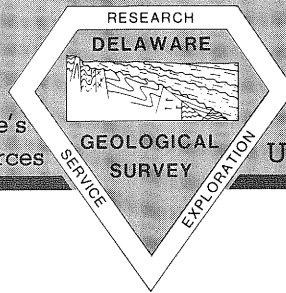


First State Geology

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



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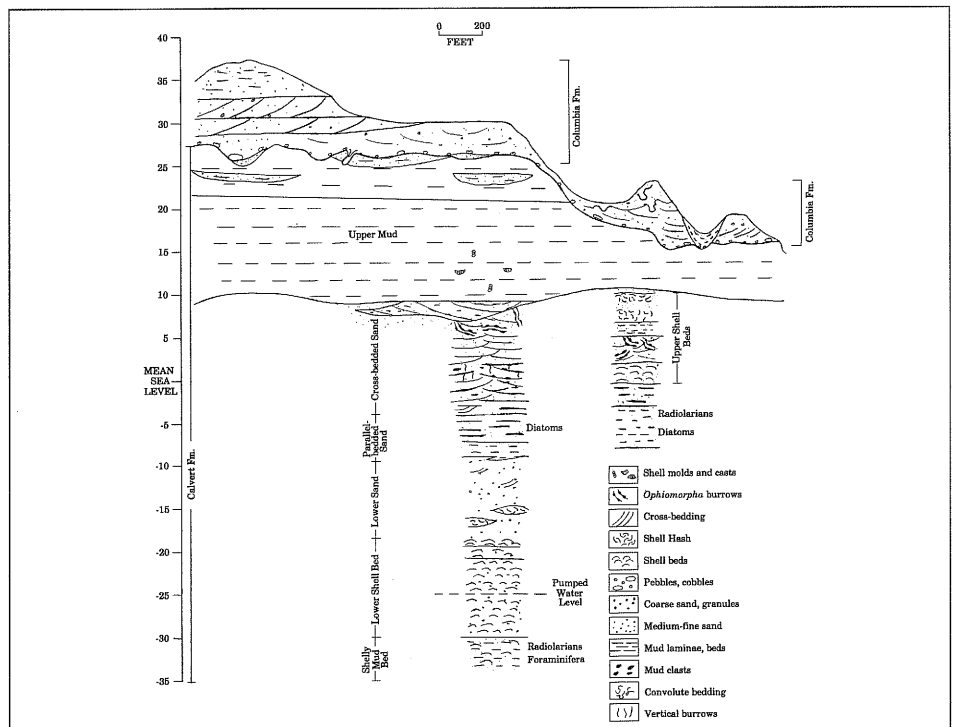
Update on Miocene Fossil Locality

By Kelvin W. Ramsey

The discovery of Miocene fossils from the Cheswold aquifer sands of the Calvert Formation along the Smyrna bypass segment of the new State Route 1 has attracted the attention of geologists working in the eastern United States. The fossils, including shells of clams and oysters, bones of both land and marine mammals, and bones and teeth of fish and sharks, represent a significant find from these deposits, determined to be between 17.5 and 18 million years old on the basis of radiolarians that identify the *Stichocorys wolfii* Zone.

Geologists and paleontologists from the Delaware Geological Survey, the Smithsonian Institution, the Virginia Museum of Natural History, Smith College, and Vanderbilt University have been studying the geology of the site and the fossils found there in order to determine the paleoenvironment during this part of early Miocene time. The site is significant in the variety of mollusks found, as well as in the presence of scattered bones and teeth of primitive horses, rhinoceroses, chalicotheres (a horse-like animal with claws), land tortoises, large rodents, and birds. The bones and teeth of the land vertebrates represent the most significant find of vertebrates of early Miocene age in the eastern United States north of Florida.

The excavation of these fossils has been made possible by the construction of a wetlands mitigation site, DGS outcrop locality Id11-a, adjacent to the Route 1 right-of-way. Excellent cooperation with the Delaware Department of Transportation and contractors Century Engineering, PKF Mark III, and Pierson Construction has allowed the geologists and paleontologists to collect fossils and study the geology of the site. The DGS is also working with area teachers and educators in developing teaching materials that make use of the



Composite stratigraphic section at Id11-a near Smyrna.

fossils. The investigation is adding to our knowledge of the Cheswold aquifer, a major source of water in central Delaware, as well as to an understanding of the local movement of water from the surface to the subsurface.

The DGS is planning a publication with the cooperating geologists and paleontologists on the geology and fossils of the site. Some of the fossils are currently on display at the Delaware Geological Survey Building, and a large permanent display of the fossils is being planned.

Three truckloads of shelly sand from the site were delivered by the Division of Highways to the University Farm. Because the construction site will be covered over it is important to obtain a very large contingency sample.

Ages of Offshore and Surficial On-shore Sediments of the Mid-Atlantic Region

By Johan J. Groot, Richard N. Benson, and John F. Wehmiller

A recently completed study of plant microfossils (pollen and spores) from a 300-m-thick Quaternary sedimentary section cored on the upper continental slope off New Jersey (U. S. Geological Survey AMCOR hole 6021C) made it possible to distinguish alternating cold and temperate periods during the past half-million years that correspond to marine oxygen isotope stages 1 through 14. Data in support of this

determination were provided by study of foraminifers and by amino acid racemization analyses of mollusk shells from the cores. The results of this study have been applied to the determination of the ages of other offshore and onshore deposits.

The investigation of the stratigraphic distribution of *Quercus* (oak) pollen species in AMCOR 6021C led to the establishment of the approximate ages of some surficial deposits in Delaware that are devoid of fossils except pollen and spores. The large body of sand and gravel of the Columbia Formation, an important source of ground water as well as construction materials and sand for beach nourishment, was deposited during a period (or periods?) of cool-temperate climate, probably by melt-water streams from continental glaciers. It contains pollen of an oak species that is characteristic of oxygen isotope stages 11 or 13, and perhaps older, indicating an age of 400,000 years or older.

Sediments adjacent to Delaware Bay and the Nanticoke River, and deposits of the upper part of the Omar Formation in Sussex County range in age from oxygen isotope stage 5 to stage 15, or from about 100,000 to 500,000 years. Most of these sediments are of estuarine origin.

The study was supported in part by the Minerals Management Service, U. S. Department of the Interior, under the MMS Cooperative Agreement with the Association of American State Geologists for Year-7 studies of the Continental Margins Program. The report will be submitted to a scientific journal for publication.

Vegetation, Climate, and Sea-Level Fluctuations in Delaware during the Late Oligocene and Early and Middle Miocene

By Johan J. Groot

The Calvert Formation, deposited in a shallow sea during the late Oligocene and early to middle Miocene (15-27 million years ago), contains a very rich fossil microflora, both in terms of number of specimens and number of species. Most abundant are pollen of oak, pine, and hickory, but exotic taxa (those that no longer occur in Delaware) are present in all samples of this formation. They include pollen of *Engelhardia* type, *Manilkara*, *Planera* (water elm), *Alangium*(?), and palms. All of these exotics are genera of subtropical or tropical regions, some occurring now in Central

America, Florida, and east Asia. The climate during the deposition of the Calvert Formation was probably subtropical and moist.

During periods of high sea level there was very little coastal plain area and, therefore, little room for swamps. During a regression, however, larger coastal plain wetlands came into being, and that this happened is indicated by few marine dinoflagellates and a relatively high percentage of pollen of taxa that occur in and around swamps. On the other hand, samples with high frequencies of dinoflagellates and low percentages of moisture-loving taxa suggest a high sea level. Periods of relatively low sea level occurred both in the early Miocene and the late middle Miocene; high sea levels were noted in the late Oligocene and early middle Miocene. These results correlate with determinations of relative sea level fluctuations based on studies of foraminifers from Dover Air Force Base test well Je32-04 (DGS Bulletin No. 17).

Radon Study

By John H. Talley

The DGS has recently completed a reconnaissance study to determine the radon-generating potential of glauconitic sediments (greensands) in Delaware. The goals of this investigation, conducted in cooperation with the Division of Public Health's Health Systems Protection Radiation Control Section, were to determine (1) if uranium concentrations are elevated in areas underlain by glauconitic sediments, and (2) if there is any correlation of subcrop location of glauconitic sediments to surface background gamma radiation and/or radon concentrations below the soil zone.

Preliminary results indicate that the highest concentrations of uranium coincide with the geologic interval encompassing the Cretaceous-Tertiary contact which occurs in the Hornerstown Formation. The elevated concentrations of uranium are associated with glauconitic sediments.

In addition, surface gamma radiation measurements can be correlated with areas underlain by glauconitic sediments. Non-glauconitic sandy sediments overlying glauconitic sediments do not appear to have an attenuating effect on surface gamma radiation readings.

Radon concentrations below the soil horizon indicate the presence of radon in the deeper subsurface. However, no statistically significant differences were found in readings between areas underlain by glauconitic sediments and those that are not.

Because of the limited number of analyses, any additional work should concentrate on treating elevated indoor radon readings as spatial data that could then be compared with underlying geology to determine if correlations exist. Additional subsurface radon data would be required in order to develop a statistically significant

data base that could be compared to underlying geology.

A Guide to the Geology of the Red Clay Creek Valley for Wilmington and Western Railroad

By William S. Schenck

The historic Red Clay Valley, Inc., in cooperation with the Delaware Geological Survey will prepare a guide to the geology along the Wilmington and Western Railroad line that follows the Red Clay Creek Valley in northern new Castle County from Route 62 in Marshallton to Valley Road in Hockessin. Margaret O. Plank, DGS volunteer geologist, and William S. Schenck will conduct the study.

The geology of the valley greatly influenced mills, water supply, mining, and land use during the 18th century. By the middle of the 19th century, burgeoning industries in the valley had become "transportation starved," and this created the initial interest that led to building the railroad in 1872.

The Red Clay Creek bisects the Delaware Piedmont and offers an excellent opportunity to observe rock exposures from the Coastal Plain up through the Piedmont to the Hockessin Valley. The guide, which will be included in a souvenir booklet, will enable train riders to learn about Delaware's complex geologic history in this area.

Cooperative Agreement on Offshore Sand Investigations

The Delaware Geological Survey has entered into an agreement between the Minerals Management Service (MMS) of the United States Department of the Interior and the Maryland Geological Survey for cooperative studies of offshore sand resources. The agreement indicates the intent to locate, study, and characterize offshore sand bodies in federal waters that may be used for beach nourishment or other uses.

The two state surveys subsequently submitted a joint proposal to the MMS for a study of these offshore sand bodies. The study will include sediment coring and seismic reflection surveys. The DGS will use the data to develop preliminary maps of offshore geology and distribution of sand bodies and to characterize the sand and determine its suitability for beach nourishment.

Minerals Management Service Opens Sample Repository with Delaware Geological Survey

The Delaware Geological Survey (DGS) and the Department of the Interior's Minerals Management Service (MMS) have signed a Memorandum of Understanding (MOU) to establish an Atlantic Outer Continental Shelf (OCS) core and well sample repository. "This agreement will give MMS the opportunity to display well cores and cuttings samples from 51 Atlantic wells," said MMS director S. Scott Sewell.

Robert R. Jordan said the DGS will administer a centralized sample repository at the University of Delaware campus in Newark. This facility will be known as the Atlantic OCS Core and Sample Repository at the Delaware Geological Survey Core and Sample Library.

"By transferring the Atlantic OCS Region's core and well samples to the Delaware Geological Survey's library, we can provide coastal scientific communities, industry, state and federal agencies, and the public with an accessible facility to analyze the samples," said Sewell.

MMS and the Delaware Geological Survey have defined responsibilities, functions, and stipulations for each party in the MOU. MMS anticipates transferring the cores and samples to Delaware and having them ready for public viewing by fall of this year.

Field Work Stage for Delaware/USGS Topographic Joint-Funded Agreement Now Complete

The U. S. Geological Survey (USGS) field crews have completed their task in Delaware. All of the remaining work will take place within the USGS Midcontinent Mapping Center in Rolla, Missouri. The field work is actually the third step in the USGS topographic mapping process that follows planning and aerial photography. Computation/mensuration, photogrammetry, photoimagery, cartometrics, printing, and distribution are the remaining steps. Most of the Georgetown Project, (essentially Sussex County) is in the cartometrics stage at this time with the Wilmington (essentially New Castle County) close behind. New topographic maps will appear in 1993 as newly revised quads progress to the printing and distribution stages of this 4-year cycle.

Funding for FY 93 will enable completion of the publication of the new maps. The funds will also be used to begin the capture of digital data layers of the maps for use in geographic information systems (GIS).

Hydrology News

By A. Scott Andres and John H. Talley

Results of Ground-Water and Nitrate Discharge to Rehoboth and Indian River Bays Study Published

DGS Open File Report No. 35, "Estimate of Nitrate Flux to Rehoboth and Indian River Bays, Delaware, Through Direct Discharge of Ground Water," by A. Scott Andres, reports the results of a year-long ground-water modeling study. The study found that the potential ground-water-borne nitrate-nitrogen flux is in the range of 480 to 1200 kilograms per day (1056 to 2640 pounds per day). This amount of nitrogen is greater than the total of surface discharges by all of the wastewater treatment plants in the area. Total ground-water discharge was estimated to be in the range of 20.7 to 39.2 million gallons per day.

This project was funded by the Inland Bays Estuary Program (IBEP). The Delaware Geological Survey continues to serve on the IBEP Scientific and Technical Advisory Committee. Project results will be used in the formulation of the IBEP's Comprehensive Conservation and Management Plan.

Ground-Water Recharge Mapping

The Ground-Water Recharge Mapping Program is in its second full year. The current mapping areas are those covered by the Seaford East, Seaford West, and Dover 7.5-minute topographic maps. Ground-water recharge mapping is a process by which land areas are characterized and defined by their abilities to transmit water into the shallow Columbia aquifer. The project provides important information on the geology and water resources of the state.

The program is funded by the Department of Natural Resources and Environmental Control. Persons interested in the program should contact A. Scott Andres at the Survey offices.

Water Conditions, October 1, 1991 - April 30, 1992

Overall water conditions for the period October 1, 1991, through April 30, 1992, have generally been below normal across Delaware. Precipitation during the seven-month period ranged from 7.36 in below normal at New Castle to 3.25 in below normal at Greenwood.

Water levels in shallow water-table observation wells have generally been below normal for the entire seven-month period in New Castle County and below normal since January in Kent and Sussex counties. Record low levels were recorded

in three wells during February. Below-normal water levels are attributed to below-normal precipitation and associated lack of seasonal ground-water recharge that generally occurs during late fall, winter, and early spring.

Below-normal streamflows were recorded on several rivers and streams in October, November, January, February, March, and April, especially in Kent and New Castle counties. Surface water from Brandywine, Red Clay and White Clay creeks, and the Christina River are used for water supply in northern New Castle County.

Present water conditions were the subject of a meeting of the Christina River Basin Drought Management Committee on May 7. The committee was formed several years ago to provide for regional evaluation (New Castle County, Delaware, and Chester and Delaware counties, Pennsylvania) of water supply conditions and to ensure cooperative management of surface and ground-water resources in the region. Members of the committee represent the Delaware Geological Survey, Delaware Department of Natural Resources and Environmental Control, the Water Resources Agency for New Castle County, the Pennsylvania Department of Environmental Resources, the Chester County Water Resources Authority, the Delaware River Basin Commission, and major public water suppliers including the cities of Wilmington, DE, and Coatesville and West Chester, PA, Artesian Water Company, and Wilmington Suburban Water Corporation.

Although water conditions have been below normal for several months, the committee concluded that specific action is not required at this time. Nevertheless, because the high water-demand season is approaching, precipitation, ground-water levels and streamflow data collection will be enhanced and overall conditions carefully monitored during the next several months. Appropriate recommendations will be made to ensure adequate water supplies if conditions deteriorate.

DGS Hydrologic Map Series No. 8

Kenneth D. Woodruff, recently retired from the DGS, has completed a hydrogeologic map entitled "Geohydrology of the Middletown-Odessa Area, Sheet 1, Basic Geology and Hydrology." The map summarizes the subsurface geology and the depths and locations of water-bearing formations from north of Middletown to south of Townsend. A hydrogeologic cross section of the map area portrays the vertical and horizontal distribution of formations and aquifers. An 860-ft gamma-ray geophysical log from a well in Middletown is correlated with geologic formations.

The map is part of the Survey's continuing hydrologic mapping program. Information contained on the map will be useful to citizens, planners, managers, consultants, municipal officials, and others concerned with the development and management of the area's ground-water resources.

Cartographic Corner

By W. S. Schenck

▪ The DGSCIC has received new CD-ROMs from the National Geophysical Data Center that contain information on the Ocean Drilling Program (ODP). The disks were produced and distributed in cooperation with and support from the National Science Foundation/Joint Oceanographic Institutions, Inc. The data were collected and compiled by the ODP, operated by Texas A&M University. The disks are an extension of the Deep Sea Drilling Project (DSDP) information released in 1989. Disk 1a contains sediment, hardrock, and underway geophysical data from legs 101-129. Disk 1b contains Gamma Ray Attenuation Porosity Evaluator (G.R.A.P.E.) data for legs 101-129.

▪ The DGSCIC has updated the BENCHMARK data base for Delaware. With the USGS topographic mapping field work completed for the state, the DGSCIC has been able to obtain recovery status for all of the vertical benchmarks. These recovery notes have been added to the system, bringing the system up-to-date for the first time since its creation in 1983.

Publications

Recent DGS Publications

Open File Reports

No. 35 Estimate of Nitrate Flux to Rehoboth and Indian River Bays, Delaware, Through Direct Discharge of Ground Water: A. Scott Andres, 1992 (in press).

Hydrologic Map Series

No. 8 Geohydrology of the Middletown-

Odessa Area, Sheet 1, Basic Geology and Hydrology: K. D. Woodruff, 1991, Scale 1:24,000.

Atlas Series

Wilmington North Quadrangle (WIN) Atlas Series: N. Spoljaric, editor, 13 p.

Staff Notes

Congratulations to **A. Scott Andres** who was promoted to Scientist, **Kelvin W. Ramsey** and **William S. Schenck** who were promoted to Associate Scientists, and **John H. Talley** who was promoted to Associate Director for Hydrogeology and Geophysics.

Johan J. Groot has retired but continues his palynological studies with the Survey. He is a Professor Emeritus at the University of Delaware.

Congratulations to **Thomas E. Pickett** who received a University of Delaware Service Award on May 14 for completion of 25 years at the Delaware Geological Survey.

Robert R. Jordan was appointed for a two-year term to the National Research Council's Committee to Assess the Adequacy of Environmental Information for Alaskan Outer Continental Shelf Oil and Gas Leasing Decisions. Another recent appointment is for a one-year term as chairman of the Finance Committee of the American Geological Institute. Jordan was elected for a two-year term as chairman of the Outer Continental Shelf Policy Committee of the U. S. Department of Interior at the committee's meeting in Houston on April 16.

Presentations

Robert R. Jordan, "Delaware's Ground Water: a Resource Worth Protecting," at the Second Annual Pesticide Conference, January 21, University of Delaware; "Delaware Geology: Resources and Hazards," to the Brandywine Rotary Club, January 30, Brandywine Hundred.

Kelvin W. Ramsey, Richard N. Benson, A. Scott Andres, Thomas E. Pickett, and William S. Schenck, "A New Miocene Fossil Locality in Delaware," at the Northeastern Section Meeting of the Geological Society of America, March 28, Harrisburg, PA.

John H. Talley, "Unconfined Aquifers, Confining Beds, and Confined Aquifers," at Delaware Water Well Association Seminar, May 8, Milford, DE.

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.
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