

Florida Geology Forum

A Newsletter from the Florida Geological Survey Vol. 22 No.1 July 2008

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Be Relevant, Communicate, or Bust

Jon Arthur, Assistant State Geologist and Acting Director

A favorite quote by Albert Einstein comes to mind as we face challenging times in our economy -- "Not everything that can be counted counts, and not everything that counts can be counted." In context of the geosciences community, whether our contributions are through public service, academics, consults or industry, ensuring that our contributions are those that can be counted and are counted is fundamental to public health, economic growth and environmental stewardship. To accomplish this in a sustainable manner, the "baseline awareness" regarding the geoscientist's vital role must be sustained and enhanced in the eyes of the public and elected officials.

Without a doubt the geosciences community has come far in the relevancy department. Years ago in state governments throughout the county there often was a mind-set of "who are those 'rock people' and why do we need them?" In today's world, the interdisciplinary nature of environmental issues is widely recognized. For example, if an environmental issue is to be fully addressed, an effective team includes not only administrators, planners and policy experts, but scientists and engineers. It is becoming more commonplace for experts in geology, hydrology, biology, chemistry, etc. to be at the table serving as the "brain trust" to provide the knowledge base on which decisions and policies are made. Geologic knowledge, research and assessment have become integral to forward-thinking decision makers involved in the protection and management of the environment. So if this is happening, can geologists kick back and assume the e-mail will arrive when we are needed?

Public awareness of geology certainly spikes when high-profile events occur, whether it is devastating earthquakes in China, the Mars Phoenix Lander or the broadcast of the American Geological Institute's "Faces of Earth" series on the Discovery Channel. These events no doubt elevate baseline awareness and contribute to education of the public. However, when budgets are being reviewed through a microscope, is that

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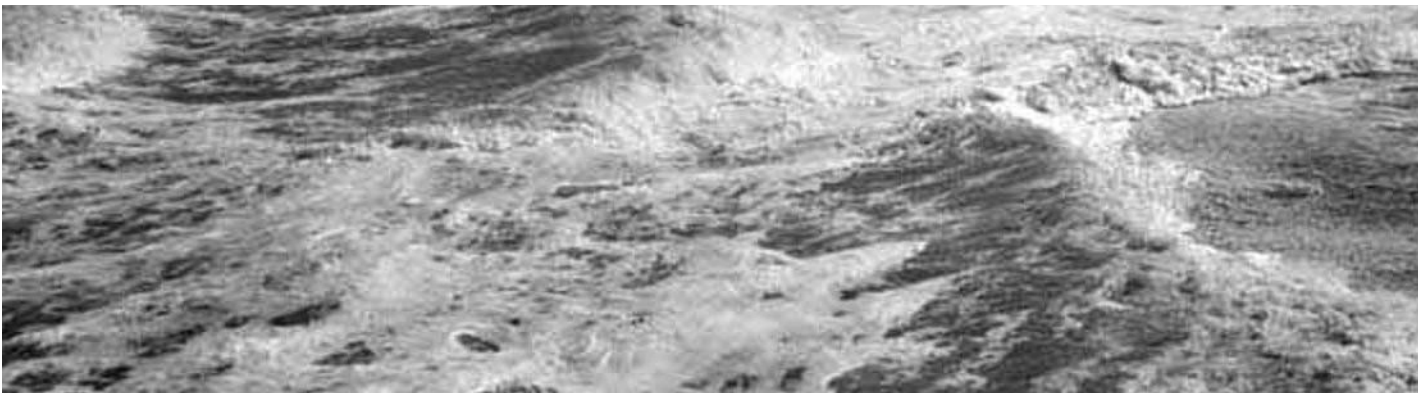
baseline high enough for it to be a “no brainer” that geologic knowledge, data, maps, models, services, etc. are essential? During a recent episode of the animated TV show *American Dad*, a character says “Have you ever had breakfast with a geologist? It’s pretty great.” Does this mean that geoscientists have reached the summit of public awareness? It would be nice to think that, but the true litmus test will be the day when nobody has to remind a decision maker to bring a geologist to the table.

Improving the baseline awareness is a process, not an event. In the succinct words of geologist colleague, Gene Shinn, lies this truth: “No rocks, no water, no ecosystem.” In other words, geology is the foundation of the ecosystem. But how often do you see that concept in a textbook? It’s rare. It is vividly clear that there is still much work to be done for geologists to increase the baseline. I recall during a Florida Association of Professional Geologists event being told “I didn’t know you guys did that” when the issue of groundwater came up. Clearly, despite our efforts to provide public education and outreach, there is much ground to cover if we are to have a geologically aware and astute public. Continued education and outreach are vital in this regard.

THE NEXT 100 YEARS

Last year’s centennial of the Florida Geological Survey came at a time when the geosciences community had already turned a corner toward improving the baseline awareness. Consider, however, what the next 100 years will bring in terms of geological challenges. About 1,000 new residents arrive in Florida every day. With each person comes the need for water, construction materials, land, etc. and with each comes their “environmental footprint.” The cost of water could exceed the cost of petroleum products. The need for energy, water, waste disposal and reduced carbon emissions could drive geologic exploration and modeling to a depth and breadth similar to technology seen in *Star Trek’s Enterprise*. Global climate change will yield a rise in sea-level. Coastal erosion will become more intense. How long will the battle to restore our beaches continue and how long will the sediment reserves sustain the battle? Will weather patterns become more severe? Geologic hazards such as storm surge, flooding and sinkhole activity may intensify, further threatening the quality of groundwater resources. The list goes on. Will Florida be prepared? We know our role in these concerns, but it is our job to be sure that those who will become our leaders also know.

During times of a slow economy, one might summarize the challenge to the geological community in a bumper-sticker-like phrase, “Be relevant and communicate, or bust.” We all know what needs to be done and many are doing it, but there remain many content with quietly being a good scientist while not communicating the important message of our relevancy. Public lectures, helping develop secondary school curriculum materials, professional presentations to groups besides other geologists, mentoring, participating in teacher education workshops – these are things we all can do to help prepare for the next 100 years that can facilitate a more geologically aware public. With that increased awareness will come the ability to put geoscience knowledge and research to work where it is needed, and more geology professionals ready to tackle the mountain of environmental issues arising before us.





Emerald Sink, Woodville Karst Plain

Hydrogeology Section Update

CHARACTERIZATION OF THE WOODVILLE KARST PLAIN

In the last year, the Hydrogeology Section has continued its efforts aimed at characterizing the Woodville Karst Plain (WKP), a coastal, karstic watershed in north Florida, in order to contribute to efforts to conserve and protect it. The group's efforts were two pronged. Some team members developed a draft steady state numerical model which theorizes water flow lines and interaction paths between Wakulla Spring and the Spring Creek system.

Other team members' efforts aimed at the assessment of the WKP for potential designation as a Hydrogeological Observatory, a concept advocated for several years by academicians and resource managers as the most effective means of protecting and managing ecosystems using collaborative multi-disciplinary and multi-institutional approaches. The WKP location on the coast has allowed researchers to evaluate and quantify the aquifer's interaction with streams and the coastal marine environment. In the case of the WKP, this coastal setting is further complicated by the existence of a submarine spring system (comprising some 14 individual springs clustered in an area of a few square kilometers) known as Spring Creek at its southern boundary. This research will provide better understanding, not only of the dynamics of water flow and contaminants transport in coastal karstic watersheds, but also of how land use and water management practices in these watersheds influence the health and integrity of groundwater, surface water, coastal estuaries and the ocean beyond. Results of this research may be viewed at the website: <http://hazlett-kincaid.com/HTML/main.htm>

Factors that support designation of the WKP as a Hydrogeological Observatory include:

- The WKP is a highly complex system of upland and coastal springs, rivers, sink holes, sinking streams, conduits, caves and wetlands that are highly interactive and are heavily influenced by tidal cycles.

- It combines rural and urban communities that are economically dependant on the sustainability of healthy natural systems within the watershed including the near-shore marine environment.
- Its location down stream of major point and non-point sources of pollution from two counties has already resulted in the degradation (eutrophication and algal growth) of the quality of its most famous springs (Wakulla Spring and Spring Creek Spring systems).
- It is perhaps one of the most intensively monitored and studied karstic systems in the country generating a wealth of data that will be instrumental in its possible designation as a hydrogeological observatory for the purpose of comprehensive management and protection.
- Its geographic location in the vicinity of Florida's state capital makes it an ideal site for collaborative efforts among scientists from two universities, many state agencies, federal agencies and a very active consulting community all located in the Tallahassee area.
- Past and ongoing studies have resulted in commitment to change certain waste management practices by municipal and local governments that should lead to better management of potential sources of pollution.
- The WKP, in general, and Wakulla Spring, in particular, have been instrumented by our team. These instruments will be transmitting data directly to our computers via telemetry system that is currently being installed.
- Members of our team include professional divers from Global Underwater Explorers (GUE) who are certified to deploy instruments underwater at depth exceeding 300 feet. They have been conducting cave exploration and mapping in the WKP for years and have provided for all of our diving needs since 2002.



Trees Reflected in a Karst Pond, Woodville Karst Plain

TRACE METALS IN GROUNDWATER AND IN FLORIDA'S AQUIFERS

The Hydrogeology Section of the FGS, along with the Department's Groundwater Protection Section (GWPS), and the Southwest Florida Water Management District (SWFWMD) are cooperatively working on an investigation to characterize sources of trace metals in Florida's aquifer matrix material and groundwater resources. Previous studies have demonstrated that carbonate rocks of the Floridan aquifer system interact with freshly recharged water during aquifer storage and recovery activities. The resultant water-quality changes can be detected in recovered water. These water-rock interactions may release undesirable metals (e.g. arsenic, iron and other trace metals) from the aquifer matrix into the recharged water in concentrations that, at times, surpass either state or

federal maximum contamination levels (MCLs).

When the federal and state MCL for arsenic in groundwater was reduced from 50 micrograms per liter to 10 micrograms per liter, many more samples that exceed groundwater quality standards were identified. These occur mainly in private drinking water wells. For these reasons, representatives from the GWPS, the SWFWMD and the FGS have a mutual interest in characterizing arsenic and other trace metals in the matrix of Florida's aquifers and the corresponding groundwater. Together, they have developed a cooperative study to assess natural and anthropogenic sources of trace metals in Florida's aquifer systems, with emphasis on arsenic.

The scope of the four-year study is to: (1) determine trace metal concentrations in both the aquifer groundwater and aquifer matrix, (2) predict whether trace metal concentrations in native groundwater are attributed to the natural system or anthropogenic influences, or both, and (3) develop one or a series of lowest possible threshold screening values for arsenic and possibly other trace metals that represent an indication that groundwater quality has been significantly impacted by human activities.

The first year of the study is nearing completion and includes a compilation of water-quality/matrix chemistry data from a variety of sources along with analysis of the data. This information will be used to generate preliminary distributions of trace metals in the aquifer matrix and in the groundwater on a statewide basis. During the second year, the groundwater-aquifer matrix chemistry relationship will be assessed in a pilot study area centered in the Tampa Bay area. It is anticipated that the third year will consist of expanding the study area to include other areas in Florida. A water-rock equilibrium model will be generated in order to assist in interpreting existing data as well as data generated during the pilot study. The fourth year consists of (a) predicting areas of the state where man's activities are most/least likely to cause violations of trace metal MCLs and (b) establishing screening thresholds for appropriate trace metals.



Deadman's Island Near the City of Gulf Breeze (Town Point shown in upper left of photograph)

Coastal Program Update

The Coastal Research Program initiated an investigation of Deadman's Island and the immediate offshore area for the city of Gulf Breeze from March through May of 2008. The project, off of Florida's Panhandle, used side scan sonar, bathymetry measurements, vibracoring, bottom sampling and granulometry to assess local sand resources

for possible use in restoration and preservation of the island's historical resources.

Deadman's Island lies near the mouth of Pensacola Bay adjacent to the city of Gulf Breeze in Santa Rosa County. The narrow, northeast/southwest trending island has been experiencing shoreline erosion in recent years, especially along the northern end. The island and adjacent waters of Old Navy Cove to the west are considered an historically sensitive area. It is thought that Old Navy Cove provided a protected anchorage for shipping from the colonial period to the modern era.

The FGS sampled the island's beach sediments and collected ground penetrating radar data along its length. They also collected six vibracores from the island, one each from adjacent waters to the north and south, as well as three from a proposed borrow site near the city of Gulf Breeze. Three hammer cores were collected in shallow waters immediately north of the island and in the waters of Old Navy Cove, lying to the west of the island, the FGS conducted a side scan sonar (SSS) and bathymetric survey. Eighty-eight miles of line were shot and 1.3 square miles of seabed imaged at approximately three-inch resolution. The FGS also collected eight grab samples from the cove's seabed for characterization of bottom sediment.

A bottom feature spread across the eastern extent of the survey area related to differences in sediment reflectance was seen on the side scan sonar data. This feature exhibits higher than average reflectance with an orientation generally parallel to the shore line south and west of Deadman Island and is thought to indicate a difference in sediment composition. On certain side scan sonar lines, most notably in those proximal to the eastern edge of the survey area, features indicative of submerged anthropogenic material were noted. Based on consultation with Dr. Roger Smith of the Florida Bureau of Archaeology, some of these features appear to correspond strongly with known or suspected locations of shipwreck debris.

Upgraded Core Storage at the Warehouse

Installation of the second half of the FGS core depository mobile shelves was completed in April 2008. This installation extends the mobile shelves installed in the 2003/2004 fiscal year to cover both halves of the bays at the FGS warehouse. These shelves will give the depository an estimated growth space of 72,000 feet of core storage. Use of mobile shelves allows us to take greater advantage of the 41' by 50' floor space in the bays. Identical to the first installation, the second system is comprised of nine shelf units. With traditional stationary shelves there is an open aisle space between each shelf unit, but with the mobile shelving there is only the need for one open space and the shelves roll apart for access. The use of the mobile shelves has gained the FGS 50% more storage space over conventional shelving.

Cooperative Program Benefits FGS and Leon County School Students

The FGS is now in its sixth year of a cooperative training project with the Leon Advocacy and Resource Center (LARC) and the Leon County School (LCS) system. The program provides special needs students with the opportunity to experience different types of entry-level jobs in many different fields including nursing, office/clerical, landscape maintenance and the computer field. The students from the Leon County Schools are under the umbrella of *Leon's Intensive Training for Employment (L.I.T.E.)* program. Aprell Merritt, an Employment & Community Training Supervisor with LARC, and Jim Barnard, an LCS Employment Consultant manage the cooperative training work experience at the FGS with the assistance of FGS Librarian Specialist **Doug Calman**.



FGS staffer Jesse Hurd with Mobile Shelves

These students work in teams and visit the FGS Library twice a week, using HP flatbed scanners coupled with Adobe Acrobat to scan the Survey's collection of lithologic logs into PDF format computer files. They gain valuable computer and clerical office skills training along with work experience for their futures. The paper lithologic logs are stored in 141 large, green loose-leaf binders called "Green Books" which are labeled by county names. The collection of "Green Books" represents data collected over approximately 75 years from many types of wells and provided by the driller's logs or geologists' written descriptions. For the project, each page of a "Green Book" is scanned into a single pdf file. These are combined using Adobe Acrobat into a much larger county pdf file that can be placed on the DEP website. Scanning the logs into digital books will provide valuable information to DEP employees, engineers and consultants across the country who often phone the Survey for data from wells in particular geographic locations. Since this project started, the students have scanned in data from 26 of Florida's 67 counties.



Anna Block (Leon High), Alexandra Holden (Leon High), Yulise Jones (LARC Job Coach) and Kami Downey (Leon High), shown left to right, work at the FGS Library Scanning Station.

Education and Outreach

WAKULLA WILDLIFE FESTIVAL

FGS staff members **Brie Coane**, **Rick Copeland** and **Sarah Ramdeen** participated in the Wakulla Wildlife Festival held April 5, 2008 at Wakulla Springs State Park. Staff passed out posters and spoke to guests about various FGS programs and the geology of Florida's springs.

EARTH DAY AT THE CAPITOL

Earth Day at the Capitol was organized by the Department of Environmental Protection's (DEP) Office of Environmental Education. The theme for the April 22, 2008 event was "Celebrating Environmental Citizenship in our Community, At Home and At School." FGS geologists **Jackie Lloyd**, **Frank Rupert** and **Paulette Bond** talked with numerous students about protecting Florida's groundwater as part of the DEP scavenger hunt and used a model, along with samples of geological materials, to explain the carbon cycle and the way that various rocks relate to it.

TAKE OUR SONS AND DAUGHTERS TO WORK DAY

The DEP celebrated "Take Our Sons and Daughters to Work Day" with a morning program for children and their

parents on April 24, 2008. Greg Ira, Environmental Education Director, kicked off the event that featured Law Enforcement demonstrations, videos, a boat and equipment used for water sampling, and a macro invertebrates and animal demonstration featuring an exotic bird and snakes. FGS Assistant State Geologist **Jackie Lloyd** and Geologist **Paulette Bond** staffed a display of rocks from throughout Florida. They used vinegar on Ocala limestone to demonstrate and explain how a weak acid can dissolve limestone.

“LAND BENEATH OUR FEET” EXHIBIT AT THE SOUTH FLORIDA MUSEUM

The FGS assisted the South Florida Museum in Bradenton, Florida with their summer exhibit titled *Land Beneath Our Feet* from May 10-August 31, 2008. Copies of all posters were supplied to be used as sources of information and for graphics depending on the exhibit’s design. In addition, FGS was able to supply samples of rocks and minerals from around the state at the request of Curator of Collections, Valerie Bell. District Geologist **Clint Kromhout** selected sections of a core representative of the area’s geology.



FGS Assistant State Geologist Jackie Lloyd at Earth Day at the Capitol, 2008

FGS Organizational Change

The 2008 Florida Legislature and Governor Crist approved several organizational changes for the Florida Department of Environmental Protection, effective July 1, 2008. One of these changes moves the Florida Geological Survey’s Oil and Gas Section to the Bureau of Mining and Minerals Regulation within the Division of Water Resource Management (DWRM). The Florida Geological Survey structure will report as an Office directly to the Deputy Secretary for Land and Recreation. As an Office, the FGS is now considered a Division level within the Department, and the head of the FGS, currently titled as “Bureau Chief” will be changed to “Director”.

The Oil and Gas Section’s Tallahassee Headquarters was physically located at the DEP Warehouse in proximity to the FGS Geological Data Collection Program and Sample Repository. Under the reorganization, this Section has moved and is now co-located with DWRM’s Bureau of Mining and Minerals Regulation at Tallahassee’s Innovation Park. New contact information for Oil and Gas is 2051 E. Paul Dirac Drive, Tallahassee, FL 32310; 850/488-8217.

It is anticipated that geologic support between the Oil and Gas Section and the FGS will continue. The FGS Director will provide historical perspective and continuity for the Oil and Gas Section during the transition to a new Oil and Gas Administrator and Chair for the Big Cypress Swamp Advisory Committee as needed. The FGS

geoscience research library collections include several oil industry journals, as well as many theses and dissertations, and other reports and documents pertinent to petroleum geology. This resource is used by our staff, other government agencies, industry, consultants, academia and the public. It is anticipated to remain intact and will remain available to the Oil and Gas Section staff.

Florida Geological Survey 2007 Employee Awards

TEAM EXTRA EFFORT AWARDS

Two teams were recognized for their extra efforts:

The Jay Oil and Gas Field Office Team was recognized for their exceptional dedication to public service as exemplified by their response to the night time collapse of a drilling rig stacked with a half a million pounds of pipe. **John Leccese** and **Dave McCarthy** rushed to the accident scene, checked for H₂S, took pictures, interviewed survivors, examined the wreckage for any sign of a cause and then wrote the inspection report.

The Association of American State Geologists (AASG) Meeting Team was recognized for their exceptional job planning and running the June 2007 AASG Annual Meeting. An amazing amount of detail and behind-the-scenes hard work was required to plan and run the meeting, including announcements, mailings, web site design and maintenance, hotel guest reservations, meeting room scheduling and logistics, meal planning, hospitality, meeting registration system, field trip planning for geologists and guests and more. The meeting not only came off without a hitch, but many guests complimented the team and commented that it was the best AASG annual meeting ever. Team members were **Jon Arthur**, **Traci Billingsley**, **Paulette Bond**, **Jeff Erb**, **Rick Green**, **Leslie Knight**, **Jackie Lloyd**, **Harley Means**, **Tony Miller**, **Sarah Ramdeen**, **Frank Rupert**, **Walt Schmidt**, **Tom Scott** and **Carolyn Stringer**.

INDIVIDUAL EXTRA EFFORT AWARDS

Doug Calman, the FGS Librarian, was recognized for his initiative and diligence. Doug is known to respond promptly to requests for research-related information, providing not only the requested materials, but additional information and related resources. Once he knows a particular area of interest, he continues to watch for new references and publications that relate to the subject. Doug informs the entire staff about the resources available through the FGS Library and has also made significant efforts to ensure maximum availability of digital publications to the staff and the public. His continued organization in the library is evident and his recent cataloging of our collection of springshed maps is a clear example of his extra effort to improve the FGS library and library services.

Employee Awards Luncheon at the Gardener's Cottage, Alfred B. Maclay Gardens State Park



Cindy Fischler was recognized for her hard work and exemplary attitude. Cindy has been one of the hardest working scientists at the FGS over the last 10 years. She makes a huge effort to follow good lab procedures and get efficient data and is always on task. When problems come along, Cindy never gets stuck, she just transforms into trouble shooting mode. She is always friendly and helpful to other staff who can count on her help with things such as the FGS Earth Science Week Open House and the annual inventory. She has a great attitude and is a great asset to FGS. We congratulate her on this award and are thrilled that she is now a full time Professional Geologist.

Guy Richardson was recognized for his dedication and exceptional contribution. Although Guy has been involved full time with the ongoing Daytona Coe Drilling project, he also put in considerable time on the Woodville Karst Plain Gravity Anomaly project. Guy assisted Brie Coane with drilling during his “time off” essentially working two full time jobs for several weeks. Guy’s assistance was extremely valuable and helped keep a difficult drilling project moving forward. Guy’s participation allowed us to keep two crews in the field -- one working nights and the other working days.

SUSTAINED EXEMPLARY PERFORMANCE AWARDS:

Three FGS employees were recognized for their exemplary service to the agency:

Lee Booth retired in February 2008 after nine years of service to DEP/FGS. Lee is recognized as a walking encyclopedia of knowledge about drill rigs, well drilling and well construction. He often works on his day off to help avert a crisis or make sure that tricky drilling or well installation procedures went well. As great a driller as Lee is, he is a better teacher. His experience is irreplaceable and his sunny self will be sorely missed.

Jackie Lloyd was recognized for consistent and important contributions to the DEP/FGS management. Her work quality and ethic have been instrumental in allowing the FGS to function as a well-oiled machine. The FGS Handbook, a comprehensive operations manual authored by Jackie, has been promoted by senior management as a model for other DEP programs. Jackie has advocated for the profession of geology as president of the Florida Association of Professional Geologists. She is a graduate of the Florida Center for Public Managers, Certified Public Manager program of Florida State University. Jackie is sought after as a source of wisdom by employees faced with difficult circumstances. She is a well-informed and compassionate manager that is highly deserving of recognition by her FGS friends and colleagues.

Steve Spencer was recognized for his 27 years of service to the FGS. His deliberate, consistent and persistent approach to problems both great and small has gone too long without formal recognition. It was noted in his nomination that he gets every project done right and on time. He is known by all who work with him as someone who is polite, responds to anyone who asks for help and never complains.

FGS 2007 EMPLOYEE OF THE YEAR:

Paulette Bond received the FGS 2007 Employee of the Year award for her work with FGS Education and Outreach programs. She planned and coordinated Earth Science Week Open House and Scout Night and participation in Earth Day at the Capital. She handles daily requests for information on the FGS web site and took over production of the FORUM newsletter when Paula Polson resigned. Her continued creativity and outreach efforts have been recognized and appreciated by DEP Communications and the public, spotlighting FGS’ continuing importance as a resource for geologic data and research.

Anastasia Formation, Martin County



FGS PERSONNEL CHANGES AND UPDATES

DEP/FGS WELCOMES NEW EMPLOYEES

Brian Clark joined the FGS as an Environmental Specialist in January 2008. Brian will function as the FGS Geographic Information Systems (GIS) Analyst. He came with an excellent resume, perfectly suited to the position along with top-notch recommendations. He has more than lived up to those recommendations and is an extremely valuable member of the FGS team.

Ginger Rinkel joined the FGS as a part-time Secretary Specialist in April 2008. Ginger came with previous DEP administrative work experience and is a student at Florida State University with a major in Environmental Chemistry and minor in Geology. Her experience and academic interests make her a unique asset to the FGS.

WE CONGRATULATE TWO EMPLOYEES ON PROMOTIONS

Cindy Fischler was promoted from OPS Environmental Specialist to FTE Professional Geologist I in February 2008. Cindy first joined the FGS in September 1998. Her expertise, experience and excellent work ethic quickly led to her planning and managing highly technical hydrogeochemical research procedures and projects. Recent duties in her OPS position included managing and scheduling aquifer storage and recovery sampling, monitoring QA/QC, running laboratory hydrogeochemical analyses and managing, assessing and interpreting hydrogeochemical data. Cindy will continue hydrogeochemical research in her new position but will also plan, design and conduct coastal environmental and geochemical research.

Another long-term OPS employee, **Dave Paul**, was promoted to FTE Professional Geologist I in February 2008. Dave joined the FGS in February 2000 to work on the STATEMAP program. He has functioned as co-principal investigator for the program supervising OPS employees, managing the STATEMAP budget, conducting field research, describing and interpreting outcrop data and samples, and drafting geologic cross-sections, geologic maps, contract deliverables and resulting FGS geologic publications. Dave will continue his invaluable contributions to the STATEMAP program and will begin to apply his field research and geologic mapping experience to coastal geology research projects.

FAREWELL

Lee Booth retired in February 2008 after nine years of service to DEP/FGS. Lee joined the FGS as a driller in 2001 already having 30 years of drilling experience, including 10 years as a driller with DEP's Site Investigations Section. He actually had specific experience with one of the FGS drill rigs because it was transferred to the FGS from Site Investigations. Lee was exceptionally skilled as a driller, had a great disposition and was willing to work hard in often unpleasant working conditions (i.e. extreme heat, humidity, mosquitoes, ticks...). He was also known as a great problem solver who remained optimistic even when encountering difficult drilling situations. His co-workers wish him well in retirement and will miss working with him.



Anastasia Formation,
Martin County



State of Florida
Department of Environmental Protection

CHARLIE CRIST, Governor
MICHAEL W. SOLE, Secretary

Florida Geological Survey
WALTER SCHMIDT, State Geologist



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