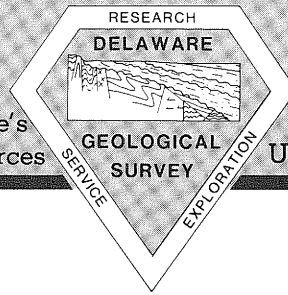


# First State Geology

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



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## Map of Mesozoic Rift Basins

The Delaware Geological Survey published, as Miscellaneous Map Series No. 5, "Map of Exposed and Buried Early Mesozoic Rift Basins/Synrift Rocks of the U.S. Middle Atlantic Continental Margin" by Richard N. Benson. The map, at a scale of 1:1,000,000, shows the areas, in color, of both the exposed basins of the eastern U.S. from Massachusetts to the Carolinas and those buried beneath the Atlantic Coastal Plain and adjacent Middle Atlantic Outer Continental Shelf (OCS). A discussion section accompanies the map.

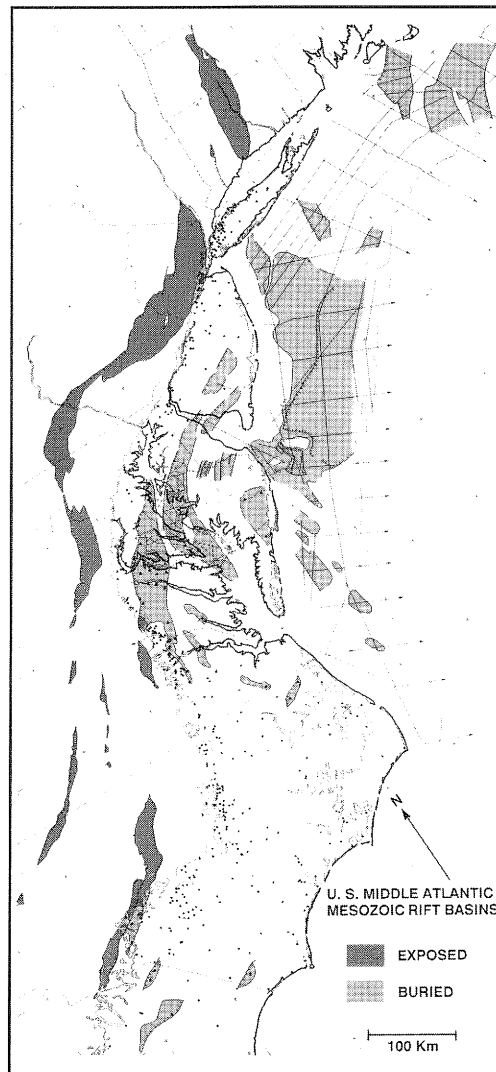
The rift basins formed during Late Triassic-Early Jurassic time (between about 230 and 180 million years ago) by extension and thinning of the earth's crust across the ancient supercontinent of Pangea, which later broke apart as the continents of North and South America, Africa, and Europe. The synrift rocks that accumulated in the rift basins comprise non-marine sedimentary rocks and basalt lava flows.

The map is a compilation of works by other researchers and the original research by the author. Areas enclosing inferred early Mesozoic rift basins/synrift rocks beneath the postrift sediments of the middle Atlantic Coastal Plain were determined by analysis of borehole data, seismic reflection profiles, and gravity anomaly and aeromagnetic maps. Two basins in Delaware (Greenwood and Bridgeville) and the Queen Anne basin of Maryland, which most likely extends into Delaware, are imaged on regional Vibroseis profile TXC-10. Areas enclosing inferred rift basins in the offshore region between the Long Island platform and Cape Hatteras were mapped from interpretations of seismic reflection profiles.

Onshore, several of the exposed basins and the buried Taylorsville basin of Virginia have been explored, unsuccessfully to date, for oil and gas. The basins are of interest because they contain organic-rich lacustrine (lake) sediments and coal beds that may be source rocks for oil and gas. By

analogy, the offshore basins may contain similar rocks with sufficient organic richness, if not lost through hydrocarbon generation, to be classified as source rocks.

The map is one product of ongoing DGS studies of the geologic framework and hydrocarbon resource potential of Delaware and the OCS. It shows some of the results of those studies in the broader context of the geology of the U.S. mid-Atlantic continental margin.



## New Topographic Maps

By W. S. Schenck

The DGS has received final funds to complete the five-year joint program with the U.S. Geological Survey (USGS) to produce new 7.5-minute, 1:24,000-scale topographic maps of the entire state. Once complete, the hypsography (elevation contours) will be collected digitally to produce maps in both analog and digital form. The maps are based on the new North American (horizontal) Datum of 1983 (NAD83). On each quadrangle map there will be a means to convert the vertical elevation information to the new North American Vertical Datum of 1988 (NAVD88).

Sussex County is complete, and some quadrangles have been printed and are available in analog form. New Castle County is in the editing stage, and quadrangles will appear by late spring of 1994. The cartography stages for Kent County are beginning, and quadrangles are expected by late 1994 or early 1995. Digital data collection will follow shortly after each quadrangle is completed.

## National Geologic Mapping Act Approved

By Robert R. Jordan

In May, President Bush signed the National Geologic Mapping Act of 1992, which thereupon became Public Law 102-285. It is noteworthy that the Act was passed by Congress without objection in the first session of its introduction. This is unusual recognition of the importance of a particular aspect of scientific investigation.

As stated in the Act, geologic mapping is fundamental to the assessment of natural resources, evaluation of geologic hazards, and protection of environmental assets. A geologic map is a succinct statement of what is known of the physical

characteristics of an area. Specialized maps may be derived from the basic geologic map to locate ground-water supplies, sand and gravel resources, and waste-disposal sites, for example.

The National Geologic Mapping Act will stimulate geologic mapping across the country and at all levels of government. It establishes mechanisms for cooperation between the state geological surveys, the U.S. Geological Survey, academic institutions, and private industry. Committees are presently being established to implement the Act and to seek full funding support for the authorized activities. The Association of American State Geologists leads the effort to gain national recognition for geologic mapping and will continue to be heavily involved in the administration of the Act.

The Delaware Geological Survey has geologically mapped almost half of Delaware at modern standards. It is difficult to sustain a long-term effort of this type in the face of immediate problems and budget pressures. The National Geologic Mapping Act will benefit Delaware by bringing attention to this critical scientific activity and by providing the potential for enhanced support.

## Mineralogical Studies of the Calvert Formation near Smyrna

By Nenad Spoljaric and Richard N. Benson

Highly fossiliferous sediments of the Miocene Calvert Formation discovered recently along the State Route 1 bypass near Smyrna have been described in some detail in the past two issues of *First State Geology*.

Recently, the mineralogy of the fossiliferous layers and overlying Miocene deposits has been investigated by the x-ray diffraction technique. The preliminary results reveal the presence of a complex assemblage of sulfates, sulfides, silicates, and oxides. The specific minerals identified so far include quartz, feldspar, hexahydrite, jarosite, alunite, gypsum, sulfur, talc, lepidocrocite, maghemite, hematite, goethite, laumontite, vermiculite, chlorite/smectite, illite, kaolinite, illite/smectite, and pyrite. Of significant interest are jarosite, alunite, laumontite, hematite, kaolinite, and talc because they can all form together from hydrothermal solutions. Some of these minerals occur as a yellow powdery material on fracture surfaces and dispersed within the fine-grained matrix.

Being investigated is the possibility that after the deposition of the Miocene Calvert Formation at Smyrna these sediments may have been invaded by hydrothermal solutions. Related information in support of possible hydrothermal activity is the

presence of darkened pollen grains from the Calvert in the Smyrna vicinity. Anomalous dark pollen grains suggest a post-depositional heating event. Also, a recent analysis of fission tracks in apatite grains in samples from the COST B-2 well in the Baltimore Canyon trough offshore New Jersey indicate a mid-Miocene heating event.

## Offshore Sand Investigations

By Kelvin W. Ramsey

Under the agreement between the Delaware Geological Survey, the Minerals Management Service (MMS) of the United States Department of the Interior, and the Maryland Geological Survey (see previous issue of *First State Geology*), work has begun to locate, study, and characterize offshore sand bodies that may be used for beach nourishment or other uses.

Since the beginning of the study, the DGS, with the cooperation of the Maryland Geological Survey, has collected a grid of shallow seismic reflection profiles between about three and ten miles offshore. These data were used to select 16 sites at which cores were taken to a maximum depth of 20 feet below the ocean bottom. Both the seismic and core data will be used to produce a map indicating areas of potential sand resources.

The cooperative agreement is expected to continue for the next few years in order to better identify the distribution and character of offshore sand bodies.

## Our Geologist Volunteers

The Delaware Geological Survey is in the unique position of benefiting from the volunteer services of three geologists. Most familiar is Johan J. Groot, the founder and first director of the Survey which began operation in 1951 as a unit of the University of Delaware. He left the DGS in 1969 to work for the United Nations on water projects in several places in South America and Africa. After retirement from the U.N., he lived in England but returned to Newark in the early 1980s. He soon began working on projects for the DGS and eventually was employed part-time for several years before officially retiring in January 1992. However, since then he has continued with his palynological studies which have become a key to deciphering the stratigraphy of Delaware's surface and near-surface Coastal Plain deposits.

Margaret O. (Peg) Plank's M.S. thesis at the University of Delaware was on the metamorphism of the Wissahickon Formation of the Piedmont in and around Delaware (see summer 1990 issue of *First State Geology*). Geology is a family affair in that her daughter Terry just completed a Ph.D. at Columbia University with her study

of arc volcanics and subduction zones. Peg and Associate Scientist Sandy Schenck are studying outcrops and cores of northern Delaware's crystalline rocks. Working together both expect the final product of their investigations to be a new geologic map of the Delaware Piedmont.

Ralph Orlandy chose Newark for retirement after a career in oil exploration in the western U.S. followed by teaching in a community college near New York City. As his Ph.D. dissertation from the University of Utah was on Upper Cretaceous palynology in Utah, he was familiar with Johan Groot's earlier work on the Cretaceous palynology of Delaware. After moving to Newark he developed an association with Dr. Groot, and, eventually, this year after a long hiatus he returned to palynology as a DGS volunteer. He is in the process of making reference slides of modern pollen and spores from samples supplied by the U.S. Geological Survey. His next project will focus on the palynomorphs above and below the Cretaceous-Tertiary boundary in Delaware.

State Geologist Robert R. Jordan notes that it is extremely gratifying to have such outstanding volunteers, not only because of their scientific contributions, but because their desire to associate with the Survey is testimony to the quality and reputation of the unit.

## Palynological Laboratory in Operation

By Charles T. Smith

Palynology, the study of fossil pollen and spores, is an important tool in stratigraphic correlation and in interpreting climates of the past. It has been very useful in the study of Delaware's surface and near-surface sedimentary deposits.

A laboratory to extract pollen and spores from sediment samples has been established at the Delaware Geological Survey under the guidance of Professor Emeritus Johan J. Groot. Pollen and spore processing has been performed in the past by the DGS, however we now are able to dedicate more laboratory space in our modern facility and to upgrade our pollen extraction technology to more current methodology.

## Wilmington Blue Rocks

By Peg Plank

"Help! What do Blue Rocks look like?" was a November headline in the *Wilmington News Journal*. The minor league baseball team that will play in Wilmington's new stadium will be called the Blue Rocks, and the sports writers wanted to know what a blue rock is. Surprisingly, they asked University of

Delaware football coach Tubby Raymond who thought it was a breed of chicken, Lt. Governor-elect Ruth Ann Minner who thought it was a nickname of a clay pigeon, and John Hickman, the grand old man of Delaware semi-pro baseball, who recalled it was a combination of Blue Hens and "The Rocks," the area where the Swedes first landed.

John Hickman was close; the original Blue Rocks baseball team was named for the rock formation that underlies most of Brandywine Hundred. The blue rock is an excellent building stone, and was extensively quarried in an earlier era. The quarrymen called it the Brandywine blue granite, however the blue granite is neither a granite nor is it blue. It is a highly metamorphosed rock called a gneiss, and it is blue only on a fresh surface.

Today, all of the quarries are closed and obviously most residents have forgotten about the Brandywine blue granite. At the DGS, we are pleased to have the baseball team spark a new interest in the local geology.

## Hydrology News

By A. Scott Andres and John H. Talley

### Ground-Water Recharge Mapping

Ground-water recharge potential maps and reports for projects in the Seaford and Dover areas are nearly completed. The maps depict areas that have been defined by their ability to transmit water into the shallow Columbia aquifer.

The next area to be mapped, as requested by the Department of Natural Resources and Environmental Control (DNREC), will be that covered by the Sharptown, Laurel, and Trap Pond 7.5-minute topographic maps. In addition, further study will be done to evaluate the use of the maps as a tool for predicting ground water quality.

The DGS is in the final stages of a project to revise and update methodology for mapping recharge areas and to apply that methodology to map such areas in the Coastal Plain throughout New Castle County. The maps will be used by planners and environmental officials to ensure that adequate supplies of ground water will be available to meet current as well as future demands, to maintain adequate discharge of ground water to bodies of surface water, and to reduce the potential for degradation of ground-water quality. The final report, which will be prepared for the Water Resources Agency for New Castle County, will contain maps showing areas where the potential for recharge is best and the more than 2,000 data points used in the investigation.

### Wellhead Protection

In a related program, supported by the Agency and a grant it received from the U.S. Environmental Protection Agency (USEPA), the DGS is refining an existing wellhead protection area at the Glendale

well field near Bear and delineating a new wellhead protection area at the Eastern States well field near Glasgow. Wellhead protection areas are defined as surface and subsurface areas surrounding public water supply wells or well fields where the quantity or quality of ground water moving toward such wells or well fields may be adversely affected by land use activity. Delineation of the areas involves the use and analysis of existing geologic and hydrologic information, application of hydrogeologic principles, and the application of relevant USEPA modules specifically designed to assist in mapping such areas. Criteria and methodologies suggested for use by the USEPA in 1987 are being evaluated for possible application to support mapping of wellhead protection areas throughout the county.

### Hydrologic Mapping

Work is progressing on DGS Hydrologic Map Series No. 9, "Geohydrology of the Seaford Area." Plans are for the map to be available by the end of 1993.

The map and accompanying discussion being prepared by A. Scott Andres will summarize available basic geologic and hydrologic information for the area covered by the Seaford East and Seaford West 7.5-minute topographic maps. This information is useful to consultants, government agencies, farmers, and citizens that need to know where adequate quantities of ground water are located and how to avoid potential water quality problems. For example, work to date has guided the City of Seaford's plans for a new well. The map information will also help homeowners and farmers make informed decisions about replacing an old well or installing a new one.

## Summary Report of the Storm of January 4, 1992

The Delaware Geological Survey has published Open File Report No. 36 containing tide, weather, and geologic data for the coastal storm of January 4, 1992. The report is part of the ongoing effort of the Delaware Geological Survey to compile information to help assess the nature and effects of such events as coastal storms and to predict the impact of future ones.

The storm was a low pressure system that moved across the Delmarva Peninsula and the Chesapeake Bay just to the south of the Maryland-Delaware state line. The intensity of the winds (to about 60 mph) and their direction from the east led to the buildup of tides and waves that produced coastal flooding and record high tides along Delaware Bay and the Atlantic Coast. Damage from the storm was reported all along the coast in both areas. Data presented in the report indicate that the storm was a model of the kind of damage

that could be produced if a tropical storm or hurricane were to make landfall on the Delmarva Peninsula south of Delaware.

## DGS Receives New Truck for Drilling Rig

By Roland E. Bounds

A new heavy-duty truck chassis has replaced the well-worn 21-year old unit operated by the DGS for subsurface research. The CME-55 drill rig assigned to the University's Water Resources Center and operated by the DGS was transferred to a new truck in September. After service to the rig's power train and hydraulic system and some painting, the drilling equipment was returned to service in October. Provost R. Byron Pipes augmented the drill rig amortization fund to make replacement of the truck possible.

## Cartographic Corner

By W. S. Schenck

▪ The DGS has received all black and white orthophoto quadrangles of Delaware from the U.S. Geological Survey who produced them under a joint-funded program with the Soil Conservation Service. The DGS holdings are paper positives, film negatives, and film positives. The orthophoto quads, at a scale of 1:24,000, were made from NAPP 1989 photography. Diazo prints are available from the DGSCIC for \$1.75 per quad, and the negatives are available for reproduction by the user.

▪ Note that there is a newer NAD83 horizontal datum called NAD83(1991). In 1991 the National Geodetic Survey (NGS) in cooperation with the Delaware Department of Transportation established a high precision horizontal and vertical control network in Delaware. Because of the precision of the survey, the NAD83 Datum was able to be adjusted. Make sure as you work with cartographic materials and spatial data you know whether you are working in NAD27, NAD83 or NAD83(1991). Transformation programs are available for each of these datums from the NGS, and the NGS printouts of the horizontal control for Delaware have correction factors listed on them for conversions.

## Publications

### Recent DGS Publications

#### Reports of Investigations

No. 50 Plant Microfossils of the Calvert Formation of Delaware: J. J. Groot, 13 p.

#### Miscellaneous Map Series

No. 5 Map of Exposed and Buried Early Mesozoic Rift Basins/Synrift Rocks of the U.S. Middle Atlantic Continental Margin: R. N. Benson, scale 1:1,000,000, with discussion.

### Open File Reports

No. 36 Summary Report the Storm of January 4, 1992: K. W. Ramsey and J. H. Talley, 19 p.

### Information Series

No. 7 Delaware Geological Survey: T. E. Pickett

### Other Publications

Delaware Geological Survey List of Publications, July 1992: J. H. Talley and D. C. Windish (eds.), 16 p.

### Other Publications by DGS Staff

- A. Scott Andres, 1992, Nitrate Contamination of Ground and Surface Waters, Coastal Sussex County, Delaware, in *Proceedings of the Focus Conference on Eastern Regional Ground Water Issues*: National Ground Water Association, Ground Water Management, Book 13, p. 715-728.
- Richard N. Benson, 1992, Exploration for Oil and Gas in a Frontier Area: the United States Middle Atlantic Continental Margin, in Schroeder, D. A., and Anderson, R. C. (eds.), *Earth Interpreters: F. M. Fryxell, Geology, and Augustana*: Rock Island, Illinois, Augustana Library Publications No. 36, p. 185-199.

## Staff Notes

**Robert R. Jordan** received the 1992 Public Service Award of the American Institute of Professional Geologists at their annual meeting in Lake Tahoe, Nevada, September 28. The American Geological Institute awarded Jordan its Certificate in Appreciation of Outstanding Service at the annual meeting of the Geological

Society of America, Cincinnati, October 27.

**John H. Talley** was appointed to the New Castle County Water Resource Protection Area Technical Coordinating Committee by County Executive Dennis E. Greenhouse. Also, congratulations to John for completing 20 years with the DGS on December 16.

### Presentations

**A. Scott Andres**, "Nitrate Contamination of Ground and Surface Waters," at the Focus Conference on Eastern Regional Ground Water Issues, National Ground Water Association, Newton, MA, October 14; "Estimate of Nitrate Flux to Rehoboth and Indian River Bays, Delaware, through the Direct Discharge of Ground Water," at University of Delaware Department of Plant and Soil Sciences, October 20, and Inland Bays Estuary Program public workshop, Lewes, October 23.

**Richard N. Benson**, "Mesozoic Rift Basins of the U. S. Middle Atlantic Continental Margin," at the third Symposium on Studies Related to Continental Margins, The University of Texas at Austin, November 17.

**Roland E. Bounds**, "A Visit to the Elmwood-Gordonsville Mine of Smith County, Tennessee," at the Mineralogical Society of Pennsylvania annual rock and gem show, Quarryville, October 18, and the Delaware Valley Lapidary and Mineral Society monthly meeting, Springfield, PA, November 24.

**Robert R. Jordan**, "Earthquakes," at the New Castle County Detention Center, July 21; "Notes on the Geology of

Delaware," Delaware Academy of Science at the Iron Hill Museum, Newark, September 9.

**Thomas E. Pickett**, "The Flowering of Geologic Art in W. P. Blake's 1858 Report of Geological Reconnaissance in California," at the annual meeting of the Geological Society of America, Cincinnati, October 27.

**Kelvin W. Ramsey**, "Discovery by Accident: the Smyrna Fossil Site," to the Delaware Mineralogical Society, October 12.

**John H. Talley**, "The Delaware Geological Survey and Hydrologic Research in Delaware," to the Friends of Agriculture, Dover, September 25.

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Robert R. Jordan  
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