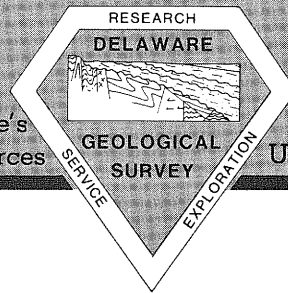


First State Geology

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



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Earthquake Shakes New Castle County, Delaware

By Kenneth D. Woodruff

A moderate earthquake shook residents of eastern New Castle County, Delaware, and Salem County, New Jersey, on the evening of October 22, 1990. The quake was recorded at about 9:34 p.m. by all five stations in the DGS seismic network and by some stations in the Lamont-Doherty and Virginia Tech networks. The magnitude was calculated at 3.2 by the DGS. The epicenter was about five miles south of Salem, New Jersey, and just east of the Delaware River.

Delaware residents reported the event as sounding like thunder or like an

"explosion in the basement." This is a common response to local earthquakes with the duration and frequency of noise depending on the distance from the epicenter.

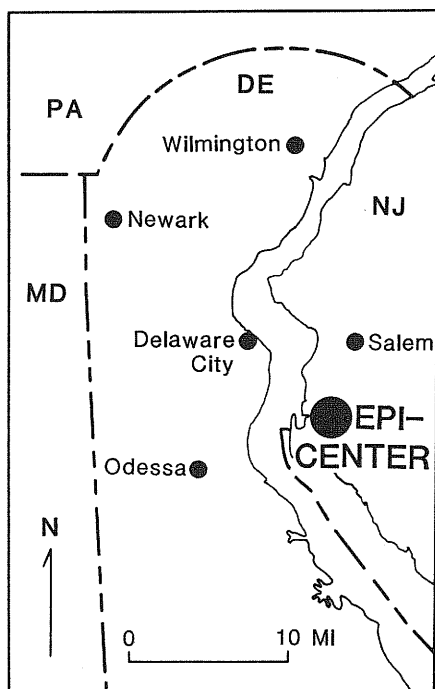
The exact nature of the faulting involved is unknown. However, a number of other earthquakes have occurred in the general area of northern Delaware and adjacent New Jersey within the last twenty years. There is evidence from seismic reflection and other geophysical data that the location and course of the Delaware River are controlled by the underlying geologic structure. Basement faulting is apparent on the seismic reflection profiles. The last felt earthquake in this region was in October 1985 when a 1.9-magnitude event occurred in the Wilmington area. For more information on earthquakes in Delaware and nearby areas request DGS Report of Investigations No. 39 (1984).

contour interval in the Coastal Plain area of the state and 10-ft with 5-ft supplemental contours in the Piedmont Province. Delaware will be the first state to have all of its 7.5-minute maps registered to the new North American Horizontal Datum of 1983 (NAD83). Collection of the new hypsography layer (contour lines) in digital form and an update of the existing digital line graphs will follow the publication of the new maps.

The DGS ascertained the needs of the state's cartographic community through its chairmanship of Delaware's State Mapping Advisory Committee. The DGS and USGS have had regular coordination meetings to ensure that the new maps will fit these needs.

The USGS has divided the state into four project areas: the Wilmington Project, essentially New Castle County; the Dover Project, Kent County; the Georgetown Project, most of Sussex County; and the Lewes Project, six quads along Delaware's ocean coast. USGS field crews are currently working on the New Castle and Sussex county projects. The Dover project has been started and will be continued into next year. The Lewes Project involves conversion of 1984-vintage maps with metric contours to English units as well as shifting the maps to the NAD83. This will be done at Eastern Mapping Center and is expected to be finished spring 1991. Field work for the Wilmington and Georgetown projects is expected to be completed by late spring 1991 and that for the Dover project by 1992.

The field work, after obtaining aerial photography, is the most basic work done in the map-making process. The crews' first task is to do a vertical and horizontal control reconnaissance. This provides an inventory of control monuments that can be used when doing actual surveying. From this information a geodetic framework can be completed for each quadrangle by another unit in the Mapping Center through a process



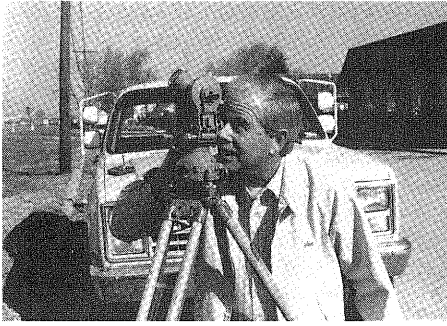
Field Work Begins on New Topographic Maps for Delaware

By William S. Schenck

U.S. Geological Survey field crews are currently working in New Castle and Sussex counties in the field-work stage of a four-year program that will provide Delaware with new 7.5-minute topographic maps. Field work follows the complete coverage of the state with aerial photography during 1989-90, and is expected to last until late spring 1991.

DGS is currently involved with a Joint-Funded Topographic Agreement with the Eastern Mapping Center, U. S. Geological Survey. The agreement provides funds for the total revision of all of Delaware's 7.5-minute topographic maps. The new maps will have a 5-ft

called aerotriangulation. From this model, the field crews know where to establish more control in order for the maps to be geodetically correct.



Jerry W. O'Brien, USGS, demonstrates how a theodolite is used for astronomic observations. This aids the crew in precisely locating horizontal control points.

In establishing horizontal control, the USGS crews have been using the latest technology in order to obtain the highest degree of accuracy in positioning. The system is called the Global Positioning System (GPS) and makes use of the Navstar satellites which orbit the earth. By using several receivers and a computational unit carried in their vehicle, the crews can, through geometric network planning, pinpoint locations within the mapping area. The data are collected in the field and processed by computer back at the field office.



Louis J. Driber, USGS, uses a plane table and alidade in level line surveying.

Level line surveying is performed to establish vertical control points that will be used later by the photogrammetrist to establish elevation contours. Using the existing vertical control found in the reconnaissance, the crews run level line surveys to areas where elevation control points are needed. These surveys are run using a plane table and alidade in combination with a theodolite.

While running these levels the field crews check place names and heads of streams; verify woodlands, swamps,

marshes, fence lines, out buildings, business/industrial buildings; and collect boundary information concerning incorporated cities and towns, parks, wildlife areas, counties, and the state boundary.

New Geologic Map of Southern Delaware

A new DGS publication (Open File Report No. 32), "Geologic Map of Southern Delaware" by Kelvin W. Ramsey and William S. Schenck, shows the geology of Delaware south of Dover at a scale of 1:100,000. It covers the portion of the state not currently mapped at a scale of 1:24,000 and shows (1) the distribution of geologic units found at the land surface, (2) the updip limits of Miocene and Pliocene geologic units found in the subsurface, and (3) locations of subsurface faults that affected deposition of the Miocene and Pliocene units.

The surficial geologic units mapped are the Beaverdam and Columbia formations, the Staytonville unit, the Omar Formation, and two informal units, the (ancestral) Delaware Bay deposits and the Nanticoke deposits; also shown are Holocene marsh, swamp, beach, and lagoonal deposits. The Delaware Bay and Nanticoke deposits are Pleistocene bay-bottom and estuarine sediments laid down during times of higher stands of sea level than at present and are now found parallel to the present Delaware Bay and Nanticoke River. The subsurface Miocene and Pliocene geologic units comprise the Calvert Formation that underlies the entire area, the Choptank and St. Marys formations that subcrop between Dover and Milford, and the Manokin and Bethany formations that subcrop south of a line from Milford to Bridgeville. These units contain the major aquifers for southern Delaware including the Frederica, Federalsburg, Cheswold, Manokin, and Pocomoke aquifers.

The map is a compilation and revision of past and current work of the DGS staff in the map area. It provides a regional framework for use in future work, especially for larger-scale geologic mapping as a part of the DGS 1:24,000 geologic map series. Open File Report No. 32 is available upon request from the Delaware Geological Survey.

Hydrology News

Pilot Project Mapping Ground-Water Recharge Areas

By A. Scott Andres

Work continues on a one-year pilot study to develop and test methods for mapping ground-water recharge areas

and for ranking their capability to transmit water to deeper parts of the aquifer. The study focuses on the area in eastern Sussex County covered by the Fairmont and Frankford 7.5-minute topographic maps. The study is supported by the Non-Point Source Pollution and Ground-Water Protection programs at the Department of Natural Resources and Environmental Control.

Our study has identified three-dimensional geologic mapping combined with flow-net analysis as the most useful method for ranking and identifying recharge areas. The method is a modified form of stack-mapping, which was developed by the Illinois Geological Survey. In addition, a number of aquifer tests have been completed in order to quantify the hydraulic characteristics of the different stack-map units.

Maps of two layers, 0 to 20 feet and 20 to 60 feet, have been completed. Work continues on collection of additional aquifer test data, computerization of the maps, and preparation of the final report.

New Castle County Resource Protection Area Program

By John H. Talley

The Delaware Geological Survey in cooperation with the Water Resources Agency for New Castle County has initiated a program to refine the mapping of resource protection areas, which include well-head protection areas. Kathleen Butoryak has been employed by the Survey to work on this project. A need for the study was spurred by increasing developmental pressures that have the potential to affect the quality and quantity of surface- and ground-water resources.

In progress is a pilot study of an area that covers approximately 40 square miles north and northwest of Middletown to (1) review the methodology that was used to develop existing maps and (2) evaluate and test alternative methods for delineating resource protection areas. Stack mapping, a method that involves detailed geologic and hydrologic investigations of subsurface rocks, in this case to a depth of 20 ft, appears to be promising. The pilot study will be completed by February 1991.

Work has begun on evaluating methodologies for refining the well-head protection areas shown on maps titled "Water Resource Protection Areas for City of Newark, City of Wilmington, New Castle County, Delaware" published by the Water Resources Agency for New Castle County. Methods range from relatively simple and inexpensive to sophisticated and costly ones. Criteria being evaluated include distance from wells, ground-water drawdown, travel time, flow system boundaries, and the ability

of an aquifer to assimilate contaminants. Currently, work is concentrated in the vicinity of Glendale well field operated by Artesian Water Company. Well-head protection areas are defined in the Safe Drinking Water Act as "...the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field."

Microcomputer Capability for DGS Data Management System

By John H. Talley

The DGS, in cooperation with the College of Urban Affairs at the University of Delaware, has designed, developed, and is using a new microcomputer-based data management system. The original system was begun in 1981 and operated on a mainframe computer. The new system was developed to take advantage of technological advances in both hardware and software, thereby enabling the DGS to efficiently store, manipulate, analyze, and retrieve information in selected formats to support its exploration, research, and service functions.

The system contains geologic and hydrologic information (well construction information, geologists' logs, geophysical logs, geologic samples, water levels, water quality, and aquifer test data) for about 25,000 wells drilled in Delaware.

Delaware Geological Association Piedmont Field Trip

On Monday, November 19th, the Delaware Geological Survey hosted a field trip for members of the Delaware Geological Association. Approximately 35 people attended and exchanged ideas on new work the DGS has been doing in the Piedmont.

Staff members of the DGS and Department of Natural Resources and Environmental Control (DNREC), along with Margaret Plank, discussed findings and conclusions of their project work. Ms. Plank recently earned the M.S. degree in geology from the University of Delaware and has been kind enough to

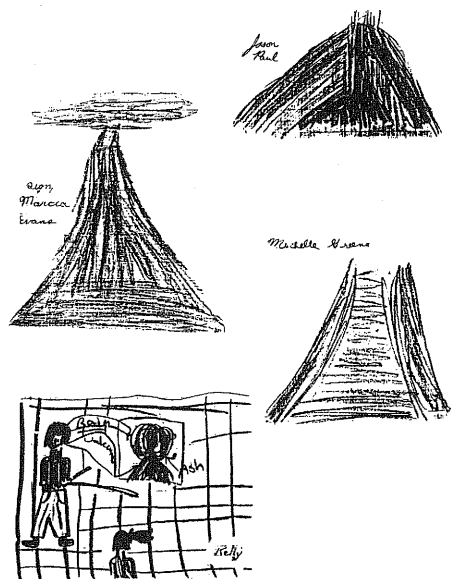
share her experience from her thesis work on the Piedmont (see Summer 1990 issue of *First State Geology*). Emil Onuschak, DNREC, described a spill remediation study at its site in Claymont.

Exchanges such as these among the geologists in Delaware are valuable for shaping our understanding of Delaware's geology and help complete specific projects such as the Cockeysville Project.

Volcanoes, Visualized by Elementary School Children

By Nenad Spoljaric

In the experience of the Survey members who give talks to elementary school children throughout the state, the subject of volcanoes is one of the hottest topics that always gets the imagination of the pupils fired up. Not only do the students ask a barrage of questions, they also include drawings of volcanoes in their thank you letters. The examples shown are by fourth-grade pupils of the Fairview Elementary School in Dover.



Cartographic Corner

By William S. Schenck

■New 1:100,000-scale bathymetric maps are available from NOAA/NOS. Ten new bathymetric maps are available for areas off the coasts of Connecticut, Delaware, Maryland, New Jersey, New York, and Virginia. The maps have a 1-meter contour interval (1 meter equals 3.28 feet or about .55 fathoms) out to the 200-meter water depth. Loran-C and some selected obstructions are also

shown. Because of their detailed bathymetry, these maps are well-suited for fishermen as well as recreational divers. An index and ordering information are available from the DGSCIC.

■Two new maps from the U. S. Geological Survey. "This Dynamic Planet" is a 5-foot wide map that shows the earth's topographic and bathymetric features, with an overlay of its volcanoes, earthquake epicenters, and boundaries and movements of the large tectonic plates that make up Earth's crust. The second map entitled "Natural Hazards Map of the Circum-Pacific Region" is a 40- by 50-inch map, with accompanying 31 pages of text, that depicts such natural hazards as polar pack ice, typhoons in the western Pacific, and thousands of earthquake epicenters and volcanoes around the rim of the Pacific.

■New state-wide, stereo photography in natural color is available to view at DGS. As a by-product of the current Joint Funded Topographic Mapping Agreement, the DGS has received the most recent aerial photography available over Delaware. The northwestern area of the state is covered by 1:20,000-scale photography, the rest by 1:15,000-scale photos. The photography is extremely sharp and useful for locating physical and cultural features.

■Digital line graphs (DLG) have been completed for all 57 of Delaware's 1:24,000 topographic quadrangles. Transportation, hydrography, and boundary data layers may now be purchased from USGS.

■The DGSCIC now has Compact Disk-Read Only Memory (CD-ROM) capability. CD-ROM provides a medium onto which entire mainframe data bases can be downloaded and used in the PC environment without storage problems. The DGSCIC has expanded its information holdings and dissemination capabilities by use of the following CD-ROM data bases.

- (1) TIGER/Line Pre-Census Files, 1990 contains the pre-census data for Delaware, District of Columbia, Maryland, and Virginia.
- (2) 1:2,000,000-scale Digital Line Graph data for the United States. The data layers include hydrography, transportation, and boundary information. The disk has software with the ability to download the data for use in other software packages.
- (3) Aerial Photography Summary Record System (APSR) contains the listings of all of the federal and some private aerial photography available over the entire U. S., Puerto Rico, and U. S. islands and territories. The data base is searchable by date, state, country, scale, film type, agency, and geodetic coordinates.

(4) USGS/USDA/SCS Digital Orthophoto Data. This disk is the first of its kind and serves as a demonstration of the capture of rectified aerial photography data on CD-ROM.

(5) Citations of publications of the U. S. Geological Survey through 1988.

(6) Deep Sea Drilling Project (DSDP) sediment/hardrock and reference files, downhole logs, and underway geophysics that were collected by the scientists on the *Glomar Challenger* during its 96 voyages between 1968 and 1987.

For further information on the above items please contact W. S. Schenck, 451-8262.

Publications

Recent DGS Publications

Open File Report

No. 32 Geologic Map of Southern Delaware: K. W. Ramsey and W. S. Schenck, scale 1:100,000.

Atlas Series

Kennett Square Quadrangle (KES):
N. Spoljaric, editor.

Marcus Hook quadrangle (MAH):
N. Spoljaric, editor.

Other Publications

DGS List of Publications, 1990: J. H. Talley and D. C. Windish, 16 p.

Forthcoming DGS Publications

Report of Investigations No. 48, Geologic and Hydrologic Studies of the Oligocene-Pleistocene Section Near Lewes, Delaware: R. N. Benson, editor.

Results of the Coastal Sussex County Ground-Water Quality Survey: I - Basic Data and Initial Analysis: A. S. Andres.

Wilmington South Quadrangle (WIS) Atlas Series, N. Spoljaric, editor.

Wilmington North Quadrangle (WIN) Atlas Series, N. Spoljaric, editor.

Wyoming Quadrangle (WYO) Atlas Series, N. Spoljaric, editor.

Marydel Quadrangle (MAR) Atlas Series, N. Spoljaric, editor.

Other Publications by DGS Staff

R. N. Benson, 1990, Geologic Structures of the Appalachian Orogen, Mesozoic Rift Basins, and Faulted Coastal Plain Rocks Revealed by New Vibroseis and Drill-Hole Data, Southern Delaware and Adjacent Maryland, in Hunt, M. C., Doenges, S., and Stubbs, G. S., eds., Proceedings Second Symposium on Studies Related to Continental Margins: Bureau of Economic Geology, the University of Texas at Austin, p. 143-150.

Staff Notes

Kathleen Butoryak joined the DGS as project geologist for the New Castle County Resource Protection Area Program.

Robert R. Jordan received the George V. Cohee Public Service Award of the Eastern Section of the American Association of Petroleum Geologists (AAPG) in London, Ontario, September 11. He was awarded the Certificate of Merit of the American Institute of Professional Geologists in Long Beach, California, October 11. Also, Jordan was elected to serve a

three-year term in the AAPG House of Delegates and to chair the North American Commission on Stratigraphic Nomenclature.

William S. Schenck was selected to co-chair the Earth Science Information Center (ESIC) National Network Steering Committee.

John H. Talley has been appointed by DNREC Secretary Edwin H. Clark II to serve on the Department's Extractive Use Committee. Talley continues to serve on the Water Well Contractor's Licensing Board and the On-Site Systems Advisory Board.

Dorothy C. Windish, Senior Secretary, graduated from the University of Delaware with a Bachelor of Fine Arts degree in August.

Presentations

A. Scott Andres, "Nitrate in Delaware's Ground Water" at the Cooperative Extension Service annual meeting, Dover, May 25, and "Ground-water Recharge Mapping" at the conference on the DNREC-USEPA Non-Point Source Pollution Program conference, Rehoboth Beach, October 26.

William S. Schenck spoke to students at Christ Our King School on cartographic information and how maps are made, November 12.

Nenad Spoljaric spoke to fourth-grade students at Fairview Elementary School, Dover, October 12.

Externally Funded Project

John H. Talley from DNREC for continuation of "Ground-Water Monitoring of Coastal Aquifers in Delaware."

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