First State Geology

RESEARCH DELAWARE GEOLOGICAL SURVEY SERVICE EXPLORATION

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

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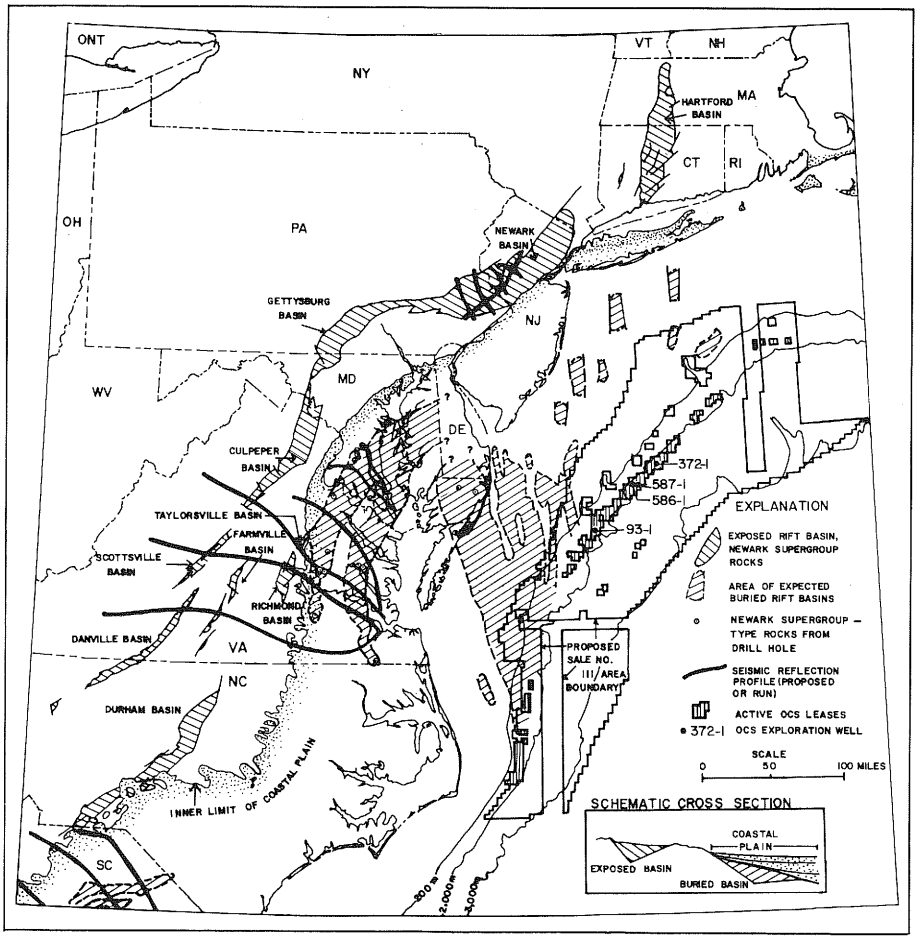
East Coast Oil Exploration Activities

Richard N. Benson

Although interest in offshore exploration for oil and gas is generally in a temporary decline, there is a modest increase in interest in onshore areas of the east coast of the United States. The major focus of attention is on rift basins that formed prior to continental breakup and subsequent separation and drifting of the continent of North America away from Europe and Africa.

On the accompanying map the exposed rift basins, those not covered by sediments of the Atlantic Coastal Plain, are named. They contain rocks belonging to the Newark Supergroup (after Newark, N.J.), all of which are of nonmarine origin. Each basin contains dark-colored shales rich in organic matter that were deposited originally as muds in large lakes. Modern analogs of the lakes are found in the rift valleys of eastern Africa. Geochemical studies of the shales indicate that many of them can be classified as source beds for petroleum, thus the interest in exploring the rift basins for deposits of oil and gas.

Rift basins also exist buried beneath the sedimentary rocks of the Atlantic Coastal Plain and adjacent continental shelf. Areas where several may be present are indicated on the map. Evidence for their existence is provided by drill hole data from the Coastal Plain and seismic reflection profiles offshore. Geologists interpreting samples from beneath the Coastal Plain recognized rocks similar to those of the Newark Supergroup. On the offshore seismic profiles, several buried rift basins have been identified beneath the sedimentary cover that extends seaward from the Coastal Plain. The buried rift basins are probably analogous to the exposed basins and should likewise contain source beds for petroleum. If so, they are also targets for oil and gas exploration.



Onshore exploration. This summary of onshore exploration activity is by no means exhaustive. Sources of information are from trade journals, newsletters of professional organizations, and State officials. The intent is to inform readers of *First State Geology* of activities nearby and to suggest that in the future there may be enquiries in Delaware regarding leasing of mineral rights. Perhaps there may be requests to conduct such exploration activities as seismic reflection profiling, particularly if there is a buried rift basin beneath the Delaware Coastal Plain.

In recent years there has been drilling activity in the exposed rift basins of North Carolina and Virginia. None of the drill holes has produced commercial quantities of oil, but one hole drilled in Virginia as part of a coal degasification study surprised the operator when 43 gravity (light) oil flowed to the surface.

To the north there has been leasing activity in the Newark Basin in both Pennsylvania and New Jersey. Seismic reflection profiles are planned or have been run across the basin (see map) and at one time one or more drill holes were planned, but at this writing none is scheduled. In the Hartford Basin of Connecticut and Massachusetts some leasing activity has been reported, but as yet there have been no seismic

profiles run nor exploratory holes drilled.

The most recent activity has taken place in the Coastal Plain of Virginia and Maryland where several seismic reflection profiles have been run over areas where buried rift basins are indicated (see map). A line is currently (January 1985) being run along Maryland routes 2 and 4 in Calvert and Anne Arundel counties. Last year many landowners were surprised when a landman reportedly paid $10 per acre for mineral rights on 10,000 acres in the buried Taylorsville Basin of Virginia and Maryland. Future seismic profiling is planned over buried rift basins in South Carolina and Georgia.

In the offshore region, on a recently published DGS map showing the configuration of the pre-Mesozoic basement of the landward margin of the Baltimore Canyon trough, several buried rift basins are indicated (see map). One or more of these may extend landward through Delmarva where three drill holes encountered rocks similar to those of the Newark supergroup that are buried beneath the sedimentary rocks of the Coastal Plain. If a buried basin extends into Delaware, future exploration activity including leasing for mineral rights is a possibility. The buried rift basins offshore would also bring OCS exploration closer to shore.

Public opinion in some eastern states is opposed to offshore oil and gas exploration within 50 miles of the shoreline. Also, some states have no rules for oil and gas operations within their boundaries onshore. Delaware's oil and gas regulations have been in existence since 1971, but they are in need of revision. In time, as the current oil glut recedes and the price of oil rises, exploration of both the exposed and buried rift basins may accelerate, and Delaware may be included in these activities.

Offshore update. Shell Offshore, Inc. has completed its exploratory drilling program in the Mid-Atlantic OCS. Four wells were drilled (see map) in the deep waters of the continental slope and all were reported as dry holes. The third well, 372-1, set a new world water-depth record of 6,952 feet. It was plugged and abandoned on July 9, 1984 after reaching a total depth of 11,631 feet. The fourth well, 93-1, was drilled in a water depth of 5,017 feet and was plugged and abandoned on November 4, 1984 at a total depth of 17,740 feet. No other drilling activity has been announced by Shell or other holders of active leases in the Mid-Atlantic OCS.

The next proposed offering of Mid-Atlantic acreage by the U.S. Minerals Management Service (MMS) is OCS Sale No. 111 scheduled for October 1985. The Draft Environmental Impact Statement (DEIS) was issued November 1984. The area of the proposed offering is shown on the accompanying map. It includes 3,566 offshore blocks (20.3 million acres) located from 25 to 140 miles offshore the Mid-Atlantic States. Areas excluded from the proposed sale are around the heads of submarine canyons and along the transit lanes for submarines. Public hearings on the DEIS were held in December 1984. All oral and written comments received by MMS will be evaluated and any revisions incorporated into the Final Environmental Impact Statement to be published in May 1985. If the Secretary of Interior decides to proceed with the sale, a proposed Notice of Sale will be issued in June 1985, indicating the blocks proposed for leasing, the stipulations to be made a part of the leases, bidding systems proposed to be used, and any information to lessees deemed necessary for potential bidders. Governors of affected States (including Delaware) will be notified directly and are allowed up to 60 days to comment on the proposed lease sale. The Secretary is required to consider the Governor's comments regarding the size, timing, and location of the sale and accept those recommendations that he determines provide for a reasonable balance between the national interest and the well-being of the citizens of the affected State. At least 30 days prior to the scheduled sale a final Notice of Sale will be published in the *Federal Register*. A copy of the DEIS is available for inspection at the DGS offices in Penny Hall.

Delaware Seismic Recording Network Expanded

Two new seismic recording stations are being added to the Survey's seismic network as a result of a recent appropriation by the Delaware General Assembly. They will be located north and east of Wilmington.

The new stations will enable Survey geologists to more accurately fix the locations and depths of earthquakes occurring in northern Delaware. The Wilmington area has experienced approximately half a dozen earthquakes in the past year, four of which were strong enough to have been felt by area residents. These events were described in previous issues of *First State Geology*. Until now, because there has been only one station, NED, located near Wilmington, it has been difficult to determine the epicenters of small earthquakes in the area.

The field sensors, or geophones, at each station will measure the vertical movement of the ground during an earthquake and transmit this information by a varying frequency tone through telephone lines to the Survey's offices at the University of Delaware. There the tone will be decoded and the resultant voltage fluctuations recorded. With the addition of the new instruments there will be five stations in the DGS network. The first station, NED, was established near Newark in 1972, followed by ones located near Georgetown and in Blackbird State Forest.

Monitoring five recording stations involves considerable time and effort by the DGS staff, but the daily record changing, general maintenance, and checking of instrument settings and calibration factors are necessary for proper evaluation of data. According to Ken Woodruff, Associate Director of the Survey, who manages the network, the new stations will greatly increase the Survey's ability to quantify the characteristics of local earthquakes and to gather data that might help in determining the mechanisms responsible for earthquakes in the eastern United States. The DGS is a member of the Northeast Seismic Network which was formed about ten years ago for the purpose of exchanging data and pooling resources to study earthquakes in the northeastern United States.

The occurrence of earthquakes in the Wilmington and nearby areas can be documented at least as far back as 1737 according to an 1874 publication of the Historical Society of Philadelphia. In DGS Open File Report No. 4, R. R. Jordan and others list earthquake events through May 1974. Events of the last ten years are described in recently published DGS Report of Investigations No. 39 entitled "Earthquakes in Delaware and Nearby Areas, June 1973-June 1984" by K. D. Woodruff. The Report also describes the DGS seismic network and the methods of determining such earthquake parameters as epicenter, magnitude, and intensity. Copies of the two publications may be obtained from the Survey offices in Penny Hall.

Delaware Geological Survey Cartographic Information Center

William S. Schenck, Coordinator

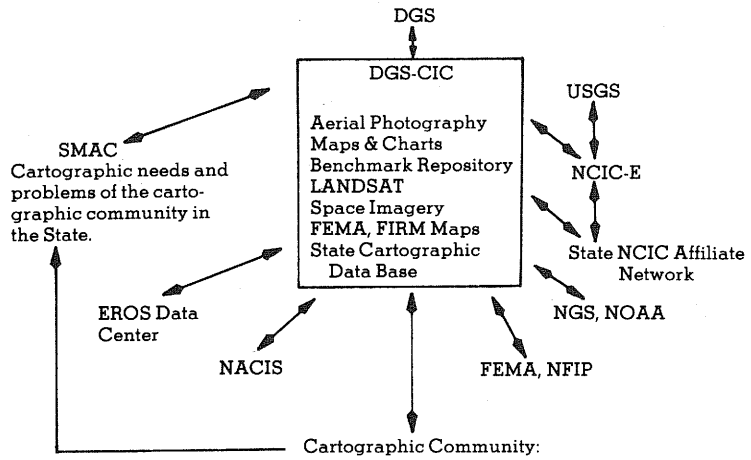
Do you have aerial photography showing the Hoopes Reservoir area before the dam was built? Where does one find all the aerial photography of a landfill site at a scale less than 1:400? How does one obtain a map covering the area of Taylor, Arizona? Where can I find a map of Cape Henlopen before 1870? Where is the nearest federal vertical benchmark to Shaft-Ox Corner, Delaware? These are examples of questions asked of the Delaware Geological Survey's Cartographic Information Center (DGS-CIC). The organization and interactions of the Center are shown on the accompanying chart.

The Center has made the DGS a focal point for questions concerning the location of all types of aerial photography, thematic maps, planimetric maps, topographic maps, historic maps, LANDSAT imagery, space imagery, side looking aerial radar (SLAR), and geodetic control for the State of Delaware. In addition, through the Center's affiliation with the U. S. Geological Survey's National Cartographic Information Center (NCIC) in Reston, Virginia, we can locate all cartographic materials covering the United States that were produced by federal agencies.

A data acquisition phase is underway in an effort to increase the DGS-CIC awareness of cartographic information and materials available within the State. We are conducting inventories of cartographic materials held by State, county, and local agencies. Each item is classified and recorded with pertinent descriptive identifiers such as map, aerial photo or report, county, producing agency, date, scale, title, area of coverage, levels of information shown, overall size, price, holding agency, contact person's address and phone number. This information is entered into the DGS-CIC computer data base and is searchable by any of the descriptive fields listed above. Once complete, the combination of this DGS-CIC data base with the NCIC listings will allow us to locate all cartographic information on the State and federal level.

The cartographic community of Delaware is quite large, and needs vary from non-technical to very technical. This group includes planners, researchers, engineers, realtors, representatives from industry, ecologists, developers, surveyors, regulators, inspectors, lawyers, bankers, transportation officials and the general public. Continuous updating of the cartographic data base takes place through interactions with the cartographic community at State Mapping Advisory Committee (SMAC) meetings when the mapping needs of the State are discussed and given priority. We hope that the DGS-CIC will act as the catalyst to draw more of the cartographic community to these meetings. To this end the Center is sponsoring a Mapping Conference at the University of Delaware Student Center on March 19. The 1985 SMAC meeting will be part of the Conference. If interested in attending or if you have an enquiry regarding cartographic information call W. S. Schenck at 302-451-8262.

ORGANIZATION AND INTERACTIONS OF THE DGS-CIC



Explanation

DGS	— Delaware Geological Survey	EROS	— Earth Resources Observation Systems
DGS-CIC	— Delaware Geological Survey-Cartographic Information Center	FEMA	— Federal Emergency Management Agency
USGS	— U. S. Geological Survey	FIRM	— Flood Insurance Rate Map
SMAC	— State Mapping Advisory Committee	NFIP	— National Flood Insurance Program
NCIC-E	— National Cartographic Information Center East	NGS	— National Geodetic Survey
NACIS	— North American Cartographic Information Society	NOAA	— National Oceanic and Atmospheric Administration

Hydrogeologic Research Projects

Eastern Sussex County. The DGS has initiated a hydrogeologic mapping program in eastern Sussex County. The work, to be conducted by John H. Talley and A. Scott Andres, will focus on aquifer mapping, water availability, water quality, and on defining environmentally sensitive areas. The products of this investigation will include a comprehensive basic data report and several hydrologic maps. The hydrologic maps will be similar in format and content to DGS Hydrologic Map Series Nos. 1-4 which cover the Dover, Newark, Wilmington, and Milford areas, respectively.

Also in eastern Sussex County, the DGS with the U. S. Geological Survey, under the Joint-Funded Program, has initiated a project to investigate the distribution and movement of chemical constituents in the shallow water-table aquifer system under different land uses. Particular emphasis will be placed on the occurrence and distribution of iron and nitrate, chemical constituents which affect the potability of ground water in Sussex County. The research, to be conducted by Judith M. Denver, will culminate in a

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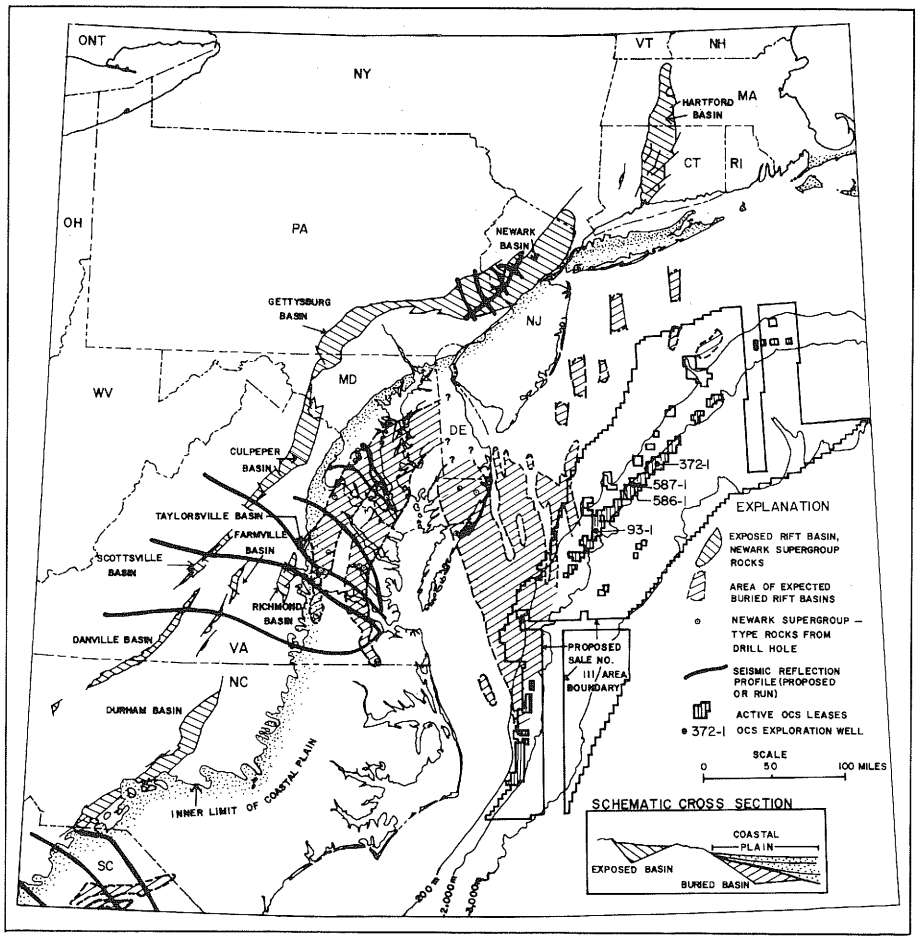

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