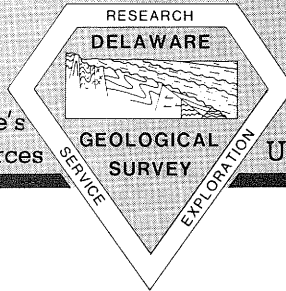


First State Geology

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



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Summer 1989

Water Conditions Improve

Normal and above normal precipitation received during the past several months has resulted in improved water conditions throughout Delaware. Precipitation recorded during the first eight months of the 1988-1989 water year was above normal with totals ranging from 35.64 inches at Dover (8.34 inches above normal) to 26.38 inches at New Castle (.09 inches above normal). A substantial portion of the precip-

itation occurred during late winter and early spring resulting in significant recharge to aquifers.

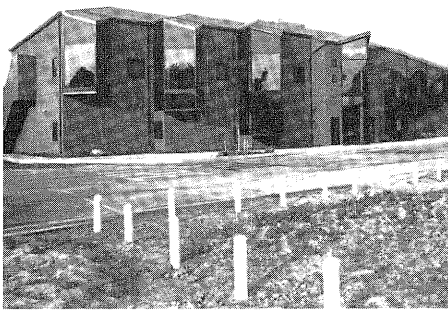
May ground-water levels in key shallow water-table observation wells were generally above normal with record high levels recorded in two wells and near record levels recorded in three wells. Monthly mean streamflows have continued to rise during the period with significant increases reported on the St. Jones and Nanticoke rivers in Kent and Sussex counties, respectively. Those rivers plus the Brandywine Creek in New Castle County had the highest mean

stream flows ever recorded for the month of May.

At a meeting of the Delaware River Master's Advisory Committee, to which the State Geologist represents Delaware, hydrologic conditions throughout the river basin were characterized as normal for the beginning of June. New York City's reservoirs in the upper Delaware River Basin were over 95 percent full. The region is reasonably prepared for the water demands of the summer months.

The Delaware Geological Survey Building

As of Monday, May 8, 1989, the DGS became officially operational in its new building located adjacent to Penny Hall on Academy Street, Newark. Most of the moving is complete, and shortly all laboratory facilities will be fully functional.



DGS Building viewed from the northeast. Photograph by John H. Talley.

We plan a dedication ceremony in September, after the summer vacation period. Specific plans will be widely distributed when finalized. We hope to use the occasion to bring all area geologists together with legislators, governmental and University officials, and the general public.

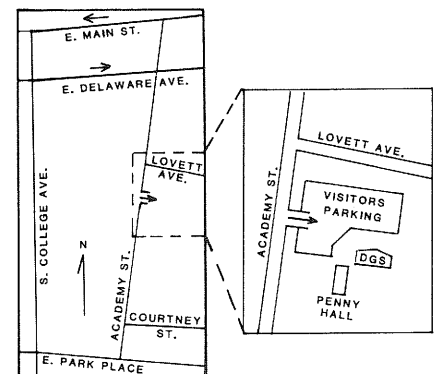
Until then, we welcome visitors. Parking is available in the University's new visitors parking lot on Academy Street, adjacent to the Delaware Geological Survey Building (see map).

Space in the new building was designed for each function of the DGS. Three new laboratories - analytical, paleontology/petrology, and geochemistry/hydrology - replace the single laboratory in Penny Hall that was used for those activities. Also, there are a geophysical/hydrologic data center, drafting/computer room, library/reading room for DGS staff, conference room, DGS Cartographic Information Center, a seismic observatory and data center, electrical instrumentation shop, a room for DGS publications, a room to house proprietary data, core and sample library, sample preparation room, sample examination room, and shop and garage for the drilling

rig, geophysical logging truck, and other field equipment.

Exhibits in keeping with the Survey's educational functions are being installed in the main entry area and the hallways. A large, automobile-sized boulder of amphibolite from the Wissahickon Formation of the Delaware Piedmont is the focal point of the ground-floor entrance hall.

The new building provides enhanced access for the public. We look forward to many visitors in the years to come and increased geologic service and research in the State.



Buried Rift Basins - Targets for Oil Exploration

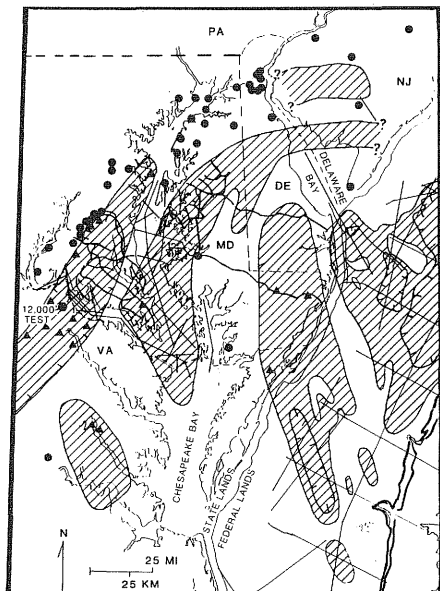
By Richard N. Benson

In northwestern Westmoreland County on the Virginia Coastal Plain, Texaco USA is drilling a 12,000-foot oil exploration well. The activity is located about seven miles south of the U. S. Highway 301 bridge over the Potomac River. The objective is to discover commercial deposits of oil or gas

trapped in the rocks of the Taylorsville rift basin of Triassic-Jurassic age. The basin is buried beneath the Cretaceous and Tertiary sediments of the Coastal Plain.

The accompanying map shows the location of the 12,000-foot test. Areas identified by the diagonal ruling indicate where rift

basin rocks are or may be present beneath the Atlantic Coastal Plain and Outer Continental Shelf (OCS). Where information is available, the thickest (basinal) sections of the rift basin rocks are shown enclosed by the hachured lines. Drill holes that penetrated rift basin rocks beneath Coastal Plain sediments are represented by solid triangles; solid circles identify drill holes that entered older (Paleozoic) rocks without encountering rift basin rocks. The solid lines criss-crossing the area mark locations of seismic reflection surveys.



The concentration of seismic surveys in Maryland and Chesapeake Bay (locations courtesy of Kenneth A. Schwarz, Maryland Geological Survey) indicate where exploration and leasing activity are concentrated in that state. The two basins shown are the Taylorsville on the west and Queen Anne on the east. Geologically, the Queen Anne basin can be traced into Delaware and New Jersey on the basis of interpretations of gravity and magnetic anomaly maps and recently acquired seismic reflection profiles in the two states. Mineral rights to over 65,000 acres covering areas of the two basins in Maryland reportedly have been leased by Texaco, Exxon, and Dallas-based Shore Exploration and Production Co. (SEPCO).

Rift basins along the eastern continental margin of North America began to form about 230-240 million years ago during the Triassic Period. The basins developed as blocks of continental crust subsided along faults that resulted from stretching and thinning of the crust within a broad linear region extending from Nova Scotia to Georgia. Sediments eroded from adjacent highlands rapidly filled the basins, and, periodically, large lakes existed and received organic-rich sediments that later became the source rocks for the oil and gas deposits being explored for today. About 170-180 million years ago (Middle Jurassic) the continental crust was thinned to nothing along a long, narrow, rift zone, and

basaltic lavas upwelled to begin forming the subsea crust of the Atlantic Ocean basin. The basin widened to its present width and is still widening as Europe and Africa to this day continue to drift away from North and South America. The rift basins that had formed on either side of the split between the eastern and western continents were buried by younger sediments deposited along the new, subsiding continental margins. The westernmost basins of the United States, extending from Massachusetts to North Carolina, were subsequently exhumed (see map in Winter 1985 issue of *First State Geology*).

If Texaco discovers commercial deposits of oil or gas in the Taylorsville basin, it is likely that exploration and leasing activities will intensify in other areas where buried rift basins are known or suspected. The Delaware Geological Survey is continuing its research activities on buried rift basins, both onshore and offshore, and will continue its close monitoring of exploration activities.

Hydrology News

Eastern Sussex County Ground-Water Study Continues

By A. Scott Andres

This project focuses on ground-water flow and ground-water quality in the Columbia aquifer, the largest single underground fresh-water reservoir in the State. The most important aquifer in eastern Sussex County, it supplies water to most wells, provides recharge to deeper artesian aquifers, and is responsible for the fair-weather flow of streams.

Work has progressed in several different areas since the last report in *First State Geology*. Water samples from domestic and monitoring wells continue to be collected and tested. Results of these tests and those on samples from selected public wells are being tabulated and analyzed for eventual publication. A poster presentation of the results to date was made at the 1989 Geological Society of America Northeastern Section Meeting, March 23-25, New Brunswick, New Jersey, and to members of the Water Supply Branch, Delaware Department of Natural Resources and Environmental Control, March 30, 1989.

With the warmer weather and arrival of seasonal residents, arrangements are now being made to begin more frequent sampling of domestic wells. Residents receiving requests to have their water tested are encouraged to allow DGS staff members to collect water samples from their homes. Additional test wells will also be installed, in conjunction with the U. S. Geological Survey, in the Fairmount and Long Neck areas during the spring and summer.

Additional information regarding this

project can be found in previous issues of *First State Geology* or by contacting Scott Andres at 451-2847.

New Castle County Resource Protection Areas to be Mapped by DGS

By Kenneth D. Woodruff

The Delaware Geological Survey recently completed an agreement with the Water Resources Agency for New Castle County to better define Resource Protection Areas for the county. The program has two main elements: (1) define well-head protection areas for selected well fields and (2) map ground-water recharge areas that are particularly sensitive to pressures of land-use development, with emphasis on those areas south of the Chesapeake and Delaware Canal.

The delineation of well-head protection areas is mandated by the Environmental Protection Agency (EPA) under the Safe Drinking-Water Act. A zone around a public well or well field is determined within which contaminants would move towards the well. Methods to outline this zone range from simply designating an arbitrary radius around the well field to simulating the hydrology of the area by means of analytical or computer models. Once such a zone is defined, it follows that land-use activities within the zone will be restricted. The DGS will select two major well fields in New Castle County for testing of the various techniques. Emphasis will be on wells that draw from the water-table aquifer and are most likely to be directly affected by pollution occurring at the surface in the immediate vicinity of the well.

Deeper artesian aquifers are generally buffered from direct surface infiltration by confining layers of low permeability. Thus, the source of ground-water recharge and the effects of pollution occurring at the ground surface are more difficult to determine for those aquifers than for water-table aquifers. However, many of the higher yielding public wells in New Castle County tap the deeper sources, and eventually it will be necessary to define protection areas for them as well.

The mapping of ground-water recharge areas is not a new activity for either the county or DGS. Initial mapping was completed in 1975 and was also supported by the Water Resources Agency. The county is covered by three maps at a scale of 1:24,000, two of which have been published as DGS Open-File reports. This mapping continues to serve as input to county planning and subdivision approval decisions. The new program will refine some of the earlier work and concentrate in areas of new growth. The existing maps show arbitrary ratings of areas for their contributions to direct ground-water recharge and for their potential as ground-water sources as determined by permeability of surficial sediments, ground-

water levels, and thickness of any surficial sands.

The program is expected to start early this summer and will last two years.

Second in Series of C & D Canal Area Hydrologic Maps

"Hydrology of the Chesapeake and Delaware Canal Area, Delaware, Sheet 2," by Kenneth D. Woodruff, is the second map in a series that covers the Canal area. The map shows the thickness of the clay layer that separates the water table or shallow aquifer from deeper artesian aquifers. This layer is critical in protecting the deeper sands from surface pollution and in determining the amount of ground water that may recharge those deeper aquifers. The map also can be used to estimate drilling depths to water-productive zones.

The first hydrologic map of the Canal area was issued in September 1986 and depicted the basic geology and the general availability of ground water. Mapping will proceed south into the Middletown-Odessa area as part of the Survey's continuing hydrologic mapping program. Each series covers a distinct geographic area and stresses the main geologic features that affect the amount and quality of ground water in the area.

Beach Sand Studies

By Kelvin W. Ramsey

The Delaware Geological Survey is involved in an ongoing cooperative study with the Beach Preservation Section of the Delaware Department of Natural Resources and Environmental Control (DNREC) for the Beaches 2000 Committee to monitor the sand textures of material placed on the Fenwick Island, Delaware, beaches in the fall of 1988. The effort includes profiling and sampling of the beaches by DNREC and textural analyses of the sand by the DGS.

This study is one of the first to assess the changes of sand textures of beach nourishment material over a period of time after the initial emplacement. Changes in textures (sand grain size and sorting) reflect the effects of wind and wave forces on the sand placed on the natural beach. The results of this study may indicate the sand textures most stable for Delaware's beaches, thus, less likely to be eroded by normal wave and wind activity.

The DGS has completed a contract with the Beach Preservation Section for the Beaches 2000 Committee to assess the presence of on-land sand sources of beach nourishment material in southeastern Sussex County. Currently, all the sand for the Fenwick and Bethany beach nourishment projects comes from a shoal in the Atlantic Ocean approximately two and one half miles offshore Fenwick Island,

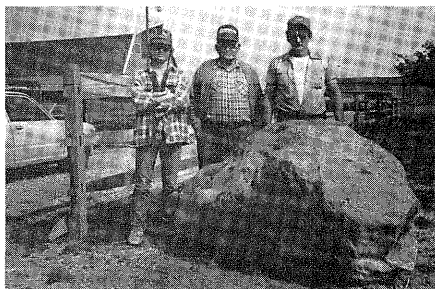
Delaware. Another joint project between the DGS and DNREC is scheduled to begin in June to assess sand resources in Delaware Bay.

Six-Ton Boulder Uncovered in Sussex County

A six-ton boulder of quartzite was recently uncovered by plowing in the field of Mr. Howard West along Route 16 near its junction with Route 1 in Sussex County. The boulder, measuring 3 1/2 by 3 1/2 by 6 1/2 feet, came from the Columbia Formation of Pleistocene Age. Although rocks of this size are not unknown from the Columbia, they are rarely found as far southeast in Delaware as this boulder.

The boulder was probably transported by an iceberg or floated in a mass of tree roots during a period of glacial melting and outwash sometime during the last 1.6 million years.

The Delaware Geological Survey is always interested in documenting geologic features of Delaware as exemplified by this boulder. Any such features can be reported by writing or calling the DGS in Newark.



Kevin Sherman, Howard West, and Wayne Aydellote (l. to r.) using two tractors and heavy chains took three hours to extricate the boulder. Photograph courtesy of Dennis Forney of The Whale, Lewes.

Pollen Record Reveals Delaware's Past Climates

A study of plant microfossils found in sediments generally devoid of other fossils is now being conducted by the DGS. The objectives of this investigation are (1) to trace changes in climate and sea level that have occurred in the past few million years and (2) to determine the ages and the environments of deposition of the sediments in which these fossils are found in order to facilitate the exploration of mineral and ground-water resources.

Preliminary results show that many climatic changes have occurred in the past. A climate warmer than present prevailed in

the Delaware area during most of late Tertiary time (up to 2 million years ago), and temperate and cold climates alternated during Quaternary time, particularly during the last 500,000 years.

A sample obtained in the Cape Henlopen area at 50 feet below present sea level contained pollen of pine, alder, spruce, grasses, and sedges as well as spores of club moss; this sample was carbon-14 dated at 28,400 ± 1800 years old. The pollen assemblage indicates a cold climate and a nonmarine environment; the sediment containing the pollen was deposited during the last ice age (late Wisconsinan). Samples obtained at shallower depths in the Cape Henlopen and Dewey Beach areas indicate that 9,000 to 10,000 years ago forests of oak, birch, and pine were established; temperature was rising, but it was still relatively cool at that time. The time interval of 8,000 to 4,000 years ago was characterized by increasing hickory and oak forests, the presence of more hemlock and sweet gum, less pine, and hardly any spruce; this suggests a rather warm and moist climate. After about 4,000 years before the present, oak, hickory, and pine were dominant, hemlock became less important, and alder and birch appeared to increase in frequency, suggesting a somewhat cooler climate than that which prevailed during the previous period.

The study is being done by former Delaware State Geologist Johan J. Groot who has returned to the DGS as a researcher on a part-time basis. The results have immediate application to the Survey's work on shoreline migration, beach nourishment, and geologic mapping.

Sinkhole

A new sinkhole was found in the west central portion of Hockessin Valley in May. The sinkhole, which developed in an area underlain by the Cockeysville Formation, is approximately 18 feet in diameter and 10 feet deep. At the time of discovery, surface water was draining into the sinkhole and disappearing into the subsurface resulting in direct recharge to the ground-water system. This is the ninth sinkhole to be documented in this area since 1978. John H. Talley's detailed report on sinkholes in northern Delaware was published in 1981 as DGS Open File Report No. 14.

Mid-Atlantic Region Geological Highway Map

The American Association of Petroleum Geologists (AAPG) has just published (1989) their revised Geological Highway Map of the Mid-Atlantic Region. The map,

compiled by Allan P. Bennison, covers the states of Kentucky, West Virginia, Maryland, Delaware, Virginia, Tennessee, North Carolina, and South Carolina, and the District of Columbia at a scale of slightly larger than 1:1,000,000. Included are listings of places of geological interest for each state and D.C., inset maps of physiography and pre-Pleistocene bedrock geology and tectonics, correlation charts for time and rock units, and descriptions of the general geology of the region as well as of three national parks and five astroblemes.

The map may be purchased from the AAPG, P. O. Box 979, Tulsa, Oklahoma 74101.

Cartographic Corner

By W. S. Schenck

- USGS National Cartographic Information Center (NCIC) renamed Earth Science Information Center (ESIC). The Delaware Geological Survey Cartographic Information Center (DGSCIC) is an affiliate of the USGS ESIC. Through this cooperative effort the DGSCIC continues to be a focal point in Delaware for inquiries on maps, earth imagery, and earth science.
- 1:100,000-scale topographic maps now available for Delaware. The USGS has just released the Wilmington, Dover, and Seaford 100K topographic maps. Copies are available from the DGSCIC.
- National Aerial Photography Program (NAPP) photography is underway for Kent and Sussex counties and will be available in late summer. New Castle County was photographed in March-April 1988 and is available from EROS Data Center, Sioux Falls, South Dakota, or the Aerial Photography Field Office in Salt Lake City, Utah.
- DGSCIC moves to new location. The DGSCIC has moved into Room 202 of the new Delaware Geological Survey Building. Office hours are from 8:00 a.m. - 12:00 noon, and 1:00 p.m. to 4:30 p.m., Monday through Friday.

Delaware Geological Survey
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Newark, DE 19716

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Robert R. Jordan
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Richard N. Benson,
Editor, First State Geology

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Publications

Recent DGS Publications

Reports of Investigation

No. 44 Ground-Water Levels in Delaware, January 1978-December 1987:

J. H. Talley, 1989, 58 p.

Atlas Series

Dover Quadrangle (DOV): N. Spoljaric, editor, 1989, 15 p.

Kenton Quadrangle (KEN): N. Spoljaric, editor, 1989, 11 p.

Forthcoming DGS Publications

Delaware Geological Survey List of Publications July 1989: J. H. Talley and D. C. Windish.

Frederica Quadrangle (FRE) Atlas: N. Spoljaric, editor.

Millington Quadrangle (MNT) Atlas: N. Spoljaric, editor.

Shallow Subsurface Temperatures at Selected Locations in Delaware: K. D. Woodruff.

Delaware's Boundaries: W. S. Schenck.

Effects of Agricultural Practices and Septic-System Effluent on the Quality of Water in the Unconfined Aquifer in Parts of Eastern Sussex County, Delaware: J. M. Denver.

Other Publications by DGS Staff

R. R. Jordan, 1989, "Do We Teach Geology?": Journal of Geological Education, v. 37, p. 168-170.

Staff Notes

Congratulations to **John H. Talley**, who received two awards this spring. One was the Water Resources Award from the Water Resources Agency for New Castle County for his outstanding contribution to the improvement of water resources in the county. The other was a Professional Merit Award from the University of Delaware.

Thomas E. Pickett led a University of Delaware Continuing Education Study Trip on May 6 to Cape Henlopen and Cape May. The purpose was to study the geology of modern capes and the similarities and differences in the two areas.

Robert R. Jordan was appointed to the National Academy of Sciences/National Research Council's Committee Advisory to the U.S. Geological Survey for a three-year term beginning July 1, 1989.

Presentations

Members of the Delaware Geological Survey presented papers at the Northeastern Section meeting, Geological Society of America, New Brunswick, NJ, March 23-25:

A. Scott Andres, "Coastal Sussex County, Delaware, Ground-Water Quality Survey."

Richard N. Benson, "Oligocene Rocks in the Subsurface of Delaware."

Thomas E. Pickett, "Remarks on John Fisher," at Barrier Island Symposium in honor of Dr. Fisher.

Kelvin W. Ramsey and Heather Mac Donald, College of William and Mary, "Development of a Pliocene Paleosoil in the Coastal Plain of Virginia," at symposium sponsored by Society of Economic Paleontologists and Mineralogists.

Richard N. Benson, "Geologic Framework Studies of Southern Delaware and Environs Based on New Drill-Hole and Vibroseis Data," at second symposium on Studies Related to Continental Margins, The University of Texas at Austin, May 21-23.

Grants

Richard N. Benson with **Johan J. Groot**, from University of Texas at Austin under the Continental Margins Research Program of the U. S. Minerals Management Service and the Association of American State Geologists for "Geological Framework of the Surficial Sand and Gravel Deposits of Delaware: Ages and Paleoenvironments of the Columbia, Omar and Beaverdam Formations as Determined by Palynology."

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