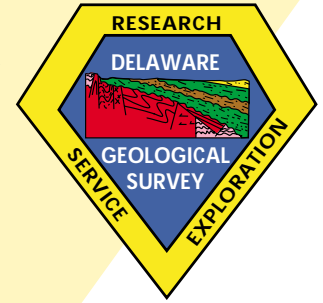


# First State Geology

Current information about Delaware's geology, hydrology, and mineral resources

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## Bethany Beach Corehole Yields New Insights into the Geology of Coastal Sussex County

By Pete McLaughlin

A recently completed 1470-ft-deep research corehole at the Delaware National Guard's Bethany Beach training facility has yielded preliminary results that significantly improve our understanding of the geologic history and resources of southern Delaware. The project was a collaborative effort between the Delaware Geological Survey (DGS), Kenneth G. Miller's coastal plain geology research group at Rutgers University, and the drilling team from U.S. Geological Survey's (USGS) Eastern Region Earth Surface Process Team. More than 1160 feet of core were recovered from the hole, providing a nearly continuous record of the approximately 25- to 30-million-year uppermost Oligocene to Recent section underlying coastal Sussex County.

The Rutgers coastal plain group initiated planning of a Delmarva hole to complement the six holes they have drilled in New Jersey as part of their research on the response of passive continental margin sedimentation to glacioeustatic (ice-volume-driven sea-level) changes during the Oligocene to the modern day (the last 34 million years). The DGS proposed that this hole be drilled at Bethany Beach in order to gain a better understanding of the controls on the deposition of the Oligocene and younger sedimentary section of southern Delaware and to apply this understanding to documenting the character and variation of aquifers (water-bearing units) of coastal Sussex County. The Delaware National Guard allowed access to their training facility for the drilling and provided logistical support including connections to water and power.

The well was drilled by Gene Cobbs II and Gene Cobbs III of the USGS drilling team and their USGS geology student interns Manuel Canabal from the University

of Puerto Rico and Matt Smith from the University of Missouri. The drilling was done by a Mobile truck-mounted rotary drilling rig using a wireline coring device to retrieve the 2- to 3-inch diameter cores.

Project chief scientists Ken Miller of Rutgers and Pete McLaughlin of the DGS organized teams of two to three geologists to work on-site each day of operations, with a total of 15 scientists from four principal institutions participating during the course of the drilling. Each core recovered from the hole was carefully cleaned, described, labeled, photographed, and packed for the Rutgers repository. The descriptions include sedimentary textures, structures, colors, fossil content, identification of lithostratigraphic units, lithologic contacts, and sequences (unconformity-bounded units). The daily drilling reports and data were shared among project participants and other interested geologists by email and the Worldwide Web.

The data obtained met or exceeded expectations. Core recovery was 80 percent of the section drilled while maintaining high drilling rates. Two suites of open-hole geophysical logs were obtained, one from surface to 205 ft and a second from surface to just short of total depth of 1470 ft. The preliminary core and geophysical log interpretations permit the recognition of a number of stratigraphically significant surfaces that may mark sequence boundaries. A sequence is an unconformity-bounded unit of strata that is considered to be time-significant and to reflect relative sea-level changes. Identification of sequences in the Miocene section in this well is important because it allows more accurate characterization and correlation of aquifer intervals in the subsurface of southern Delaware. For example, the stratigraphic interval from the Pocomoke to Manokin aquifers is a nearly continuous sand section in this well, in contrast with other sites in the area in which the aquifer sands are separated by fine-grained sediments. Another significant finding was the penetration of Oligocene (25 million years or older) sediments in the lower part of the well, notably



Driller Gene Cobbs III removing the shoe of the core barrel.



Drillers Manuel Canabal and Gene Cobbs III and the Mobile truck-mounted drilling rig.



Core into shell bed just below the top of the Choptank Formation

older than the lower Miocene (approximately 20 million years) strata expected in the bottom of the hole.

Future work planned by the project collaborators includes detailed sedimentological, micropaleontological, and geochemical analyses. Further analyses of the sedimentary facies and biofacies in the cores will permit clearer delineation of the succession of paleoenvironments present. Biostratigraphy and Sr-isotope analyses (the latter to be conducted at Rutgers University labs) will provide a temporal framework for these changes. These findings should yield a more detailed picture of the sequence stratigraphy of the Oligocene to Recent section of coastal Sussex County, the climatic controls on the deposition of the sequences, and the implications of this depositional history for better understanding the distribution and character of aquifers in the area.

## Investigation of Faults in Northern New Castle County Continues

By *Stefanie J. Baxter*

This spring, the Delaware Geological Survey completed a third drill hole in its continuing investigation of possible earthquake faults hidden in the subsurface of northern New Castle County. Two earlier holes were drilled to verify the interpretation of the high-resolution seismic reflection profile collected in June 1998 (see Winter 1999 and Summer 1999 issues of *First State Geology*). The preliminary interpretation of the profile suggests potential faulting in Cretaceous-age sediments.

In May 1999 the DGS contracted with the Eastern Region Earth Surface Processes Team (ERESPT) of the U.S. Geological Survey to drill the first hole (hole 1 in figure), a continuously-cored hole to crystalline basement on the downthrown side of an imaged fault (see Summer 1999 issue of *First State Geology*). Top of weathered basement (saprolite) occurs at 420 feet. Total core recovery was 76 percent.

In February 2000, the DGS contracted with Walton Drilling Corporation to drill a second hole approximately 60 meters from hole 1. DGS personnel described cuttings from hole 2 in the field as no cores were taken. The total depth drilled was 351 ft. When drilling was complete natural gamma and electrical geophysical logs were run. Drilling of this hole was necessary to verify, by means of comparison of the geophysical logs of the two holes, the seismic interpretation that indicated possible faulting between the two holes.

In March 2000, the DGS again contracted with the ERESPT of the USGS to drill a second continuously-cored hole to crystalline basement (hole 3). This hole was approximately 500 meters north of hole 1 and was drilled along the edge of a graben-like feature imaged on the seismic profile. The cores were washed, photographed and described by DGS personnel. The total depth drilled was 508 ft. The top of the saprolite occurs at 430 feet. Total recovery was 77 percent.

A strong similarity between the geophysical logs obtained from holes 1 and 2 does not support faulting between them. The apparent offset of stratigraphic units represented by the reflectors on the seismic image is more likely due to lateral facies changes within the

Cretaceous-age Potomac Formation and younger Quaternary-age sediments.

Comparison of the core material and geophysical logs obtained from holes 1 and 3 indicates that saprolite (top of basement) occurs at nearly the same depth in both holes. This was unexpected as the regional dip of the basement surface as mapped from regional drill-hole data indicates that the top of the basement should be approximately 50 ft higher in hole 3 than in hole 1. Saprolite is also thicker in hole 1 than in hole 3. In addition, Upper Cretaceous sediments are absent in hole 3. One possible explanation for these observations is the presence of faulting, which is consistent with the seismic data. Hole 3 may be on the upthrown side of a fault which could account for saprolite occurring at the same depth in both holes. The missing Upper Cretaceous sediments would have been removed by erosion of this upthrown block. The youngest age of the rocks that are offset by the faulting imaged on the seismic profile is estimated as early Late Cretaceous or about 97 million years. Faulting, if real, must be younger than this.

Faulting, however, is not a unique solution in that the observations also may be explained by paleotopography. Further investigation will be needed to determine the extent or presence of potential faulting. Support for this project is provided by the Federal Emergency Management Agency (FEMA) and the Delaware Emergency Management Agency (DEMA).

## Atlantic Beach Sand Textures

By *Kelvin W. Ramsey*

“Beach Sand Textures from the Atlantic Coast of Delaware” (DGS Open File Report No. 41) by Kelvin W. Ramsey summarizes the textures of sand on Delaware’s Atlantic beaches prior to the major beach nourishment projects that began in the late 1980s. Data collected from 1929 through 1984 show that the texture (grain size) of sand on Delaware’s beaches did not change significantly during that period. Most of the beaches have medium to coarse sand (0.25 to 1.0 mm in diameter). No clear trends in grain size were recognized along the coast other than at Cape Henlopen where the sand is slightly finer than that to the south.

This work is important in showing the natural sand textures of the beaches. The size of sand particles on the beach is a function of the agitation and sorting of waves, currents, and winds and tends to be in equilibrium with the energy of the environment. Any sand placed on the beach should have properties similar to that of the natural beach in order to maintain that equilibrium and have stability.



Map showing locations of seismic reflection line (purple) and the three drill holes.

Sand coarser than the natural sand tends to form a steeper and narrower beach and sand finer than the natural sand tends to get washed away easily.

Open File Report No. 41 is available on the DGS Web site at <http://www.udel.edu/dgs/pub/OFR41.pdf>.

## Earth Science Week 2000

By William S. Schenck

Preparations for National Earth Science Week 2000, October 8-14, are underway at the DGS Earth Science Information Center. Along with other activities, in cooperation with the Iron Hill Museum we plan to schedule as many tours of the DGS facilities and the University Mineral Museum in adjacent Penny Hall as possible. If you are interested in scheduling your class or other group for a tour, please contact William Schenck at (302) 831-8262 or via email at [rockman@udel.edu](mailto:rockman@udel.edu). For more information on programs at the Iron Hill Museum, please contact Laura Lee at (302) 368-5703 or via email at [ironhill@magpage.com](mailto:ironhill@magpage.com). As October nears, the DGS web site will have additional information on Earth Science Week 2000.

## New Web Pages

By William S. Schenck

Two new pages have been added to the DGS web site. The DGS is maintaining web pages for the Delaware Board of Professional Geologists (DBPG), Delaware Geographic Data Committee (DGDC), and State Mapping Advisory Committee (SMAC).

The DBPG page has general information about the board, board officers, and specific information on items such as rules and regulations, meeting minutes, and forms. Its URL is <http://www.udel.edu/dgs/DBPG/DBPG.html>.

The DGDC/SMAC page is a data-sharing page. It contains links to digital data sets and specialized software data sets used by geographic information systems users for Delaware applications. Its URL is <http://www.udel.edu/dgs/smac/sharing/datasharing.html>.

Both pages are expected to constantly change, so check them often.

## DBPG News

By Elizabeth Brown, President DBPG

On May 5, a public hearing was held for comments regarding the proposed rules and regulations to implement the new law govern-

ing practicing geologists. In brief, the regulations were adopted. They can be found on the Internet at the Delaware Geological Survey web site at

<http://www.udel.edu/dgs/DBPG/DBPG.html>.

For the record, I would like to thank two people who have a long history with the board, State Geologist Dr. Robert R. Jordan and past board president William S. "Sandy" Schenck. Together they mapped out the direction of the new regulations—to assure public protection and affirm and enhance the professional standing of geologists in Delaware. The adopted regulations were derived from our past regulations, fresh internal discussion, and review of procedures of other states' geologist boards. Mary Paskey, our administrative assistant, deserves many thanks as well for her contributions regarding processes for renewals, continuing education, testing, and review.

Now the work begins for all of us to prepare for the first licensing period that will include continuing education (CE) which must be in a field related to geology. Approval of courses, meetings, and other activities for CE units (CEU) will be at the discretion of the Board. We strongly encourage you to review the listing of societies whose courses and meetings are automatically approved and to submit information about other education opportunities to the CE Coordinator, Jerome Cooper, at Board of Professional Geologists, Delaware Division of Professional Regulation, 861 Silver Lake Blvd., Dover, DE, 19904. Approved activities completed on or after August 1, 2000, will be eligible for CEUs for renewals in 2002. Forms for tracking activities will be available on the DBPG website in the near future.

In response to comments received at the public hearing, the board is in the process of contacting the many professional societies and vendors of training courses encouraging them to offer courses in our area and to emphasize hydrogeologic subject matter. We encourage you to add your voice to ours within your professional societies to bring meetings and activities to Delaware and the surrounding states.

## Piedmont Geologic Map Earns GIS Award for Nicole Minni

Nicole Minni, Water Resources Agency at the University of Delaware, received two first place (blue ribbon) awards at the Towson University GIS Conference held May 1-4 in Baltimore, Maryland. One award was for best use of color on a map showing the Brandywine Village Revitalization Project. The second was for best cartographic design



Nicole Minni with her two blue ribbon entries. Piedmont geologic map on the right.

for a map of the Bedrock Geology of the Piedmont of Delaware and Adjacent Pennsylvania by William S. Schenck, Margaret O. Plank, and LeeAnn Srogi. The geologic map and accompanying reports will be published by the DGS this summer. The map will be available as a full size Portable Document File (PDF) and as digital layers in ARC INFO and ARC VIEW files from the DGS web site.

## DGS's Part-Time Assistants

The DGS is well-served by its part-time assistants, most of whom are students, who are classified as miscellaneous wage employees by the University. Our one professional part-timer is Kimberly K. McKenna, wife of staff member Tom McKenna. Kim is a coastal geologist with most of her experience in Texas. For the past two years she has been working with Kelvin Ramsey on offshore sand resources.

Sixteen student assistants have worked recently or are still working with DGS staff members on various projects: Adam Bryant (GIS project); Erin B. Clymans, Derek M. Dimeo (paleo data entry and database); Erin P. Cole (Piedmont); Jennifer L. Gresh (Statemap); Jordan E. Hegedus, Katherine A. Porter (EPA CISNet); Todd A. Keyser, Patrick W. Rohrbough, Jill Wakefield (DNREC ground water project); Mary D. Lemcke (DNREC ground water project, DGS seismographs); Andrew D. Klingbeil (various projects); Marijke J. W. Reilly (offshore sand resources, Statemap); Linsey E. Saxer (Earth Science Information Center); and Lori Schnick, Bart Wilson (paleo data entry and database, DNREC ground water project).

## Publications

### Recent DGS Publications Open File Report

No. 41, Beach Sand Textures from the Atlantic Coast of Delaware: Kelvin W. Ramsey, 1999, 6 p., available only online at <http://www.udel.edu/dgs/pub/OFR41.pdf>.

### Out-of-Print DGS Publications Online Report of Investigations

No. 42, Stratigraphy and Depositional History of the Post-Choptank Chesapeake Group: A. Scott Andres, 1987, 20 p., <http://www.udel.edu/dgs/pub/RI42.pdf>.

No. 47, Ages of the Bethany, Beaverdam, and Omar Formations of Southern Delaware: Johan J. Groot, Kelvin W. Ramsey, and John F. Wehmiller, 1990, 19 p., <http://www.udel.edu/dgs/pub/RI47.pdf>

## Staff Notes

### Presentations

**A. Scott Andres**, "Non-Point Source Pollution in Delaware," at Soil Science Seminar sponsored by Department of Plant and Soil Sciences, University of Delaware, February 25; with Karen B. Savidge, Wendy Carey, Megan J. Roadman, Joseph R. Scudlark, and William J. Ullman, all of the University of Delaware College of Marine Studies, "Nutrient Biogeochemistry of Delaware's Inland Bays and their Watershed," at the Geological Society of America, Southeastern Section Meeting, Charleston, S.C., March 24.

**Kimberly K. McKenna**, "Using the 'Stack-Unit Mapping' Method for Evaluating Delaware's Offshore Sand Resources, Hen and Chickens Shoal," at the 26th Annual Assateague Shelf and Shore Meeting, Coastal Carolina University, Conway, S.C., April 7.

**Peter P. McLaughlin, Jr.**, "Dinosaurs in Delaware," at Delaware Museum of Natural History, Greenville, April 8.

**Kelvin W. Ramsey**, "Rocks, Minerals, and M&Ms," to 3rd grade science classes at Independence School, February 22; with **Marijke J. Reilly**, "Floyd's Great-Grandfather: The Hurricane of October 1878 and its Effects on the Mid-Atlantic Region," at the Geological Society of America, Northeastern Section Meeting, New Brunswick, N.J., as part of a session on Coastal Hazards and Management Problems in the Mid-Atlantic Bight, March 14; and "The Hurricane of October 21-24, 1878: The Hurricane of Record for the Delaware Bay and River," at the 26th Annual Assateague Shelf and Shore Meeting, Coastal Carolina University, Conway, S.C., April 7.

**William S. Schenck** and **Margaret O. Plank**, "A Day Along the Brandywine," to Friends of Wilmington Parks and six presentations of "Delaware Piedmont Geology, Rocks, and Minerals" and "Equipment Geologists Use in the Field" to participating middle schools, April 14.

### Service and Awards

Congratulations are in order for several staff members who received University of Delaware awards: **Richard N. Benson** for completing 25 years of service with the DGS and University of Delaware; **Thomas E. McKenna** and **Mary F. Sullivan** who

received Merit Awards for professional and salaried staff, respectively; and **Marijke J. Reilly**, one of our part-time student assistants, who received the Outstanding Student Teaching in Earth Science Award on Honors Day at the University and a Special Merit Award from the Department of Geology at graduation.

**Robert R. Jordan** has received the Certificate of Merit of the American Association of Petroleum Geologists "In Recognition of Dedicated and Meritorious Service to the Association as Chairman of AAPG Commissioners, North American Commission on Stratigraphic Nomenclature." He has been appointed by Governor Carper to another term on the Delaware Board of Professional of Geologists. Another appointment is to the Science Language Technical Team, a cooperative effort of the Association of American State Geologists, the U. S. Geological Survey, the Canadian Provincial surveys, and the Geological Survey of Canada, to develop a common language for describing and interpreting geological features and units in space and time.

**William S. Schenck** and **Margaret O. Plank** led an all-day Piedmont geology field trip for the Delaware Nature Society, Ashland Nature Center, March 18.

**John H. Talley** has been selected to receive the George V. Cohee Public Service Award for distinguished service and achievement in public affairs from the Eastern Section of the American Association of Petroleum Geologists. He also serves as vice president of the Capitol Section of the American Institute of Professional Geologists and has been designated an associate of the Association of American State Geologists.



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