flocculated" or edge-to-face fabric. It should be noted that certain "sensitive clays" experience "thixotropic" behavior which leads to a decrease in viscosity over time under a constant strain rate.

   "Sensitive clays" generally exhibit some "thixotropic" behavior. Both highly "sensitive clays" ("quick clays") and "thixotropic clays" can lose their strength dramatically and undergo liquefaction when disturbed or shaken by vibrations from earthquake-related movements. Marine clays may be characterized by an edge-to-face or "flocculated fabric" when found in an undisturbed state. If later leached by fresh water, the original fabric may be greatly weakened becoming unstable and easily collapsible when suddenly disturbed. Examples include the infamous "quick clays" that may give rise to catastrophic engineering failures.

4. The answer is choice "c" or "V = 881 and 270 mph". The proof follows:

   The velocity of an ideal ocean wave is:

   $V = [(gL/2\ \Pi) * \tanh (2\Pi d/L)]^{1/2}$ (eq. a)

   In "equation a" above, "g" is acceleration of gravity, "L" is wavelength and "d" is water depth.

   In deep water, d > L/2 and tanh (x) approximates 1. In shallow water, d is small and tanh (x) approximates x.

   If we take the deep-water condition first, where tanh (x) = 1 and substitute into "equation a" above:

   $V = [(gL/2\ \Pi) * \tanh (2\Pi d/L)]^{1/2}$ (eq. a)
   $\tanh (x) = \tanh (2\Pi d/L) = 1$
   $V = (gL/2\Pi)^{1/2}$ (eq. b)

For the shallow-water condition, tanh (x) = x. Then, substituting into "equation a" above:

$V = [(gL/2\,\Pi) * \tanh(2\Pi d/L)]^{1/2}$ (eq. a)
$\tanh(x) = x$ or $\tanh(2\Pi d/L) = 2\Pi d/L$
$V = [(gL/2\,\Pi) * (2\Pi d/L)]^{1/2}$
$V = (gd)^{1/2}$ (eq. c)

In our example, "equation b" and "equation c" become:

$V = (gL/2\Pi)^{1/2}$ (eq. b)
$V = [(9.8\ m/sec^2 * 100{,}000\ m) / (2 * 3.1416)]^{1/2}$
$V = 395$ m/sec (eq. d)

$V = (gd)^{1/2}$ (eq. c)
$V = (9.8\ m/sec^2 * 1{,}500\ m)^{1/2}$
$V = 121$ m/sec (eq. e)

Now, since 1 m/sec = 3.6 km/hr and 1 km/hr = 0.62 mph, equations "d" and "e" above become:
$V = 395$ m/sec = 881 mph (eq. f)
$V = 121$ m/sec = 270 mph (eq. g)

Equations "f" and "g" are the answers that we sought, equivalent to choice "c" in our question.

American Geological Institute
GEOSCIENCE CURRENTS
No. 46
12 July 2011

Geoscience Academic Provenance Series

Geoscience Student Populations: Natives, Immigrants and Refugees

Houlton (2010) found that geoscience students followed 6 distinct pathway steps in pursuing their career in the discipline (see Geoscience Currents #45). Further investigation illuminated that students could be categorized into 3 major and 6 minor population groups, each exhibiting a unique pathway trajectory. Explicitly mapping these trajectories results in valuable insight into future recruitment and retention initiatives because it allows geoscientists to specifically target student populations who are pursuing different geoscience careers.

Native Population: students who decide to major in the geosciences ***at the time of, or prior to, college enrollment*** (i.e. they are native to the major).

Natives

- **True** — Students who decide to be geoscientists after initial childhood experiences catalyzed interests to follow a geoscience career trajectory.
- **BA** — Students who have childhood interests but pursue the Bachelor of Arts degree with fewer rigorous math and science courses.
- **Exploratory** — Students who considered other options prior to college but chose the geoscience major by college enrollment.

Immigrant Population: students who were studying a different major and ***switched into the geosciences*** (i.e. they immigrated into the major).

Immigrants

- **Committed** — Students who changed major and interests now lie in traditional geoscience disciplines. They are committed geoscience and are likely to pursue those careers after graduation.
- **Related-Fields** — Students who see the major as a good pathway to other disciplines. Geoscience would give them the skills and knowledge necessary to pursue related fields.

Refugee Population: students who major in the geosciences as a backup and ***do not intend on following a geoscience oriented career*** post-graduation (i.e. they seek refuge in the major as a means to an end).

Refugees

- **Refugee** — The one refugee's pathway in Houlton's study was not detailed enough to determine a full trajectory. Sub-populations could not be identified from one Refugee.

This is the second of four Geoscience Currents on the topic of Geoscience Academic Provenance. AGI is hosting a **GeoWebinar** to discuss this set of Geoscience Currents on **August 23, 2011 from 1:00-1:30 pm US EDT.** Register at:
www.agiweb.org/workforce/webinars.html
To read Houlton's full study, go to:
http://www.eas.purdue.edu/riggslab/Houlton_Final_Thesis.pdf

-Heather R. Houlton

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

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Applicants for certification must meet AIPG's standards as set forth in its Bylaws on education, experience, competence, and personal integrity. If any Member or board has any factual information as to any applicant's qualifications in regard to these standards, whether that information might be positive or negative, please mail that information to Headquarters within thirty (30) days. This information will be circulated only so far as necessary to process and make decisions on the applications. Negative information regarding an applicant's qualifications must be specific and supportable; persons who provide information that leads to an application's rejection may be called as a witness in any resulting appeal action.

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NV	Walter Dzick
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NY	Erin Quell
OH	Colin Flaherty
OH	Nicholas Petruzzi
WI	Marty Koopman
Guyana	Kantharaja Chandrappa

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CO	Michael Sheehan	MEM-2002
MI	Kenneth Roznay	MEM-0970
MI	Tony Anthony	MEM-2083
RI	Jonathan Alvarez	MEM-2063
VA	Loren Setlow	MEM-2068
Canada	David Groves	MEM-2069

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NV	Anthony Longo	CPG-11445
NV	Robert Marvin	CPG-11444
NY	Thomas Bosshard	CPG-11450
NY	Gerard Leclerc	CPG-11428
NY	Jean Neubeck	CPG-11438
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AK	Jenny Holmes	MEM-2085
AZ	Carl Kuehn	MEM-2096
AZ	Bibhuti Panda	MEM-2086
AZ	Hall Stewart	MEM-2091
AZ	Carl Kuehn	MEM-2096
CA	Jonathan Rohrer	MEM-2055
CO	Robert Lewis	MEM-2054
IL	Joe Robertson	MEM-2057
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IN	Noel Daniel	MEM-2059
IN	Tony Gray	MEM-2061
IN	Bruce Bultman	MEM-2064
IN	Rusty Wheat	MEM-2071
IN	Michael Schutz	MEM-2080
IN	Sean Hall	MEM-2092
KS	Darin Duncan	MEM-2066
KS	John Farmer	MEM-2077
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KS	Michael Dealy	MEM-2082
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PA	Joshua Gowan	MEM-2018
PA	Mikel Pype	MEM-2084
RI	Jonathan Alvarez	MEM-2063
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VA	Loren Setlow	MEM-2068
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Niger	Salifou Lamine	MEM-2060

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LA	James Kimbrell	YP-0007
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AZ	Michelle Aigner	SA-3131
CA	Derek Burle	SA-3114
CO	Jordan Logan	SA-3103
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FL	Trevor Cole	SA-3108
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GA	Katherine Cannon	SA-3117
GA	Danny Redding	SA-3118
GA	Alex Colon	SA-3119
GA	Andrew Aspinwall	SA-3120
GA	Douglas Sagul	SA-3121
GA	Emily Randall	SA-3122
GA	Amanda Snow	SA-3123
GA	Chris Smoot	SA-3124
GA	Rebecca Thompson	SA-3125
GA	Kathryn Holtzclaw	SA-3126
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IL	Christine Knudson	SA-3101
IL	Emma Reinemann	SA-3104
IL	Ryan Sego	SA-3129
IL	Karel Waska	SA-3130
IL	Jane Grundin	SA-5049
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MO	Rabia Hunky	SA-3132
NC	Quancidine Gribble	SA-3105
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TX	Krystal Walraven	SA-3128
Egypt	Osama Eltabakh	SA-3112
Egypt	Osama Hazem	SA-3113

AIPG Membership Totals

	As of 08/24/10	As of 08/31/11
CPG / Active	3,505	3,437
CPG / Non-Practicing	396	376
Prof. Member	937	921
Associate Member	17	24
Young Professional	0	9
Student Adjunct	383	914
Corporate Member	3	3
TOTALS	5,241	5,684

AIPG National would like to say *Welcome* to all of our new members.

DUES, DUES, DUES,

The 2012 membership dues invoices have been mailed. You may log into the AIPG website to pay your dues. A receipt is automatically emailed to you, once the payment is processed.

Earth Science Week Kicks Off with International EarthCache Day

Alexandria, VA – Earth Science Week 2011 will kick-off with the fifth annual International EarthCache Day on Sunday, October 9th. The public is invited to join the Geological Society of America (GSA), organizer of the global EarthCache program, and the American Geological Institute (AGI), Earth Science Week coordinators, in exploring this exciting and educational earth science experience.

International EarthCache Day is a time when EarthCachers around the globe organize small gatherings where people can learn something about the Earth. An EarthCache is a place that people locate with a GPS device while participating in a "treasure hunt" called geocaching.

"The treasure you find at an EarthCache is a lesson about the Earth itself," says EarthCaching Program Director Gary Lewis of GSA, a longtime Earth Science Week partner. "Each EarthCache site will teach you something about the science of our dynamic planet - you actually have to do a task to prove that you have been observing and learning from your EarthCache visit."

EarthCache events are being held around the world this October 9th. To view the locations for EarthCaching events, go to h*ttp://www.earthcache.org/*.

In 2004 Lewis developed the world's first EarthCache on an Australian headland, which features geologic evidence of an ancient ice age. Since that time, more than 11,200 EarthCaches have been established by geocachers around the globe, and some 1,250,000 people have visited the sites. More EarthCaches are added daily.

As Earth Science Week approaches, stay tuned for more details on the international gathering of EarthCachers scheduled to take place in September 2012 in Portland, Maine. For more information, contact Lewis, Senior Director of GSA Education and Outreach, at 720-201-8132.

Earth Science Week is an annual event sponsored by AGI to expand public understanding and appreciation for the earth sciences and to encourage stewardship of the Earth. This year's Earth Science Week will be October 9-15. To learn more about Earth Science Week, visit *http://www.earthsciweek.org/*.

Earth Science Week 2011 Contest Themes Announced

Alexandria, VA – The American Geological Institute (AGI) is sponsoring three national contests as part of Earth Science Week 2011, celebrating the theme of "Our Ever-Changing Earth," October 9-15.

Students, geologists, and the general public are encouraged to enter this year's Earth Science Week photography contest, "A World of Change in My Community." Use your camera to capture the evidence of the long-or short-term changes taking place around our planet and even in your own neighborhood.

Students in grades K-5 are eligible to enter the visual arts contest, "Picturing our Ever-Changing Earth." Create a two-dimensional piece of artwork to illustrate the various ways air, water, land, and living things change over time.

The essay contest, "How Change Shapes our Planet," is open to any student in grades 6-9. In a brief essay, explain how interactions between Earth's systems can change our world over time. Discuss the processes used to study these change and how human life can be affected by geologic transformation.

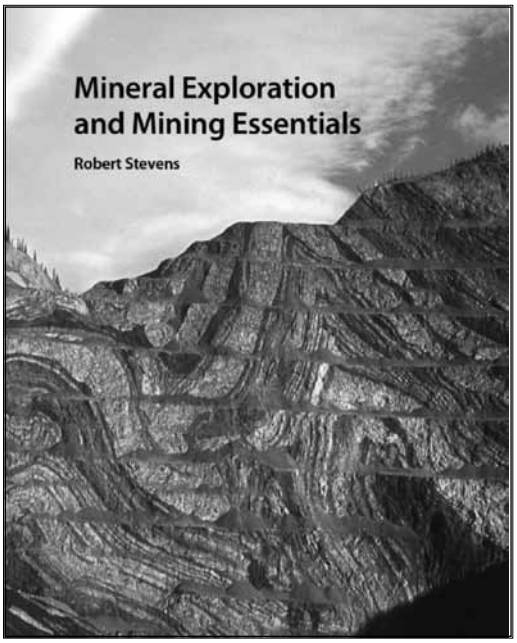
For more information on these annual contests, including guidelines, deadlines, and information on how to correctly submit your entry, please visit *http://www.earthsciweek.org/contests/*.

Earth Science Week is organized annually by AGI with support from U.S. Geological Survey, the AAPG Foundation, NASA, the National Park Service, ExxonMobil, ESRI, and others. To learn more about Earth Science Week, please go to *http://www.earthsciweek.org/*

The American Geological Institute is a nonprofit federation of 50 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..

Mineral Exploration and Mining Essentials

By Robert Stevens, 2010, Pakawau GeoManagement Inc., Port Coquitlam, BC, www.miningessentials.com, 322 p.



David M. Abbott, Jr. CPG-04570, and William J. Siok , CPG-04773

"The mineral exploration and mining industry…combines science and engineering with business and finance and is fueled by a drive for discovery. It is an industry requiring the expertise of a vast array of participants, where technical and business professionals work alongside entrepreneurs, risk takers and creative thinkers to discover, develop, operate and decommission mines." "This book is aimed at non-technical individuals and professionals who are working, or interested, in the mineral exploration and mining industry. It will also be of benefit to students, investors, community leaders, regulators and the general public. The book provides an overview of the industry from exploration to mine closure and should serve as a valuable reference that can be reviewed and re-read over time." These statements from Robert Stevens' Preface to *Mineral Exploration and Mining Essentials* concisely set out Stevens' aims and objectives for the book. This well-illustrated book generally achieves its goal. While economic (mining) geologists will find technical details lacking, the non-technical professional will get both a good introduction to the topics discussed and references for further reading should more detail be wanted.

The book grew out of materials that Stevens assembled for courses on mineral exploration and mining for business and investment professionals, government employees at all levels, and regulators presented at the British Columbia Institute of Technology and run in partnership with the Association for Mineral Exploration BC. The book differs from similar books one of us (Abbott) has read in that the role of the mining investment community (brokers, analysts, and investors) in supplying the financing for mineral exploration and, at least initial, development is recognized and explained. Mineral exploration and mining has always been a capital intensive business as reflected in Agricola's discussions of financing in *De Re Metallica* (1556).[1] However, as Stevens admits, his book focuses on those mineral deposits of primary interest to investors, the precious metals (gold, silver, platinum, and palladium), the primary base metals (copper, lead, and zinc), and diamonds. Other mineral deposit groups such as the ferrous metals (iron, molybdenum, chromium, cobalt, manganese, and tungsten—used primarily for steel), the fissionable minerals and fuels (uranium, coal, and oil sands), gemstones other than diamonds, and the industrial minerals and rocks are mentioned primarily in passing, although some references are given for those interested in these mineral groups.

Stevens organized the book in a logical sequence commencing with an industry overview, a summary of basic geology, a discussion of the formation of the various types of mineral deposits, a discussion of exploration methods and related business arrangements, a discussion of the mineral resource and reserve classification system and the technical reports used in Canada, mining methods, mineral processing, environmental considerations, and evaluating exploration companies and technical news releases. Stevens' objective in educating the non-technical investors in the mining business clearly shows in the table of contents.

The text is a distinctive summary of the major components of the mining industry. The graphics are well done. The photographs are generally crisp and nicely descriptive of the subject matter. The diagrams are simple and the colors used in the diagrams clearly present the technical features described.

Mineral Exploration and Mining Essentials is a publication which professional geologists who are not engaged in the resource industry will find to be an indispensable introductory reference. A new graduate who might be uncertain about which path to follow in pursuit of a interesting and productive career would find this text ideal for gaining insight. An aspect of the text which is particularly attractive is the clarity with which

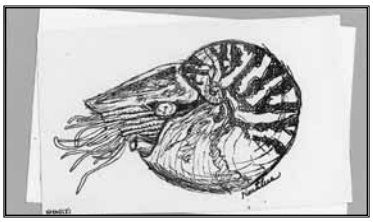
1. *De Re Metallica* was translated by Herbert C. Hoover and Lou Henry Hoover in 1909 and published by Dover Publications. It is still in print.

technical, financial, and environmental considerations are presented.

An ever increasing amount of misinformation is served up to the public by those individuals and groups opposed to resources development. Individuals and organized opposition groups arm themselves with emotionally driven opinions about mining. This text is an excellent antidote for misinformation campaigns, particularly with regard to the positive economic impacts derived from mining and the attention to environment, especially with regard to ultimate closure after extraction of the valuable ores.

The final chapter even provides guidelines and suggestions for investigating development corporations. For anyone interested in understanding the full gamut of activities in the effort to bring minerals to market. for the products necessary to modern health and well-being, this text is worth the time. The content is easily understandable and easily digested.

In summary, *Mineral Exploration and Mining Essentials* provides an excellent introduction to the mining industry for its target, non-technical audience. It is also a book that economic geologists may find useful in providing basic information that can be used to guide presentations to non-technically trained associates. If you wish to buy this book, go to *www.miningessentials.com*.



Drawing By Krystyne Kornecki

Dear AIPG,

I am truely honored to be a recipient of your scholarship. I have greatly enjoyed my time at St. Lawrence University, especially with the Geology department. I am so blessed to be part of such a caring community as well as by the generosity of others. I am very excited for my senior research as well as pursuing graduate studies and a career as a geologist.

I look forward to being a contributing member of the geological community, and look forward to writing an article for *TPG* as well.

Many, many thanks.

Sincerely,
Krystyne Kornecki, SA-2073

Dear AIPG Education Committee, Executive Committee, William Siok and Everyone at AIPG,

Thank you so much for the $1000 scholarship. I am honored to be one of the recipients of the AIPG student scholarship.

This scholarship will help me continue my studies in geology and environmental studies.

I look forward to continue my relationship with AIPG and other geologic organizations.

Sincerely,
Rebecca Dozier, SA-2050

Typographical correction on the chemical formula for "andalusite" for Test Your Knowldege Answer, from the TPG July/August 2011.

Question

1. Which of the following minerals does not qualify as a silicate?
   a) andalusite
   b) apatite
   c) almandine

Answer

1. The answer is choice "b" or "apatite". Apatite or $Ca_5(PO_4)_3(F,Cl,OH)$ is a phosphate mineral with a defining hardness of "5" in Moh's scale of hardness.

   All silicates have silicon and oxygen in their chemical formulae and constitute the most common and important rock-forming minerals that are found in the earth's crust. Andalusite is a silicate of aluminum ($\boldsymbol{Al_2SiO_5}$) and a common regional metamorphic mineral developed under low pressure and moderate to high temperature. Almandine $[Fe_3Al_2(SiO_4)_3]$ is also a silicate, generally a deep-red to purplish specimen of garnet

   (The ***bold/italic*** formula above is the correct formula.)

AIPG National Conference - 2012

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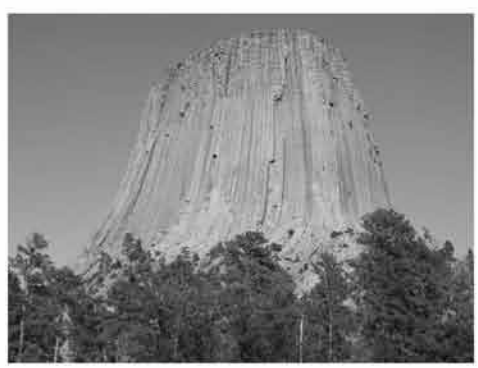

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*See Rates and Services Chart for detail of Savings and Discounts, which depend on total weekly gross shipping charges incurred.

NGWA offers course, 'Applications of Groundwater Geochemistry'

(Westerville, OH — August 23, 2011) The National Ground Water Association is offering the course, "Applications of Groundwater Geochemistry," October 17-18 in Nashville, Tennessee. A basic understanding of geochemical concepts is a good start, but knowing how contaminants will behave in a variety of geochemical settings is vital in conducting site assessments or designing an effective remediation project. This course will examine conditions resulting from groundwater and aquifer/soil interactions, and the effects of introducing a variety of contaminants. Case studies will be used to explain data collection requirements, laboratory analytical methods, and interpretation of data. Class exercises will be used to reinforce concepts presented in the lectures. Attendees will learn about: Groundwater characterization Mobility of organic and inorganic contaminants Redox chemistry of organic compounds Principles of remediation Intrinsic remediation of inorganics Geochemistry of organic remediation How different geochemical conditions will affect contamination and influence remediation decisions. This intermediate-level course is best suited to: Geologists Engineers Project managers Environmental professionals involved in risk assessment and remediation Regulators Attorneys. Attendees should possess a basic understanding of groundwater geochemistry. Two semesters of undergraduate chemistry and a degree in Earth sciences or engineering are recommended, and attendees may also want to review a college-level chemistry text prior to the course. The course instructors are Bill Deutsch, senior geochemist at Pacific Northwest National Laboratory operated by Battelle, and Patrick Longmire, Ph.D., hydrogeochemist at Los Alamos National Laboratory. To learn more about this short course, as well as the many other NGWA educational programs, visit the events/education section of our website or call 800 551.7379 (614 898.7791).

Detection of Coastal and Submarine Discharge on the Florida Gulf Coast with an Airborne Thermal-Infrared Mapping System

Ellen Raabe, David Stonehouse, Kristin Ebersol, Kathryn Holland, and Lisa Robbins

Abstract

Along the Gulf Coast of Florida north of Tampa Bay lies a region characterized by an open marsh coast, low topographic gradient, water-bearing limestone, and scattered springs. The Floridan aquifer system is at or near land surface in this region, discharging water at a consistent 70-72°F. The thermal contrast between ambient water and aquifer discharge during winter months can be distinguished using airborne thermal-infrared imagery. An airborne thermal-infrared mapping system was used to collect imagery along 126 miles of the Gulf Coast from Jefferson to Levy County, FL, in March 2009. The imagery depicts a large number of discharge locations and associated warm-water plumes in ponds, creeks, rivers, and nearshore waters. A thermal contrast of 6°F or more was set as a conservative threshold for identifying sites, statistically significant at the 99% confidence interval. Almost 900 such coastal and submarine-discharge locations were detected, averaging seven to nine per mile along this section of coast. This represents approximately one hundred times the number of previously known discharge sites in the same area. Several known coastal springs in Taylor and Levy Counties were positively identified with the imagery and were used to estimate regional discharge equivalent to one 1st-order spring, discharging 100 cubic feet per second or more, for every two miles of coastline. The number of identified discharge sites is a conservative estimate and may represent two-thirds of existing features due to low groundwater levels at time of overflight. The role of aquifer discharge in coastal and estuarine health is indisputable; however, mapping and quantifying discharge in a complex karst environment can be an elusive goal. The results of this effort illustrate the effectiveness of the instrument and underscore the influence of coastal springs along this stretch of the Florida coast.

Key Words

aquifer discharge, thermal infrared, karst – Florida, Gulf Coast, geology, high resolution, airborne mapping

Introduction

The top of the Floridan Aquifer System (FAS) is near land surface along the Florida Gulf Coast north of Tampa Bay (Miller, 1990), discharging at named springs and many small discharge locations known anecdotally, if at all. Coastal-aquifer discharge can be substantial, influencing water quality, ecosystem health, coastal biogeochemistry, and economic resources such as fishery and shellfish harvests (Cable and others, 1997). The temperature contrast between FAS discharge, 70-72°F, and surface waters is most evident at night during winter. Solar gain of surface-water and landscape features is quickly lost after sunset, providing a strong thermal contrast between cool surface waters and relatively warm FAS discharge (Raabe and Bialkowska-Jelinska, 2010). The locations of previously unmapped FAS discharge sites have been identified successfully with airborne thermal infrared imagery (TIR; Davis, 2007; Raabe and Bialkowska-Jelinska, 2007).

Study area

The Big Bend region, located on the northwestern Florida Gulf Coast, is characterized by a broad and shallow limestone shelf, low wave energy, and limited sediment supply (Coultas and Hsieh, 1997). Spring-fed rivers and tidal creeks provide links between terrestrial and marine environments. Coastal marshes occupy the Silver Bluff marine terrace of the Coastal Lowland Province, where soils are generally shallow to bedrock (Healy, 1975). Coastal forest, agriculture, silviculture, and rural developments occupy higher ground. Tourism, fishing, and the shellfish industry are also important to local economies.

Geology and Hydrologic Framework

The topographic relief of this coastal terrace is limited to 0-10' (NAVD88) except where relict sand dunes are present (Healy, 1975). Generally, the Eocene Ocala Limestone is situated near the land surface in Levy and Dixie Counties, and Oligocene Suwannee Limestone is at the surface along the coast in Taylor and Jefferson Counties. Both the Ocala and Suwannee Limestone are important aquifer-bearing units due to enhanced porosity, cavernous flow systems, and permeable composition (Scott and others, 2004). The intermediate confining unit is virtually absent in this region, and the top of the Floridan aquifer system (FAS) is at or close to land surface (Scott, 1992).

A combination of inherited structures, sea-level fluctuations, and weathering has given rise to the rocky, pitted terrain and dissolution features of this paleokarst environment (Denizman and Randazzo, 2000). Aquifer flow is enhanced and directed via secondary features, such as fractures, discontinui-

ties, and sinkholes (Tihansky, 2004). Diagenesis, primarily in the form of dolomitic limestone, can reduce porosity and restrict flow locally (Denizman and Randazzo, 2000).

Near the coast, aquifer flow is also a function of sea level, tides, and aquifer levels (Coultas and Hsieh, 1997; Cable and others, 1996). These fluctuations in the hydraulic gradient can produce mixing where both fresh and saline groundwater move horizontally and vertically along preferential flow paths (Tihansky, 2004). Seawater flows inland during periods of low groundwater levels in a process called reverse flow and may result in saltwater intrusion (Tihansky, 2004).

The aquifer discharges to the surface through springs, submarine vents, and lesser-known fractures and seeps. Although discharge volume is currently an unknown, groundwater discharge to the coasts and estuaries is estimated to be substantial and plays an important role in estuarine health and productivity (Taniguchi and others, 2002). Named 1st-order springs discharge 100 cubic feet per second (cfs) or more, while 2nd- and 3rd-order springs discharge between 10-100 and 1-10 cfs, respectively. Scott and others (2004) documented eleven 2^{nd}- and 3^{rd}-order coastal and submarine springs along this stretch of coast. Lancaster Spring, located near Cedar Key, was estimated to be a 3rd-order spring with flow at 5 cfs in 1999 (Scott and others, 2004). The 3rd-order rank was verified twice by the USGS in 2009, coincident with TIR overflight, at 2.8 and 3.5 cfs (NWIS, 2011). On the submarine side, Cable and others (1996) estimated submarine-groundwater discharge (SGD) from both diffuse and point source to be approximately 10-40 cfs per km^2 near Apalachee Bay to the west. Santos and others (2009) reported high inflow of saline groundwater with less than 5% fresh groundwater contribution in the submarine environment of northeastern Gulf of Mexico.

Conditions

The 2009 TIR flight covered the coast and near shore along Jefferson, Taylor, Dixie, and Levy Counties in Florida (Fig 1; Verimap, 2009). Regional air temperatures on March 29 at 10 p.m. were between 54 and 60°F and continued to decrease by as much as 16°F to the low 40s by 2 a.m. (SERCC, 2009). Data acquisition took place during a low-to-rising tide, 0.10 to minus 1.52 ft. MSL NAVD88 (National Ocean Service, 2009). Regional hydrologic conditions were less than ideal for mapping aquifer-discharge sites. Data acquisition occurred during the dry season and during a prolonged drought. The SRWMD (2009) reported declining groundwater levels, lake levels, springflow, streamflow, and rainfall in the months prior to the March 2009 data acquisition. Low streamflow and groundwater levels can result in diminished aquifer discharge because the FAS is closely tied to rainfall and surface-water conditions in this region. An analysis conducted with 2005/2009 TIR image overlap showed discharge detection during a dry year could be one-third lower than discharge detection during a wet year (Raabe and Bialkowska-Jelinska, 2010). Field reconnaissance during the 2009 drought year confirmed few visible boils and documented estuarine salinities in ponds up to two miles from the coast (Raabe and Bialkowska-Jelinska, 2010).

Methods

Two areas were mapped in 5.5 hours, providing 12,000 images over 2600 km^2. Imagery for the primary site, Waccasassa Bay Preserve State Park (WBPSP), covering approximately 300,000 acres, was collected in east/west flight lines, 2.9 miles wide with an image resolution of 5 ft (1.5 m). The WBPSP imagery was analyzed and prepared in a U.S. Geological Survey report (Raabe and Bialkowska-Jelinska, 2010). The second site was the northwest flight approach to the Waccasassa Bay, along the coast from Jefferson County to Cedar Key, approximately 350,000 acres in a swath 4.7 km wide. The flights were completed between 1:20 a.m. and 4:05 a.m. on March 30, 2009, within the predawn window for optimal temperature contrast.

A new and unique Thermal Step-Stare array was employed, with a modified Mitsubishi SW thermal sensor on a Cessna 310 twin-engine aircraft with a flight speed of 185 mi/hr and an altitude of 12,500 ft. The 640 × 480 focal-plane array with Sterling cycle cooler has a thermal response of 1.2 µm to 5.9 µm, and a lens focal length of 50 mm, with a 15° field of view (FOV). The unique Step-Stare chassis enables the system to perform up to a 90° swath. However, a 55° FOV (with 5-image-step per sweep) was employed on this mission. The Inertial Reference Gyro Navigation System was coupled to a real-time differential GPS satellite positioning system that provided 1.6-ft x, y, z positioning to the aircraft during flight, eliminating the need for GPS ground stations for final Imagery Geometry Solution (VeriMap, 2009).

Imagery was assembled into mosaics through a common planar-projected coordinate system and georectified (VeriMap, 2009). An anti-vignetting routine was run on the thousands of images constituting the two regions. This image processing usually smooths the transition between images in the larger mosaic while preserving the dynamic thermal range of the original imagery. However, where temperatures are consistent over a large area, such as the Gulf, an artificial grid-like pattern may remain.

Temperature calibration was conducted for water temperatures from real-time data sondes near Cedar Key and Horseshoe Beach (Florida Dept. Agriculture and Consumer Serv., 2009). Actual image values have a dynamic range of 11 to 255, each count equivalent to approximately 0.1°F. A generalized post-processing approach was employed on the 126 miles of coastline imagery presented here. Land and water pixels were separated, histogram values were extracted for water only, and the background water-temperature range was established. Image values near the ambient surface-water temperature correspond to normal water-temperature variations due to differences in water depth, substrate, and vegetation cover and do not represent temperature anomalies. A high value with a low probability (occurring in the right-hand tail of the distribution) is more likely to represent possible groundwater influence rather than minor variation in surface conditions. These low-probability, high-temperature features were extracted with $p< 0.01$ (2.58 SD is in the 99% confidence interval (C.I.) with a probability of 0.01).

Image values exceeding the established temperature threshold were extracted, and a single point was generated for each thermal anomaly or "hot spot," representing potential discharge sites. Image-derived points are close to discharge sites, but are not precise locations. Identified hot spots represent water bodies with temperatures exceeding background temperatures by 6°F or more. Some thermal features were associated with anthropogenic structures, including swimming pools in Cedar Key, excavation sites, road-building borrow pits, and the Florida Barge Canal. Anomalies at swimming pools were eliminated, and all other identified locations were separated into three groups: submarine features, landward features, and artificial or man-made discharge points. Temperature anomalies in TIR imagery were compared to spring locations reported

by Scott and others (2004). Discharge was then estimated for the entire region based on lowest-known spring-order and number of sites. A clustering analysis was conducted on the natural discharge locations to explore feature connectivity and geologic control.

Results

A total of 874 hot spots were identified and mapped using the contrast of warm-water against cooler background water temperature, with a conservative threshold of plus 6°F or more. Of those sites, 193 (22%) are submarine, located in the near-shore zone just off the coast (Figs 1b, 1c, 1d), and 681 (78%) are landward within the creeks, rivers, and ponds of the marsh and coastal forests (Figs 1a, 1e; Table 1). Approximately 12% of the landward features are man-made, the result of excavation for canals, borrow pits, and limestone-extraction sites. Although the origin of a man-made seep is artificial, such features do represent newly established exit points for the FAS and may play an important role in regional hydrology.

Identification of hot spots can vary between wet and dry years. One-third of hot spots identified in a wet year (2005) were not identifiable in a dry year (2009) due to low groundwater levels and reduced flow (Raabe and Bialkowska-Jelinska, 2010). In a wet year, one could expect the number of coastal springs identified with TIR imagery to increase by 33% (Table 1). Table 1 contrasts the number of features identified during a dry year, using a 6°F contrast threshold, and estimated for wet years along 126 miles of coast. Averaged, there may be roughly seven to nine discharge sites per mile of coast.

Discharge Estimates

Known, named, and documented sites are a small fraction of the FAS exit points in the region. Several small coastal springs in Levy and Taylor County, documented by Scott and others (2004), were geographically located within the 2009 TIR imagery. Each of the 11 springs was visible as a warm-water feature. Eight 2nd- or 3rd-order springs were identified as hot spots (exceeding the established +6°F threshold), and were among the smaller thermal anomalies identified in the TIR imagery (Fig 1b). Compare the feature TAY616991, a 3rd-order spring, in Figure 1b with larger features in Figures 1a and 1d. The remaining known springs, while visible, fell below the temperature threshold and had been rated 3rd-order or smaller. The threshold of +6°F approximates the cutoff between high-flow 3rd-order and low-flow 2nd-order springs, representing a discharge of roughly 10 cfs.

To calculate freshwater discharge for the region, average flow across all sites, both large and small, was set at 10 cfs. An estimate of the landward discharge from 681 sites produces 6,810 cfs or 4,400 mgd (million gallons per day; Table 2). This would be the equivalent of approximately 70 1st-order springs along 126 miles of coast, or one 1st-order spring every two miles. A similar calculation for the submarine sites produces a total of 1,930 cfs or 1,247 mgd. Of this, the freshwater component may be only 5% (Santos, 2009), or 97 cfs (62 mgd), the equivalent of one 1st-order submarine spring for the entire 126 miles. Discharge during wet years may be substantially higher.

These calculations assume that FAS discharge from landward sites is freshwater. However, discharge water quality may vary from year to year due to the potential for saltwater intrusion in this coastal region. The combined impact of sea-level rise, water withdrawals, and low water levels increases the likelihood of saltwater flow along preferred flow paths, and can result in thermally distinct, but saline discharge at coastal sites (Raabe et al., 2007).

Clustering of Thermal Anomalies

An analysis of density and dispersal was also conducted on the naturally occurring sites at varying spatial scales. Clustering of natural discharge locations is largely local, occurring within 0.5 to 5 miles. Clustering at this scale was greater than would be expected with random distribution. At distances beyond 12 miles, natural sites are more dispersed than would be expected. This indicates that natural FAS discharge occurs in localized exit zones with concentrations of multiple sites.

Discussion

Images from the airborne TIR system depict thermal contrasts in coastal-water bodies along the coastline of Jefferson, Taylor, Dixie, and Levy Counties in Florida, highlighting aquifer discharge and associated warm-water plumes. The thermal camera records variations in the distribution of emitted energy, which we represented with a dynamic color scale for visualization. Heat energy, by definition, flows from hotter to cooler areas. If a heat source is external (solar radiation during the day), warm-surface features will cool naturally after sunset, becoming thermally invisible as they reach equilibrium with ambient nighttime temperature. If a heat source is internal or local, energy output will be distinguishable by a thermal contrast at night during the winter. Energy emissions exceeding ambient temperatures are reflected in higher thermal values. In theory, greater thermal contrast and greater aerial spread should

Hot spots in TIR	Submarine	Landward		Total	Per mile
		Natural	Man-made		
Dry year	193	600	81	874	6.9
Wet year	257	800	108	1165	9.2

Table 1. Total submarine and landward hot spots and average per mile of coastline for dry years and estimated for wet years.

Estimated discharge	Submarine sites	Discharge 5% (cfs)	Landward sites	Discharge (cfs)	Total estimated discharge (cfs)	Equivalent 1st-order springs per mile
Dry year	193	97	681	6,810	6,907	0.5
Wet Year	257	129	908	9,080	9,209	0.75

Table 2. Freshwater discharge estimate for submarine and landward sites for wet and dry years.

represent greater discharge. We showed a relation between several small springs and small thermal anomalies. However, no effort was made to distinguish among low- to high-order springs because discharge data are lacking.

Estimates of dry- and wet-year FAS discharge locations vary from 874 to 1,165, respectively, in this region. The number of identified features is a conservative estimate of discharge sites based on two moderating factors: 1) TIR imagery acquired in a dry year, and 2) high threshold set for positive identification. Additional thermal contrasts are visible in the imagery but do not exceed the established threshold. Unselected, but visible, temperature anomalies may indicate low-velocity discharge mixing with surface water or discharge from greater depth.

Previously known springs located within the image area (Scott and others, 2004), represent a fraction of the sites documented with TIR imagery. Regional discharge estimates were based on the size of previously known coastal springs relative to the bulk of TIR-identified discharge features. A modest flow of 10 cfs was applied to the number of discharge sites, producing a combined total discharge equivalent to one 1st-order spring for every 1.5 to 2 miles of coastline, or the equivalent of 70-90 1st-order springs across the entire region.

Since the zone of influence, or plume, of many identified features was larger than that of the known, low-discharge springs, the discharge estimate is both conservative and generalized. It is hypothesized that high thermal values and the area of influence of each thermal anomaly are related to discharge volume, water depth, and the degree of flow confinement. Unfortunately, there is currently insufficient discharge information in this region, whether during high- or low-flow years, to fully assess the hypothesized correlation. To address the hypothesis adequately, one would need discharge data on a range of features, small-to-large, shallow-to-deep, and from confined ponds to open waters, preferably in low-to-high water years. Temperature intensity and aerial extent of each feature in the TIR imagery may be used eventually to evaluate a correlation.

The concentration of discharge in localized exit zones provides evidence for preferred flow paths and the presence of less porous rock and/or dolomization. Man-made canals and borrow pits represent newly established exit points for the aquifer through bedrock excavation, particularly near coastal communities. An unanticipated contribution from TIR imagery was documentation of cold water seeping from tidal wetlands during low tide. Increased subsurface seepage during low tides and a seepage-temperature decrease of 21°F as winter approached were recorded in tidal wetlands near the Suwannee River (Raabe and others, 2007). The combination of cold water exiting the marsh fringe and FAS discharge in the region may contribute to the cold and low-salinity tongue described by He and Weisberg (2002).

Aquifer-discharge locations and estimates can be applied to scientific inquiries on water quality, estuarine health, sustainability, and modeling, location of saline and freshwater interface, improved understanding of subterranean structure, the location of unique habitats, and risks to coastal water supply. TIR imagery acquired in 2009 is a snapshot of coastal-groundwater discharge at a single point in time. Repeat assessments during moderate to high groundwater levels could address questions on volume, variability, and vulnerability to drought, sea-level rise, or urban-development pressures.

Airborne thermal-infrared mapping is an under-utilized mapping tool that can be applied in a variety of settings. In this case, we tackled a familiar topic: the location of coastal seeps in the Big Bend region of Florida where the Floridan aquifer is at or near the land surface in a complex karst landscape. Few of the identified sites had been previously documented, though some were known locally by anecdote. The volume of water and the sheer number of seepage sites far exceed previous documentation in the region.

Acknowledgments

We acknowledge the invaluable contributions of Butch Miller, pilot with MARC Inc., Mario Patacic, VeriMap sensor operator, and Leigh McDonald, VeriMap software programmer.

Note

The southern section of the 2009 TIR imagery was processed and analyzed for the Waccasassa Bay Preserve State Park and prepared in a U.S. Geological Survey report (Raabe and Bialkowska-Jelinska, 2010). The project in WBPSP highlights and expands relevant topics, including interpretation of nighttime TIR, benefits of airborne mapping efforts, the role of groundwater levels on feature identification, feature omission, and the role of underlying structure on site location and distribution.

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Any use of trade names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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Reviewed by AIPG Associate Editors: Solomon Isiorho, CPG-07788, Robert Minning, CPG-02565, and Ray Talkington, CPG-07935.

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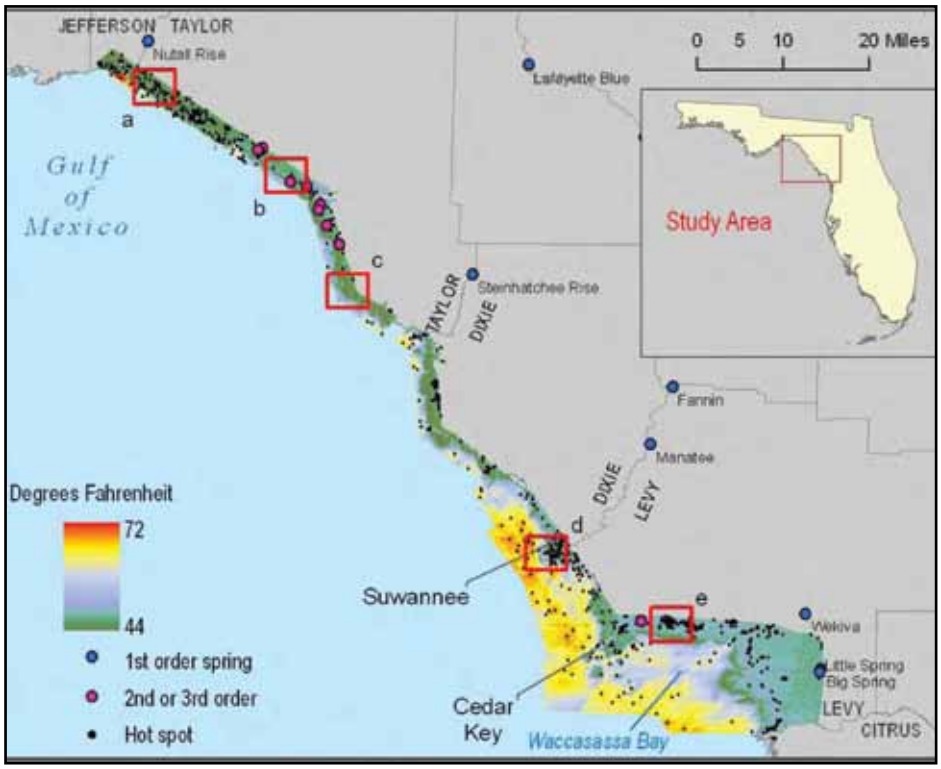

Figure 1. 2009 TIR imagery covers the coastline of Jefferson, Taylor, Dixie, and Levy Counties – 126 miles on the Florida Gulf Coast. The general overview map illustrates the cold landscape in light to deep green, ambient water in gray/lavender, plumes or traces of discharge in yellows, and orange/ red representing discharge locations. Named 1st-order springs, previously reported 2nd-and 3rd-order springs, and identified hot spots are marked. Sections of the imagery are shown in detailed insets Figures 1a-1e.

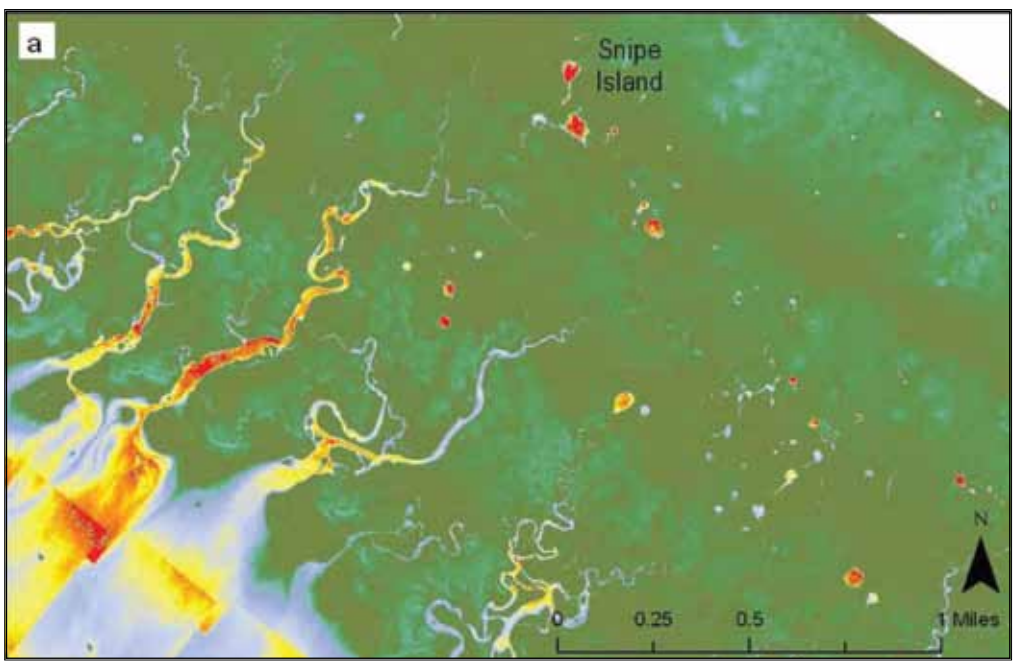

Figure 1a. Tidal creek near Snipe Island in Taylor County illustrates the difference between tidal creeks with and without aquifer discharge. Scattered ponds in the interior also provide a strong visual contrast between aquifer-influenced ponds and typical surface-water bodies. The coastline is characterized by a broad stretch of tidal marsh, discharging distinctly cold water (dark green) into the near shore during low tide.

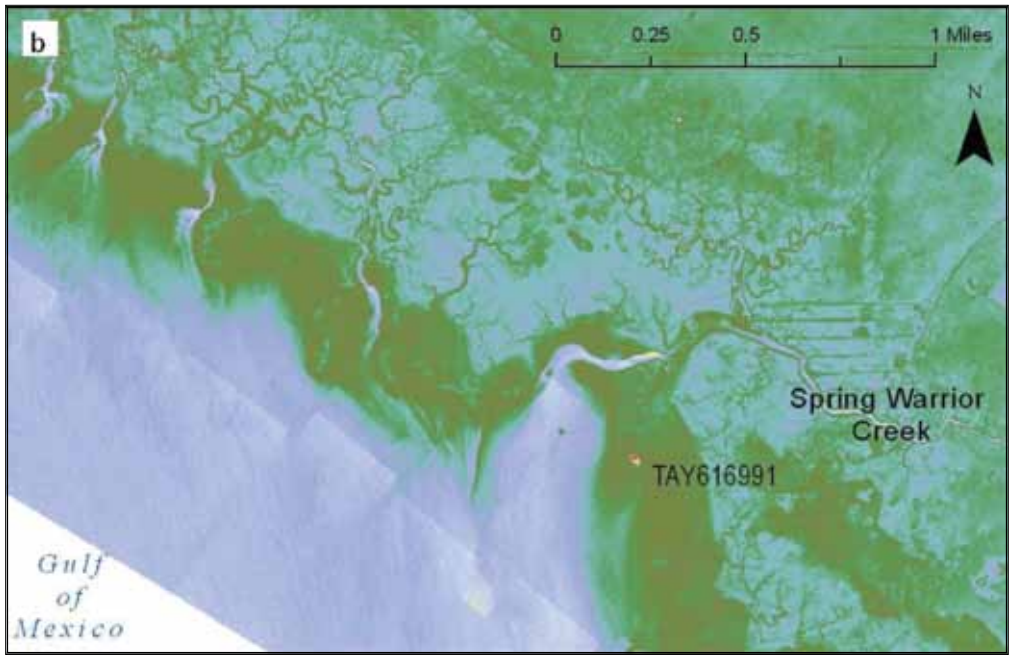

Figure 1b. Spring Warrior Creek is situated in an area with limited aquifer discharge. The paucity of discharge sites along this section of coast indicates a less porous, and perhaps more highly dolomitized limestone. A known submarine-discharge site, TAY616991 (Scott and others, 2004), is located in the mouth of Spring Warrior Creek. The discharge, estimated as a 3rd-order spring (1-10 cfs), was clearly visible in the imagery and was identified as a hot spot.

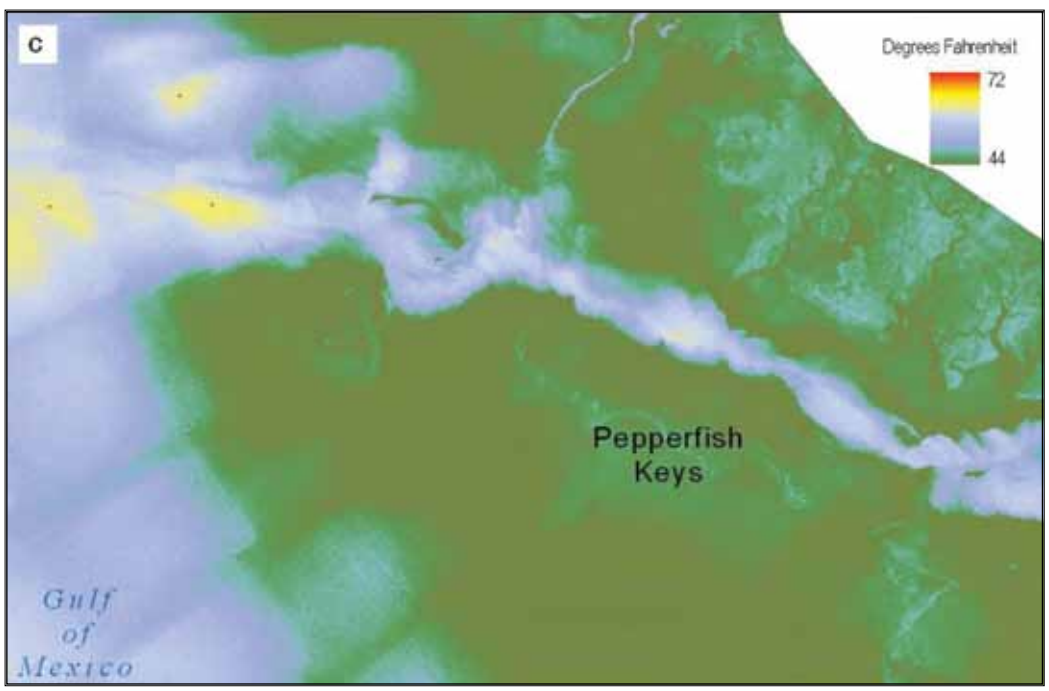

Figure 1c. Pepperfish Keys-A series of small temperature anomalies is located between the mainland and Pepperfish Keys in an almost linear configuration. A large volume of cold water was discharging from both the mainland marshes and the keys. The temperature contrast was sufficient to identify several thermal anomalies at the west end of this feature.

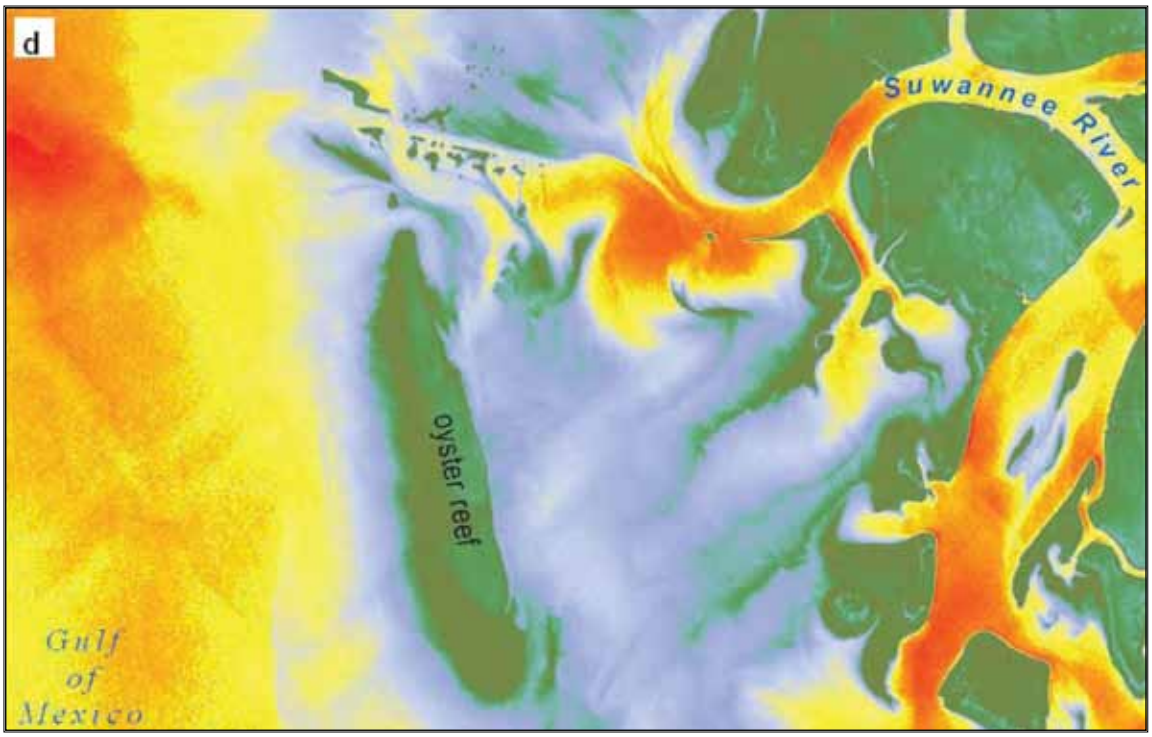

Figure 1d. Suwannee Estuary-Several submarine hot spots are notable within and just offshore of the Suwannee River. Each zone of higher temperature is distinct and separate from each other. The large hot spot to the west is several degrees warmer than either the river plume or the Gulf waters.

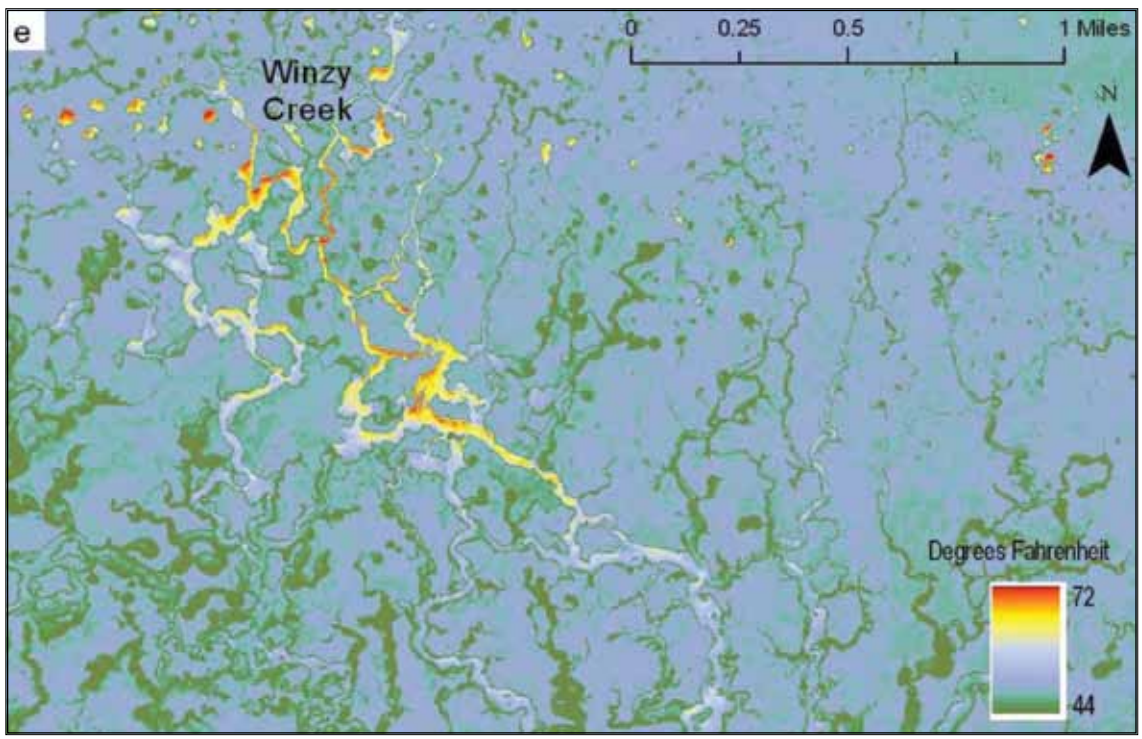

Figure 1e. Winzy Creek, just to the east of Cedar Key (on Fig. 1), is an example of a complex karst plain, water-bearing limestone, and localized discharge concentration. Parallel and linear creeks, angled intersections, and many temperature anomalies occur in a rocky and marshy environment. The birds-eye view from airborne sensors has many advantages, including the ability to map an area difficult to access by boat or by land due to pitted, swampy terrain, exposed limestone, and many shoals and oyster bars.

Georgia Section

Waterfall Field Trip-We picked the right weekend to have a field trip! I'd been out the weekend before scouting one of the waterfalls and the weather was so hot and the humidity so high that you would be drenched in sweat in no time. Luckily for us, the temperature on the day of the field trip was in the 80s and very pleasant. We had a total of 14 people and visited three different waterfalls. Falls Branch Falls is only about a 15-minute drive from the Blue Ridge area. The fall is well marked and an easy hike.

Long Creek Falls is located off a national forestry road and takes about 45 minutes to an hour to reach the trailhead. From there it's a nice one-mile hike to the falls. After we got back to the trailhead, we had lunch along one of the many mountain stream tributaries. From there we drove to Sea Creek Falls. This waterfall is also well marked and only a short walk from the parking. It turned out to be a great day to spend with friends, co-workers, and a few university students.

Ron Wallace,
Section President

Ron Wallace, CPG-08153, presenting Ashley White, SA-1868, from West Georgia,with her student membership plaque and scholarship.

Sea Creek Falls with swimming pool in front.

Group picture at Long Creek Falls.

Falls Branch Falls.

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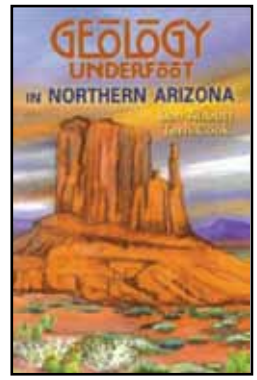

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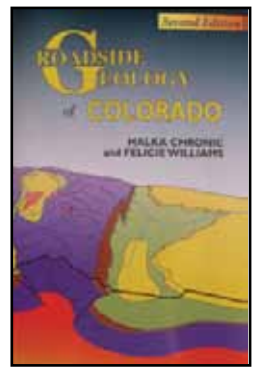

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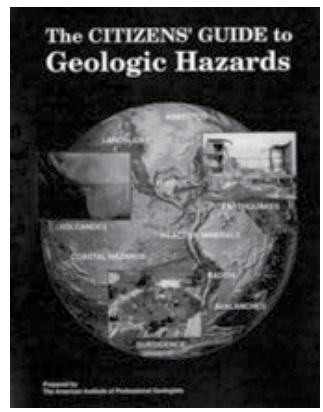

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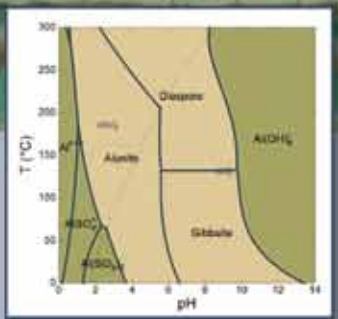

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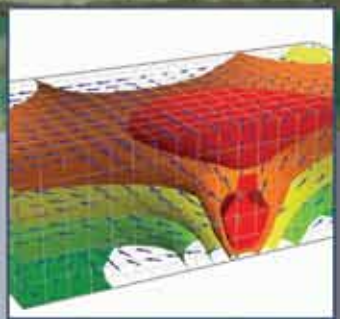

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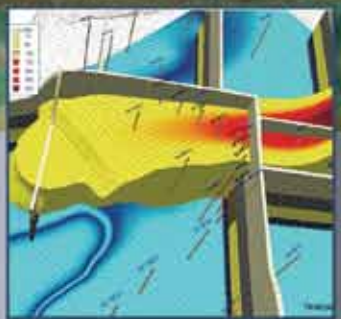

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