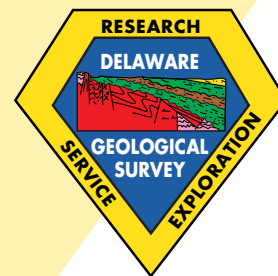


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New DGS Report Enhances Understanding of Potomac Aquifers

By R. N. Benson

The Delaware Geological Survey released a new technical report entitled "Internal Stratigraphic Correlation of the Subsurface Potomac Formation, New Castle County, Delaware, and Adjacent Areas in Maryland and New Jersey," which presents the results of research by Richard N. Benson. Peter P. McLaughlin, Jr., provided palynological (fossil pollen) analysis for the study.

The Potomac aquifer is the largest source of ground water in New Castle County supplying approximately 22 million gallons of water per day for public, domestic, industrial, and agricultural use from thick fluvial sand layers. However, the subsurface geology of this interval is complex; individual aquifer sands are known in some cases to be laterally discontinuous between wells over distances of a few miles. Given increasing development in rural areas, and the resulting increased demand for water, a sound

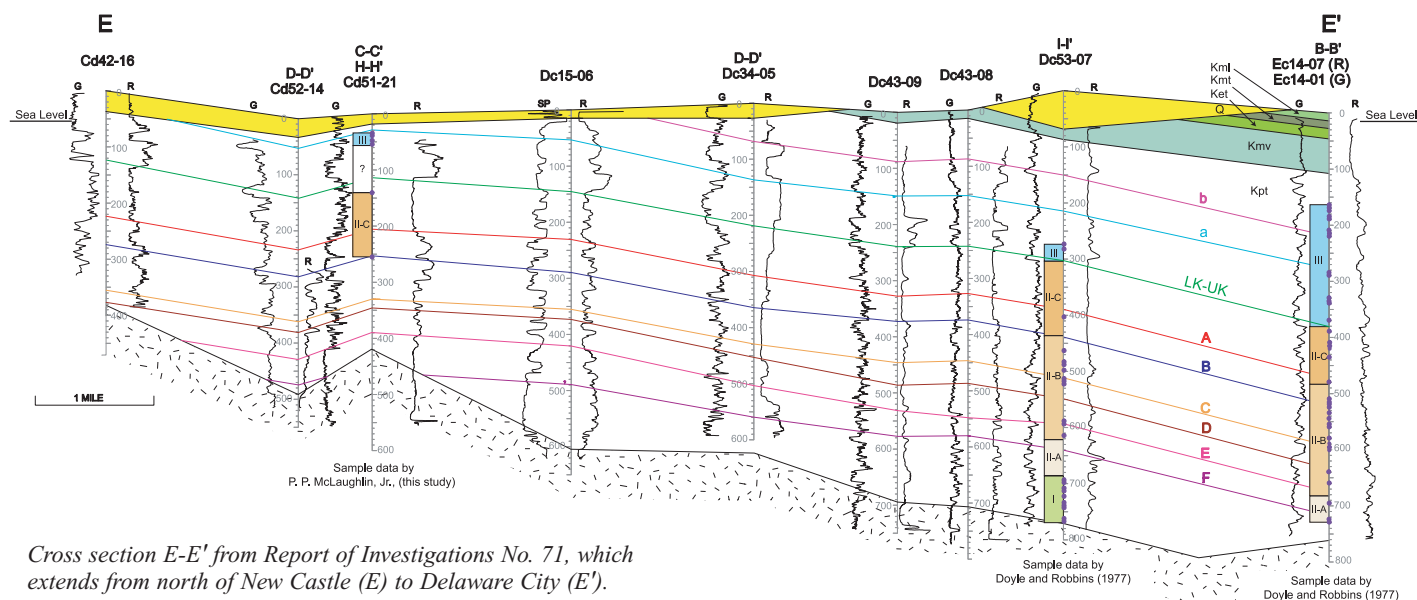
understanding of the distribution and physical characteristics of Potomac aquifer sands is of growing importance to managing ground-water resources. An accurate stratigraphic framework is an essential starting point.

DGS Report of Investigations No. 71 establishes a new stratigraphic framework for the internal correlation of the Potomac Formation in the Coastal Plain of northern Delaware and nearby areas that provides an improved geological framework for aquifer delineation and modeling.

The basis for the time-stratigraphic correlation presented in this report is a geophysical log datum approximating the contact between Lower Cretaceous (LK) sediments containing pollen identified with Palynozone II and overlying Upper Cretaceous (UK) sediments yielding pollen identified with Palynozone III. The LK-UK boundary represents time approximately 100 million years ago. Additional time lines were identified on geophysical logs by correlatable log markers for mud beds above and below the datum. This new stratigraphic framework will allow better delineation of the degree of lateral connection between potential

aquifer sands. This time-stratigraphic framework also provides a genetic context for correlating and mapping the sedimentary facies of the Potomac Formation. It allows the degree of lateral connection, and therefore hydraulic conductivity, between potential aquifer sands to be better determined in order to define aquifer architecture and determine water-bearing and water-transmitting properties.

The results of this study are being used in an aquifer modeling project of the Potomac and Columbia Formations by the U.S. Army Corps of Engineers (USACE) to determine the long-term availability of ground water from Potomac aquifers based on the concept of "safe yield." The USACE model layers follow the time-stratigraphic framework of this report, with layers onlapping the basement as well as truncation from above. As a result, direct recharge from the surficial aquifer is only to the uppermost, youngest aquifer sands with limited or no recharge to lower aquifer sands. This is a significant advance over older hydrogeologic models based on basement-parallel correlations of broadly defined aquifer units of the Potomac Formation.



Cross section E-E' from Report of Investigations No. 71, which extends from north of New Castle (E) to Delaware City (E').

Dorothy C. Windish Retires

Dorothy (Dotti) Windish retired at the end of September following 30 years of service to the Delaware Geological Survey. As the DGS staff assistant, Dotti's responsibilities included managing and updating databases such as the DGS library, requests for information and publications, as well as for inventory and maintenance of DGS archives and mailing lists. She served as the DGS liaison between the DGS and the University's Morris Library and Public Information Office, as well as federal and state governmental libraries and public and university libraries. These responsibilities required the development and management of complex filing systems, including computerized systems. She was directly or indirectly involved in preparing, distributing, maintaining inventories, archiving, and completing requests for information for more than 187 DGS publications since 1976.

Dotti was always willing to broaden her skills and knowledge that led to significant contributions to the mission and goals of the DGS during her 30-year career. She came to the Survey with an A.A.S. degree from West Texas State and later (1990) was awarded a B.F.A. degree from the University of Delaware. She helped the Survey transition to the computer age in the early 1980s with electronic word processing and later, use of PCs for word processing and spreadsheets. She worked closely with DGS staff on a major project to convert paper file databases to a computerized, integrated, and automated geologic, hydrologic, and mineral resource management system that is still in use today. Her skills, dedication, perseverance, and willingness to accept challenges were an asset to the DGS, while her smile in the morning and caring attitude were gifts given daily to the staff. We will miss you Dotti, and we hope you and Bill enjoy good health and happiness in the years to come.

The DGS Welcomes Laura Wisk

We are pleased to welcome Laura K. Wisk as the new administrative assistant at the DGS. Laura joined the staff in November and is responsible for providing administrative support to the administrative and scientific staff of the DGS by performing a full range of administrative

and records duties. Laura ensures implementation of and compliance with internal and external administrative policies, and creates, manages and updates critical databases. She also manages complex records issues, including the department library and distribution of DGS publications.

Laura brings valuable experience to the DGS, which includes seven years as section leader and shift supervisor at the University of Delaware in the Graphic Communications Center where she was responsible for supervising second-shift staff, recording invoices and preparing monthly statements, calculating price estimates for clients, maintaining files for work orders, and assisting in quality assurance and decision making. She also served as the system administrator for PrintSmith estimating and billing applications.

We welcome Laura to the DGS staff and look forward to many years of rewarding association.

DGS Completes Review of Water-Quality Data for Delaware Cancer Consortium

By A. S. Andres, V. Pellerito, and M. Neimeister

The Delaware Geological Survey conducted a review of existing statewide ground-water quality data collected from shallow (< 100 ft deep) domestic water supply wells and small public water supply wells (serving fewer than 100 residents). The purpose of the review was to determine the extent to which toxic and carcinogenic compounds are present in the shallow ground water serving domestic water-supply wells and to assess the risk to domestic water supply wells from known contaminated sites. This study was conducted at the request of the Environmental Subcommittee of the Delaware Cancer Consortium (DCC) in its effort to reduce possible exposure to carcinogenic substances in the ambient environment. Funding for this project was provided by the Delaware Division of Public Health (DPH). Because this study relied on existing water quality data, the occurrence of some contaminants that now are coming to national attention were not documented, which include endocrine disrupting compounds, pharmaceuticals,

and other organic compounds used in industrial and commercial processes.

A database application was developed from electronic data delivery requirements proposed by the U.S. Environmental Protection Agency. The database application ensured that stringent metadata requirements and quality assurance and control were met and that only appropriate data were used. Water quality data from more than 200 wells were characterized in this study. In general, the spatial distribution of wells was adequate to describe overall conditions for the general population of domestic water supply wells. Water quality data are comprised of four general contaminant categories: volatile organic compounds (VOCs), pesticides, metals and major ions, and nutrients.

The results of the review indicate that although pesticides and VOCs are ubiquitous in shallow ground water throughout the state, concentrations of these compounds rarely exceed maximum contaminant levels (MCL). Atrazine and alachlor are the most commonly detected pesticides. These findings are consistent with findings of surveys of pesticides and VOCs in the nation's ground water. The frequency of detection of VOCs and pesticides in shallow domestic and small public wells is less than that found in previous surveys of public water wells in Delaware. Nitrate was detected in a majority of wells sampled and concentrations in excess of the MCL occur in nearly 18 percent of wells sampled. Concentrations of nitrate in excess of the MCL occur most frequently in wells located in agricultural areas.

In addition to the work on well water quality data, a GIS-based, two-dimensional, ground-water flow model was used to analyze the relationships between land use and well water quality and between known risks associated with likely point sources of contamination (i.e., leaking underground storage tanks, Superfund sites) and nearby wells. With water-table elevations, ground-water recharge potentials, contaminant source characteristics, and well depths as input data, the model computed the areas likely to be impacted within 10 years by ground water flowing from sites of known contamination. This method predicted that a very small number (< 20) of permitted shallow domestic water wells were in locations with elevat-

ed risk. Similarly, the model computed the areas contributing water to sampled wells and compared those areas to mapped land use/land cover. This evaluation found that the most frequently occurring contaminant, nitrate, most commonly occurs in wells located in agricultural settings.

Findings of this study were presented at the 2005 Geological Society of America Annual Meeting, the 2006 Delaware GIS Conference, the Environmental Subcommittee of the Delaware Cancer Consortium, and to staff of the DNREC and DPH.

New DGS Drill Rig Unveiled at Coast Day

By L. T. Wang

The DGS performed drilling demonstrations and allowed children to express their creativity on October 1st at Coast Day, an annual open house sponsored by the University of Delaware, College of Marine and Earth Studies, in Lewes, Delaware.

The event provided an opportunity for the DGS to unveil its new drill rig—a CME-55 combination auger, core, and rotary boring machine mounted on a 4x2 truck. DGS staff members P. Steven McCreary, a State of Delaware licensed well driller, and Charles T. Smith demonstrated on-site drilling methods and techniques for the public. The new vehicle replaces a 1967 drill rig, which had been in continuous use for almost 39 years. Drilling at the DGS is conducted to sup-



DGS staff member, Steve Bertsche, helps young artists at Coast Day.

port investigations related to such activities as geologic and hydrologic mapping, operation and maintenance of water-level and water-quality monitoring networks, ground-water recharge mapping, investigation of natural hazards, and exploration for mineral resources such as sand and gravel.

In addition to the drill rig demonstration, children unleashed their artistic abilities with natural paints made from local and regional iron minerals. Surficial deposits of clay and rock have been mined for over 60,000 years and mixed with water to make natural paints to color skin. Clay from the Potomac Formation was collected at Stancill's quarry in Cecil County, Maryland to make red, orange, and yellow paint, and clay from the Merchantville Formation in northern Delaware was used to create green paint.

Special thanks to Tom McKenna, Beth Gehrman, Steve Bertsche, Kelvin Ramsey, and Miriam Pomilio for their assistance with the event.

Final Edits Underway on Kent County Geologic Map

Early this summer, the Delaware Geological Survey will release "Geologic Map of Kent County, Delaware," which presents the results of research by Kelvin W. Ramsey.

This map is the second in a series of three 1:100,000-scale county-wide geologic maps showing the formations found at the land surface (see Winter 2006 issue of *First State Geology*). This map, when combined with subsurface geologic information, will provide a basis for locating water supplies, mapping ground-water recharge areas, and protecting ground and surface water.

Kent County lies entirely within the Atlantic Coastal Plain physiographic province. Surficial geologic deposits in

the Coastal Plain consist primarily of a thin veneer of Pliocene and Quaternary deposits that are underlain by a gently southward-dipping sedimentary section of Upper Cretaceous to Miocene strata. In Kent County, the thickness of the Quaternary section is usually less than 30 feet but can be as much as 100 feet in paleochannels.

Kent County is undergoing growth pressure from new suburban communities. This is an especially critical area for our understanding of the surficial geology of Delaware—covering a transition from the dominance of Pleistocene fluvial sediments in the north to Pliocene fluvial to marginal-marine sediments to the south.

In addition to the map, accompanying cross-sections show the stratigraphic units found in the subsurface to a depth of approximately 300 feet. Descriptions and ages of all the units found on the map and cross sections are also included. This project is funded in part by a grant from the STATEMAP component of the National Cooperative Geologic Mapping Program, a cooperative effort of the Association of American State Geologists and the U. S. Geological Survey.

Publications

Recent DGS Publications Report of Investigations

No. 71, Internal Stratigraphic Correlation of the Subsurface Potomac Formation, New Castle County, Delaware, and Adjacent Areas in Maryland and New Jersey: **Richard N. Benson**, 15 p., 3 plates.

No. 72, Geology and Extent of the Confined Aquifers of Kent County, Delaware: **Peter P. McLaughlin, Jr.**, and Claudia C. Velez, 40 p., 1 plate.

Other Publications by DGS Staff

Volk, J. A., Savidge, K. B., Scudlark, J. R., **Andres, A. S.**, and Ullman, W. J., Nitrogen loads through baseflow, storm-flow, and underflow to Rehoboth Bay, Delaware: *Journal of Environmental Quality*, v. 35, p. 1742-1755.

Leorri, E., Martin, R. E., and **McLaughlin, P. P., Jr.**, 2006, Holocene environmental and parasequence development of the St. Jones estuary, Delaware (USA): foraminiferal proxies of natural climatic and anthropogenic change: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 241, no. 3-4, p. 590-



607; Miller, K. G., Sugarman, P. J., Browning, J. V., Aubry, M.-P., Brenner, G. J., Cobbs, G., III, de Romero, L., Feigenson, M. D., Harris, A., Katz, M. E., Kulpecz, A., **McLaughlin, P.P., Jr.**, and others, 2006, Sea Girt site, in Miller, K.G., Sugarman, P.J., Browning, J.V., et al., Proc. ODP, Init. Repts., 174AX (Suppl.): College Station, TX (Ocean Drilling Program), 1–104.

Staff Notes

Presentations

Members of the Delaware Geological Survey made presentations at the 2006 Geological Society of American annual meeting, Oct 22-25, in Philadelphia: **A. Scott Andres**, Andrew Klingbeil, and Eric Taylor, “Three-D Mapping Applications at the Delaware Geological Survey;” **Richard N. Benson** and **Peter P. McLaughlin, Jr.**, “The Potomac Aquifer of Northern Delaware: Resolving Aquifer Issues in the Delaware Coastal Plain Using Sequence Stratigraphic Concepts I;” **Kimberly K. McKenna** and **Kelvin W. Ramsey**, “Quaternary Evolution of the Inner Continental Shelf Offshore Bethany Beach, Delaware;” **Thomas E. McKenna**, Tracy DeLiberty, **Lillian T. Wang**, and Kerrilyn P. Lepp, “Ground-Water Discharge Areas Identified Using Remote Sensing Compared to Water Budget Estimates for Delaware’s Inland Bays;” **Peter P. McLaughlin, Jr.**, Claudia Velez, and **Jaime Tomlinson**, “Aquifer Geology of Kent County, Delaware: Resolving Aquifer Issues in the Delaware Coastal Plain Using Sequence Stratigraphic Concepts II;” **Peter P. McLaughlin, Jr.** with J. V. Browning, K. G. Miller, and others, “The Effects of Eustasy,

Subsidence and Sediment Supply on Miocene Sequences, U.S. Mid-Atlantic Margin;” **Peter P. McLaughlin, Jr.** with R. E. Martin and S. Moskalski, “Palynologic Determination of Historical Paleocological Variation in Marshes on the St. Jones River, Delaware, USA;” **Peter P. McLaughlin, Jr.** with P. P. B. Eichler and K. Billups, “Relationship of $\delta^{18}O$ and $\delta^{13}C$ of Foraminiferal Tests to Bottom-Water Salinity in an Atlantic Coastal Lagoon, Delaware, USA;” **William S. Schenck**, “100 Years of Wissahickon-What’s in a Name?”

Other Presentations

P. P. B. Eichler and **Peter P. McLaughlin, Jr.**, “Population Dynamics of Foraminifera as Indicator of Estuarine Environmental Health,” Forams 2006, Sept. 10-15; E. Leorri, R. E. Martin, and **Peter P. McLaughlin, Jr.**, “Paleoclimatic Changes During the Holocene of the St. Jones Estuary, Delaware (USA): Foraminiferal Proxies for Sequence Stratigraphy Reconstruction,” Forams 2006, Sept. 10-15; P. P. B. Eichler, B. K. Sen Gupta, **Peter P. McLaughlin, Jr.**, and B. Eichler, “Freshwater Influence and Water Masses Interaction on the Foraminifera along the SW-Atlantic Continental Shelf,” Forams, 2006, Sept. 10-15.

Service and Awards

P. Steven McCreary helped organize and actively participated in the Maryland-Delaware Children’s Water Festival, Chesapeake College, Mar. 23.

Thomas E. McKenna led a Geology and Archaeology Workshop for Boy Scouts, Greenbank Mill, Oct. 7; EarthCache at Iron Hill, Newark, Oct. 8.

Peter P. McLaughlin, Jr., invited speaker, “Stratigraphy and Aquifer Architecture of the Mid-Cretaceous Potomac Formation, Northern Delaware,” URS Corporation lunch-time seminar series, Aug. 23; invited speaker, “Life of Our Ancient Lands and Seas: Dinosaurs, Plants, and Marine Life of the Delaware Valley Region in the Mesozoic Era,” Delaware Museum of Natural History, Dec. 27.

Miriam L. Pomilio, Delaware Technology Conference, DataMIL presentation, Dover, Oct. 10; Statewide Professional Development Day Workshop on GIS use in the Classroom for K-12 teachers, Dover, Oct. 13; GIS Day event with New Castle County 4-H groups, Newark, Nov. 11; and ESRI Mid-Atlantic User Group Meeting, DataMIL presentation, Philadelphia, Nov. 29.

William S. Schenck led a fieldtrip of A.I. du Pont High School seniors to study rock outcrops around Red Clay Creek, Dec. 6.

John H. Talley was a recipient of the 2006 Ratledge Family Award for Public Service. The award is given annually to recognize University of Delaware employees for their contributions to the well-being of all Delawareans; also reappointed by the U.S. Department of the Interior Secretary, Dirk Kempthorne, to serve and represent Delaware on the Outer Continental Shelf Policy Committee. **Peter P. McLaughlin, Jr.** was reappointed as alternate member.

Kelvin W. Ramsey participated in a live interview on *Delaware Tonight* aired on Channel 12 WHYY regarding the geological effects of hurricanes in Delaware, Oct. 2; invited speaker, “Delaware during the Ice Ages” Delaware Museum of Natural History, Oct. 13.



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