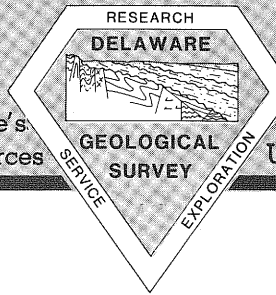


First State Geology

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



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150th Anniversary of the First Delaware Geological Survey



James C. Booth,
Delaware's
first State
Geologist,
1837-1841.

February 19, 1987, marks the 150th anniversary of passage of the Delaware General Assembly's 1837 act "to procure to make a geologic and mineralogic survey of the State." Three commissioners, one from each county, were named to hire a geologist and assist him in the field when necessary: Thomas Stockton, New Castle, Jonathan Jenkins, Kent, and Dr. Henry F. Hall, Sussex.

On June 1, 1837, they hired James Curtis Booth (1810-1888) as the Delaware State Geologist at a salary of \$1,200 a year. Booth had been an important part of the first Pennsylvania Geological Survey in the summer of 1836. He left that Survey in the fall to teach chemistry at the Franklin Institute in Philadelphia. He also established an analytical chemistry laboratory, still in existence, that was probably the first private lab in the United States to offer practical training in analytical chemistry.

Delaware's first Geological Survey was one of the early state surveys (but not the first). It predated the U. S. Geological Survey by 42 years.

Booth's report on Delaware's geology was issued in 1841 and was his final act as Delaware State Geologist. One-hundred and ten years later, in 1951, the General Assembly established the present Delaware Geological Survey with the appointment of Johan J. Groot.

The current State Geologist, Robert R. Jordan, was appointed following Groot's resignation in 1969.

DGS geologists have used Booth's 1841 report as a guide to rediscovery of outcrops. He was ahead of his time in promoting legislation to protect fragile wetlands and in the application of geology to agriculture. Of special note is his work on glauconitic greensand marl which was used extensively at that time as a fertilizer.

Seismic Reflection Profiling in Delaware

Richard N. Benson

Two separate seismic reflection profiling projects recently completed in Delaware are expected to reveal new information about the subsurface geology of the State. Because both were initiated by private geophysical companies, however, data will remain proprietary.

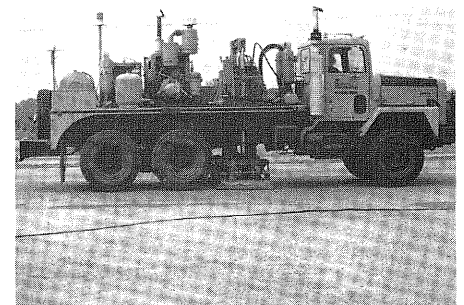
Teledyne Exploration of Denver is running a series of land-based regional seismic reflection profiles across the Appalachian-Piedmont-Coastal Plain of the eastern United States. The primary purpose of the survey is to provide a group of regional, reconnaissance profiles investigating the basic structural fabric of the region. Paleozoic-age structures of the eastern overthrust belt together with exposed and buried Mesozoic-age rift basins are the targets of study. Teledyne's program is non-exclusive; i.e., it is offering the seismic profiles for sale to interested parties on a cost per mile basis.

Based in part on data obtained at the Delaware Geological Survey, Teledyne decided to run a seismic profile across a magnetic and gravity anomaly in Sussex County and to continue the line westward nearly to the Chesapeake Bay Bridge in Maryland. The line was run in late May-early June, from

Rehoboth Beach to Five Points on Route 1 then west on Route 16 to the Maryland border, a distance of about 37 miles. Another 20 miles was surveyed in Maryland. The DGS examined the entire line and decided on purchasing about 10 miles of the profile between Greenwood and Ellendale, the portion that crosses the steep gradients in the gravity and magnetic anomalies.

Although the original data are proprietary, the DGS will publish interpretations of the seismic profile. Preliminary examination suggests the presence of a buried Mesozoic rift basin underlain by older, presumed sedimentary layers of Paleozoic age that appear to have been offset by thrust faults. The Coastal Plain sedimentary rocks overlying all of this are well represented by strong reflecting horizons, offset in places by normal faults.

The land-based seismic profiling used by Teledyne is the Vibroseis system that was developed several years ago by Conoco. It replaces explosives with a mechanical vibration system (see photograph) as the seismic energy source. The sound waves reflected from the earth's layers were received at the earth's surface by groups of geophones placed at 110-foot intervals along the survey route. The signals were recorded and field-processed by instruments and computers in the recording truck.



Vibroseis truck. Vibrating pad in contact with the ground generates sound waves that penetrate the earth and are reflected from the earth's layers back to the surface.

The second profiling project differs from Teledyne's in two basic aspects. First, it was water-based and ran for about 55 miles in November, from the Atlantic Ocean through Delaware Bay. The ship towed an air gun seismic energy source trailed by a 4500-foot-long floating streamer cable containing the geophone groups placed at 12.5-meter (41-foot) intervals. Second, it was an exclusive survey, run for a private client by the geophysical company Spectrum Resources of Houston.

Because the survey was done in State waters, it required a geophysical exploration permit under Delaware's oil and gas regulations. In the permit application, Spectrum named Texaco as its client. As a stipulation in the permit granted by the Department of Natural Resources and Environmental Control, Spectrum will allow the State Geologist to inspect the data and to receive copies of the processed geophysical data obtained in the State. Data may remain confidential for a period of up to five years.

The new data available for study by the DGS will provide much information about Delaware's subsurface and provide an important link between onshore and offshore geology. Much more is actually known about offshore than onshore deep subsurface geology because of the extensive holdings of marine seismic reflection profiles and offshore exploratory oil well data in the DGS library.

First State Geology is published by the Delaware Geological Survey, a State agency established by an Act of the Delaware General Assembly in 1951 and organized as a unit of the University of Delaware.

Robert R. Jordan,
State Geologist and Director
Richard N. Benson,
Editor, *First State Geology*

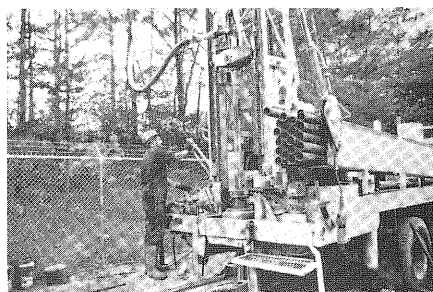
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Deep Test Hole in Sussex County



Hydraulic rotary drilling rig operated by driller Ed Kelley of American Water Well Systems, Inc.

The Delaware Geological Survey recently completed a 1,338-foot test hole in Sussex County about 3 miles southwest of Lewes. The hole penetrated several fresh water-bearing aquifers above 300 feet. Two observation wells were installed. One was screened from 210 to 240 feet in the Manokin aquifer, which contains fresh water. A second well was screened from 390 to 410 feet in a sand below the St. Marys Formation. Preliminary results suggest that the water in this sand is brackish with a chloride content of 650 ppm. The fresh/salt-water interface occurs between 300 and 400 feet.



Scott Andres and Tracy Stapleford collecting samples of drill cuttings from the mud pit.

Geophysical logs and results of paleontological studies of drill-cutting samples will be used to correlate the units penetrated in the hole with those revealed in other deep holes in coastal Sussex County. The subsurface geology also will be correlated with onshore and offshore seismic reflection profiles.

The project is funded by the Minerals Management Service, U. S. Department of the Interior, under a cooperative agreement with the University of Texas at Austin on behalf of the Continental Margins Committee of the Association of American State Geologists. The primary purpose of the project is to develop a better understanding of the subsurface geology and hydrology of both the offshore and onshore portions of Delaware.

Hydrology News

Drought Conditions

Below normal precipitation has prevailed throughout Delaware since October 1985, resulting in below normal streamflows and water levels in wells. Record and near record lows were recorded for several streams and wells. Precipitation deficiencies for the period October 1, 1985-September 30, 1986, ranged from 6.94" at Porter reservoir in Wilmington to 15.39" at Dover.

As a result of the dry conditions, Governor Castle declared a drought warning in July 1986. Voluntary water use restrictions were requested. In September, the warning was continued and mandatory restrictions were imposed for the area north of the Chesapeake and Delaware Canal to ensure adequate water supplies as water levels and streamflows continued to decline while water demand remained high.

After careful review of water supply demands and hydrologic conditions in mid-November, the Governor's Drought Advisory Committee recommended that the drought warning be continued and the mandatory restrictions be rescinded. Above normal precipitation during November and early December has resulted in increased streamflows and some recharge to ground-water systems.

Christina Basin Study Group

The Delaware Geological Survey hosted a meeting of the Christina Basin Study Group on December 21. The group, which consists of state, municipal, and local representatives from Delaware and Pennsylvania, was formed to review methods of hydrologic analyses, drought indices, and actions associated with drought conditions within the bi-state Christina River Basin. It is important that all parties agree on what constitutes a drought and on what actions should be taken during drought or drought warning conditions.

Hydrologic Maps

Chesapeake and Delaware Canal Area. The area in the vicinity of the Chesapeake and Delaware Canal was recently mapped as part of the DGS's continuing hydrologic mapping program. "Geohydrology of the Chesapeake and Delaware Canal Area, Sheet 1, Basic Geology," Hydrologic Map Series No. 6 by Kenneth D. Woodruff, indicates the hydrologic characteristics of the geologic units underlying the St. Georges, Delaware City, and Delaware portion of the Elkton 7.5-minute quadrangles. Also shown are the depth to basement rock

and basement structures as interpreted from drilling records and geophysical surveys. The area will undoubtedly experience future growth with an increasing demand for both shallow and deep ground-water supplies. Ground water is fairly plentiful but the highest yields are generally found in sands of the basal Potomac Formation.

Northern Atlantic Coastal Area. Basic geohydrologic data for the northern Atlantic coastal area of Sussex County is shown in Sheet 1 of Hydrologic Map Series No. 5 entitled "Geohydrology of the Northern Coastal Area, Delaware" by A. Scott Andres. The mapped area extends from Primehook Beach on the north to Long Neck on the south, an area that includes part of the rapidly developing Inland Bays region.

The map provides information on the occurrence, availability, quantity, and quality of ground water for planners, managers, consultants, regulators, and others who are concerned with the development and management of the ground-water resources of the area. On the map are the locations of high-yielding wells and selected geologic test borings and observation wells. A hydrogeologic cross section shows the lateral and vertical distribution of individual aquifers in the map area. Also depicted are precipitation, ground-water quality and surface-water data, as well as two hydrographs showing water-level fluctuations.

Water Quality

A DGS report on southwestern Delaware indicates that the quality of water in the shallow, unconfined aquifer is closely related to land use. Results of the first part of a four-year cooperative study conducted by the U.S. Geological Survey were recently published as DGS Report of Investigations No. 41, "Hydrogeology and Geochemistry of the Unconfined Aquifer, West Central and Southwestern Delaware" by Judith Denver, hydrologist with the U. S. Geological Survey. Denver was able to show how small changes in the ratios of dissolved ions such as potassium, calcium, chloride, magnesium, bicarbonate, and nitrate could be tied to land use. She also studied the soil types and drainage characteristics and indicates in the report the effect of these variables on water quality. The study has now been shifted to eastern Sussex and Kent counties. Eastern Sussex County in particular is experiencing rapid growth and conversion of land from farming to suburban development. The work should provide base-line data against which future changes in water quality can be measured.

Domestic Water Well Construction

The first of several information series pamphlets describing individual water systems is now available. DGS Information Series No. 2 entitled "Domestic Water Well Construction" by John H. Talley contains information on well design and construction methods used in Delaware, including drilled, driven, jetted, and bored wells. It also presents information on selecting a water well contractor, criteria used to estimate well construction costs, and well completion reports.

Subsurface Stratigraphy of Coastal Delaware

A new report entitled "Stratigraphy and Depositional History of the Post-Choptank Chesapeake Group" by A. Scott Andres presents an interpretation of the stratigraphy and depositional history of several subsurface geologic units of Sussex County and adjacent counties in Maryland. The study was based on the analysis of well log and seismic reflection data.

Published as DGS Report of Investigations No. 42, the report is one product of the Survey's intensive study of the geology and water resources of eastern Sussex County. The increased understanding of the area's geologic framework will be useful in the exploration for additional water supplies.

Prior to this study, subsurface stratigraphic units were defined according to the water-bearing characteristics of the rocks (i.e., Manokin, Ocean City, and Pocomoke aquifers and intervening confining beds), a practice that caused considerable confusion regarding the correlation and distribution of individual aquifers and confining beds. In this study, two new lithostratigraphic units, the Manokin and Bethany formations, are defined. The data indicate that the Manokin and Bethany formations were deposited in at least three sequences in a wave and fluvial energy-dominated delta complex. This information helps to explain the distribution and occurrence of specific rock types and, therefore, the distributions and occurrence of aquifers and confining beds.

Boundary Surveys in Delaware

Restoration of Delaware's boundary monuments has been completed along the east-west Transpeninsular Line, the north-south Tangent Line, and the 12-mile Arc (see Summer 1986 Issue of *First State Geology*). Funding for this work was provided by the Delaware General Assembly to the State Boundary Commission through the DGS. In response to interest in work of the Commission, Tracy Stapleford has compiled a chronological record of the restoration of the First State's boundaries.

The record notes important events that have occurred since the early 1600's when the original deeds for the land that is now Delaware were granted to William Penn. Emphasis has been placed on activities following the appointment of the present Delaware State Boundary Commission on May 27, 1971. The Commission has negotiated with officials of the states of Maryland, Pennsylvania, and New Jersey to clearly delineate the common boundaries between the states. The efforts of The Delaware State Boundary Commission have resulted in restoration of 179 monuments and the negotiation of agreements with adjacent states.

When completed, the boundary research will provide documentation of the historic and most current boundary surveys for the State of Delaware. A final compilation of this information will be a forthcoming publication of the Delaware Geological Survey.

Cartographic Corner

By W. S. Schenck
Coordinator, DGSCIC

Cartographic Corner begins with this issue. Its purpose is to announce items of interest to the cartographic community in Delaware. For further information, please contact the DGS Cartographic Information Center (DGSCIC) at 302-451-8262.

- 1:100,000-scale planimetric quadrangles available for Delaware. The U. S. Geological Survey (USGS) has completed publishing the Planimetric 100K quad series for the State of Delaware. There are four quads covering the State: Wilmington, Dover, Seaford, and Salisbury. At present, only the Salisbury quad is available in topographic format with a 5-meter contour interval. The Delaware State Mapping Advisory Committee has requested that the remaining three quads be published as topographic

editions as soon as possible. The USGS plans to have the 100K quad transportation and hydrography data available as digital data sets by March 1987.

- The DGSCIC has recently received 16mm roll film containing NASA photography over various parts of the United States. If you are interested in NASA or any aerial photography over any part of the U.S., the DGSCIC can conduct a photography search for you.
- The Northeast National Cartographic Information Center (NENCIC) affiliates are now linked by a computer mail network housed in the College of Forestry Resources of the University of Maine at Orono. Through this system, requests for cartographic information can be streamlined, especially in the northeastern US.
- The DGSCIC explains the services of Delaware's focal point for cartographic information in a recently published pamphlet, DGS Information Series No. 1 entitled "Delaware Geological Survey Cartographic Information Center."
- Sixty-seven USGS vertical benchmarks in Delaware are no longer congruent with National Geodetic Survey (NGS) vertical benchmarks. The DGSCIC has updated its BENCHMARK data base to account for this discrepancy. The 67 benchmarks were not relevelled in 1979 for inclusion in the 1982 publication of NGS vertical control data. Although both NGS and USGS benchmarks are based on the National Geodetic Vertical Datum of 1929, they cannot be used interchangeably. The USGS and NGS are currently working on plans to incorporate the USGS vertical benchmarks across the United States into the NGS vertical data base.
- The U. S. Geological Survey announced in November that major changes are coming to the current National High Altitude Photography (NHAP) program. They consist of: (1) changing the scale from 1:58,000 to 1:40,000; (2) use of single camera configuration with quarter-quadrangle format instead of quad-centered format (under the new format, ten photos will be needed for stereo coverage of 7.5-minute quadrangles); (3) use of Kodak color infra-red #2443 film only, no black and white; (4) greater flexibility for agencies contributing to NHAP to control their areas of interest; and (5) expected changes in coverage, processing, and pricing.

Publications

Recent DGS Publications

Reports of Investigations

- No. 41. Hydrogeology and Geochemistry of the Unconfined Aquifer, West-Central and Southwestern Delaware: J. M. Denver, 1986, 100 p.
- No. 42. Stratigraphy and Depositional History of the Post-Choptank Chesapeake Group: A. S. Andres, 1986, 39 p.

Special Publications

- No. 13. Operations Manual, University of Delaware Drilling Rig: R. E. Bounds, 1986, Part I, 19 p; Parts II and III, 91 p.

List of Publications, 1986: J. H. Talley and D. C. Windish

Miscellaneous Map Series

- No. 4. Seismic Stratigraphy Along Three Multichannel Seismic Reflection Profiles off Delaware's Coast: R. N. Benson, A. S. Andres, J. H. Roberts, and K. D. Woodruff, 1986.

Other Publications by DGS Staff

A. S. Andres, 1986, A Ground Water Supply Plan for Coastal Sussex County, Delaware, *in* L. K. Aller, ed., Proceedings of the Third Annual Eastern Regional Ground Water Conference: National Water Well Association, p. 407-424.

Forthcoming DGS Publications

- Middletown Quadrangle (MID) Atlas: N. Spoljaric, editor.
- Hydrologic Map Series No. 5, Geohydrology of the Northern Coastal Area, Delaware: Sheet 2, Geohydrology of the Columbia Aquifer: A. S. Andres.
- Hydrologic Map Series No. 7, Geohydrology of the Southern Coastal Area, Delaware: Sheet 1, Basic Geohydrologic Data: A. S. Andres.
- Information Series No. 3, Groundwater in Delaware: K. D. Woodruff.
- Special Publication No. 14, Laboratory Operations Manual: M. Kramer.
- Basic Hydrologic Data for Coastal Sussex County, Delaware: J. H. Talley and A. S. Andres.

Staff Notes

Congratulations to **John H. Talley** who was promoted to Senior Scientist and to **Dorothy C. Windish**, Secretary, who received her ten-year service award from the University in October.

Robert R. Jordan, State Geologist and Director, was appointed Chairman of the delegation representing the American Association of Petroleum Geologists to the North American Commission on Stratigraphic Nomenclature. He was also appointed to the Federal Liaison Committee of the Association of American State Geologists. He chaired meetings of the Ad Hoc Committee on Opportunities in Water Resources and Waste Management for the American Association of Petroleum Geologists at Alexandria, Virginia on August 18 and at Dallas, Texas on September 10. On October 3, he spoke on "Environmental Geology" at the Annual Meeting of Texas Section, American Institute of Professional Geologists, Dallas. With Jack Tarburton, Jordan co-chairs the Water Resources Committee of Delaware's Environmental Legacy.

A. Scott Andres, Research Associate III, presented a paper titled "A ground water supply plan for coastal Sussex County, Delaware" to the third Annual Eastern Regional Ground Water Conference held July 28-30 in Springfield, Massachusetts.

Richard N. Benson, Senior Scientist, discussed "Geologic framework of Delaware and nearby offshore areas," at the symposium of Atlantic coastal

state geological surveys to present results of research projects funded by the U. S. Department of Interior's Minerals Management Service, Virginia Institute of Marine Sciences, Gloucester Point, Virginia, October 16. **Benson** and **Thomas E. Pickett**, Associate Director, attended the 51st Annual Field Conference of Pennsylvania Geologists, Huntingdon, Pennsylvania, September 25-27. This year's conference commemorated the 150th anniversary of the First Pennsylvania Geological Survey.

William S. Schenck, Research Associate II, presented "History of the Northeast NCIC Affiliates" at the first National Meeting of the National Cartographic Information Center (NCIC) State Affiliates in Denver, Colorado, August 11-15.

John H. Talley, Senior Scientist, represented the Delaware Geological Survey on an inspection tour of the New York City water supply facilities conducted for the Delaware River Advisory Committee on Oct. 6-7. He also participated as a panel member and gave a talk on the hydrologic characteristics of Red Clay Creek at the November 13th Delaware Nature Education Society Seminar, "Red Clay Creek - Problems and Prospects."

Kenneth D. Woodruff, Associate Director, gave a short course on water well logging at the Water Systems Association Seminar held May 28 at the Sheraton Inn in Dover.