SOUTHERN MARYLAND IN DEEP TIME

A Brief History of Our Geology
Part II: The Post-Breakup Sediment Wedge

By Peter R. Vogt

Guests, lusting after fossil shark teeth, often accompany me on beach walks. Every now and then someone asks "But what about dinosaur fossils?" "Below us," I reply, pointing straight down at the beach. "Just dig down six hundred feet or so to reach the top of sediments from the age of dinosaurs." "Of course," I add, "there is a much easier way — drive northwest." The blanket of post-dinosaur-age sediment, including the stuff in the Calvert Cliffs, thins gradually toward the northwest, until finally along the Potomac shore of Prince George's County you encounter sediments of "dinosaur age" exposed on the ground, that is to say, in shallow construction sites, road cuts, and in eroding bluffs along tidal rivers.

Dinosaurs branched off an extinct reptile family (Thecodonts) early in the Triassic period, but they had their greatest flowering during the following Jurassic and Cretaceous periods (see accompanying time scale). The dinosaur-aged sediments actually exposed on Maryland's land surface, however, cover only two portions of the Cretaceous, the time from 130 to 95 million years ago, represented by a package of largely non-marine, river and swamp deposits called the "Potomac Group," and a later time from about 86 to 70 million years ago, represented by mainly marine sediments from a time when the ocean shore reached inland close to Washington, D. C., and covered the area of present Annapolis. These ancient inner-shelf sediments are similar to those in the Calvert Cliffs in that the remains of marine animals (in the Cretaceous sediments, mosasaurs, plesiosaurs, crocodiles, and turtles, while in our Miocene cliffs, whales and porpoises, plus later species of crocodiles and turtles) are mixed in with occasional remains of land animals (in the Cretaceous case, dinosaurs, and in our Miocene cliffs, peccaries, ancestral elephant-like animals, and others). The Cretaceous sediments outcrop in a northeast-arching belt increasing from a few miles wide near Fredericksburg, to twenty miles wide in northern Anne Arundel County, and petering out again northeast toward Wilmington, Delaware. (CMM members interested in collecting in these sediments and in learning more about Maryland's dinosaurs should read Dinosaurs in Maryland, by Peter M. Kranz, Educational Series No. 6 of the Maryland Geological Survey, published in 1989.)

Wet beach sand is a great "blackboard," so I like to draw with a sharp stick a deep slice through Southern Maryland from southeast to northwest. The section starts out in the Atlantic beyond Ocean City, continues across the Chesapeake, and west to the Appalachians. (See illustration on page 6.) A conspicuous feature of this section of our area is the sediments that have accumulated in the Atlantic and west to the Fall Line (the eastern edge of the exposed and much older rocks of the Piedmont) since the time the African and North American continents parted company ("broke up") about 180 million years ago during the early Jurassic period (more about plate tectonics in a later installment). Southern Maryland and the Eastern Shore simply form the cap of this enormous sediment mass stretched out along the edge of North America around the Gulf Coast, along the eastern seaboard, and along the Canadian margin. This great sediment apron is basically just debris washed off our continent over the ages, and organic limestones such as the living coral reefs off Florida. The inhabited dry lands along the inboard edge of the sediment mass, plus all the submerged shallow lands out to the edge of the continental shelf about seventy-five miles east of Ocean City, is called the Atlantic Coastal Plain.

The sediments below Southern Maryland represent a very fragmentary record of 180 million years of warfare between the Atlantic Ocean and North America. There are probably no

(Continued on Page 6)
**TENNISON CRUISES RESUME ON MAY 1**

Members and visitors can enjoy another summer of cruises on the museum’s 1899 buyboat Wm. B. Tennison, beginning the season on Friday, May 1, and continuing through October. The schedule will be the same as that of 1997: daily hour-long cruises of the Solomons harbor and lower Patuxent River will depart from the Drum Point Lighthouse, Wednesday through Sunday, at 2:00 p.m., with extra cruises on weekends during July and August at 12:30 p.m. — all weather permitting. Boarding for scheduled cruises will be on a first-come, first-served basis, with no minimum number of passengers, but a maximum of forty-five. For more information about regular cruises, call CMM on 410-326-2042, or to inquire about chartering the Tennison, call 410-326-8217.

**MARINERS’ GUILD WORKSHOP IN JULY**

The Calvert Marine Museum presents a new educational program for young people between the ages of 12 and 17. This two-week long workshop will be held July 6 through 17 at the museum from 3:00 to 4:30 p.m. each day during the week. The program will give participants the opportunity to experience the local waterways and blue-water voyages in the tradition of true mariners. They will learn about safety and navigation on inshore waters, knotting, rope-work and line skills, local watercraft, dugout canoes, and weather through hands-on projects and world-famous ocean passages in the Atlantic, Pacific, and Antarctic oceans. Upon completion of this workshop, participants will be eligible to become youth volunteers in maritime-related work through the education department. There is a $10.00 fee; the deadline for registration is June 26. For a registration sheet or information, call Leslie Scher Brown at 410-326-2042.

**NEW STAFF AT CMM**

Mrs. Cassia F. Garcia joined the museum staff in March as business manager, replacing Ginny Allman who retired on January 30 after thirteen years of museum service. Cassie comes to CMM from eighteen years in private industry or private consulting. A graduate of Chaminade University in Honolulu and a certified public accountant, she is well qualified to take on the financial responsibilities of the business manager’s position. A native of Florida, Cassie and her family have resided in the St. Leonad area for the past four years. Her office will be in the Administration Building. (Staff and friends bid adieu to Ginny Allman at a reception in the museum’s Exhibition Building on January 30.)

Although he will not report until July, the new curator of paleontology has been chosen. He is Dr. Stephen Godfrey who comes to CMM from Edmonton, Canada, where he has worked in several paleontology-related museum positions or as a private consultant, with particular success in recent years in planning exhibits and in educational training programs. A native of Quebec, his education includes Bishop’s University in Lennoxville, Quebec, and McGill University in Montreal, where he earned his doctorate in paleontology. Dr. Godfrey also served as a postdoctoral fellow at the University of Toronto. He replaces Dr. Mike Gottfried who left CMM last July for Michigan State University.

**IN MEMORY OF FORMER BOARD CHAIRMAN ALBERT C. GROSVENOR**

Albert C. Grosvenor, who chaired the Calvert Marine Museum’s Board of Governors in 1982, died on February 4. Mr. Grosvenor, a retired electronics scientist for the Naval Research Laboratory, was a long-time resident of Calvert County, with a historic home located at the mouth of Hellen Creek. He was active in many county organizations. In the 1970s he was on the board of the Calvert County Historical Society, and was president of the society in 1976-78. In that capacity he also attended meetings of the historical society’s museum committee, serving on that committee in 1979 at the time the historical society turned over management of the museum to Calvert County. He was appointed to the first museum board in 1979 and served through 1982, the year in which he was board chairman. Mr. Grosvenor and his wife Barbara are life members of the museum and have been active in museum affairs. The museum board and staff extend condolences to the Grosvenor family.
OF SPECIAL INTEREST TO MEMBERS...

SOCIETY SNAPSHOT


TAKING MEMBERSHIP A LEVEL HIGHER are members who upgraded recently: Mr. & Mrs. Joe Arendes; David & Jean Alscher; Robert & Bonnie Anderson; Tom & Linda Arnold; Stuart & Brenda Belfield; Dr. David Brownlee & Family; Mr. & Mrs. Ronald Cooley; H. Vernon Davis; Norman & Rosemary Dawson; Gary & Tina Dennis; Shirley Dixon; Mr. & Mrs. Charles L.B. Dougherty; Mr. & Mrs. Maurice Dunkle; Marcia Early; Mike & Kathy Ellwood; Mr. & Mrs. Willard Entwistle; Peggy Estes & Andrea Rea; Pat & Celeste Furey; Mr. & Mrs. F.R. Graninger; Ms. Mary Gott; Elizabeth Gunn; Sue Hamilton; Darryl & Ruth Hansen; Dr. R.M. Harris & Ms. Anne Whitaker; Bruce & Donna Henry; Mr. & Mrs. Robert Hoffman; Michael & Rebecca Ironmonger; Dr. & Mrs. Ronald Johnson; Dorothy Joy; Capt. James Keen; Alan & Lucille Keeny; Richard Kendall & Stephanie Kuhn; Dr. & Mrs. Anderson; Tom & Linda Arnold; Stuart & Brenda Belfield; Dr. David Brownlee & Family; Mr. & Mrs. Ronald Cooley; H. Vernon Davis; Norman & Rosemary Dawson; Gary & Tina Dennis; Shirley Dixon; Mr. & Mrs. Charles L.B. Dougherty; Mr. & Mrs. Maurice Dunkle; Marcia Early; Mike & Kathy Ellwood; Mr. & Mrs. Willard Entwistle; Peggy Estes & Andrea Rea; Pat & Celeste Furey; Mr. & Mrs. F.R. Graninger; Ms. Mary Gott; Elizabeth Gunn; Sue Hamilton; Darryl & Ruth Hansen; Dr. R.M. Harris & Ms. Anne Whitaker; Bruce & Donna Henry; Mr. & Mrs. Robert Hoffman; Michael & Rebecca Ironmonger; Dr. & Mrs. Ronald Johnson; Dorothy Joy; Capt. James Keen; Alan & Lucille Keeny; Richard Kendall & Stephanie Kuhn; Mr. & Mrs. Robert Kennedy; Ash & Diane Kesler; Mr. & Mrs. Thaddeus Kraemer; Mr. & Mrs. Warren Kunz; H. Kirke Lathrop; Don Leseman; Mr. & Mrs. Harold Liddle; Mr. & Mrs. Ron Majewicz; The Milczarz Family; Fred & Shirley Morton; Dianne Nestor & John Jones; George & Edna Nevin; Robert & Donna O'Brien; Al Peters; Robert Pfeiffer & Shirley Mihursky; Margaret H. Phipps; Bill & Patricia Pufenbarger; Mr. & Mrs. Herman Popka; Mr. & Mrs. Henry Price; Dr. & Mrs. William Randolph; Ken & Sue Ratterree; C. Michele Rockhill; Bud & Barbara Schantz; Eric Seifter; Ethel J. Smith; Charles & Barbara Stauffer; Joe Szymanski & Sandy Leitner; Russell Walker; Edward & Vivian Zumstein.

ANNUAL REPORT ADDENDUM

We regret that some of our friends were inadvertently omitted from the membership roster of the 1996-1997 Annual Report: Jim & Sue Bowers; Mr. & Mrs. Bruce Briggs; Mr. & Mrs. Robert Burch; Mr. & Mrs. Charles L.B. Dougherty; Mr. & Mrs. Michael Entwistle; Mr. & Mrs. D. Kissler; Mr. & Mrs. Ronald Johnson; Dorothy Joy; Capt. James Keen; Alan & Lucille Keeny; Richard Kendall & Stephanie Kuhn; Mr. & Mrs. Robert Kennedy; Ash & Diane Kesler; Mr. & Mrs. Thaddeus Kraemer; Mr. & Mrs. Warren Kunz; H. Kirke Lathrop; Don Leseman; Mr. & Mrs. Harold Liddle; Mr. & Mrs. Ron Majewicz; The Milczarz Family; Fred & Shirley Morton; Dianne Nestor & John Jones; George & Edna Nevin; Robert & Donna O'Brien; Al Peters; Robert Pfeiffer & Shirley Mihursky; Margaret H. Phipps; Bill & Patricia Pufenbarger; Mr. & Mrs. Herman Popka; Mr. & Mrs. Henry Price; Dr. & Mrs. William Randolph; Ken & Sue Ratterree; C. Michele Rockhill; Bud & Barbara Schantz; Eric Seifter; Ethel J. Smith; Charles & Barbara Stauffer; Joe Szymanski & Sandy Leitner; Russell Walker; Edward & Vivian Zumstein.

SET SAIL FOR BUGEYE BALL 1998!

The 1998 Bugeye Ball will be held Saturday, September 26. Don’t miss out on this unique annual gala. Your personal involvement as a benefactor, sponsor, patron, guest, or donor not only ensures you’ll have a wonderful time, but also makes you a partner in reaching over 65,000 visitors who each year are educated and entertained at CMM.

Since 1990, the Bugeye Ball has provided over $80,000 in support of special CMM projects including the Estuarium, Treasure from the Cliffs, Patuxent Small Craft Restoration Center, and Lighthouse Preservation Endowment.

Please consider placing your reservation early or pledging your sponsorship by returning the form below by May 1, 1998. Sponsorships and reservations are deductible at the rate of gift amount less $25 per reservation. Donations are 100% tax-deductible.

I’m setting sail for Bugeye Ball 1998!

Reservations / Donations:
Advance reservations at $75 each
Donation enclosed ($ )

Sponsorship Categories:
Benefactor $1,000 (4 complimentary reservations)
Sponsor $500 (2 complimentary reservations)
Patron $250 (1 complimentary reservation)

Name:
Address:
Phone:

To reply early, return this form by May 1, 1998. Please make your check payable to CMMS, P.O. Box 97, Solomons, MD 20688. Formal invitations will be mailed in August.

JOIN IN THE OYSTER HOUSE ROW DURING PATUXENT FAMILY DISCOVERY DAY

It’s time to start thinking about getting your feet wet for the spring season! Why not start by participating in the Patuxent Small Craft Guild’s Annual Oyster House Row sponsored by the museum? Join us on Saturday, May 2 (Patuxent Family Discovery Day), at 9:00 a.m. (sharp) in the boat basin, at which time the boats will be launched and headed for the J. C. Lore Oyster House. Once at this location, refreshments will be offered before the return trip to the museum. Participants must bring their own boats and life jackets. Most small craft will be acceptable — propelled by oars, paddles, sails — but no engine-powered boats. There is no entry fee and no prizes — just the fun of making the trip by water between these two museum facilities. For more information, call Bill Lake at 410-586-1534.
Living history actor Brian Bagley portrays Jacob Butler, a free African-American sailor and carter living in Baltimore in the 1840s. Here, Jacob reminds young audience participants in the museum auditorium that "sometimes to solve life’s puzzles we must look at things in a different way." Bagley’s performance on February 22, entitled “Baltimore Through My Eyes,” was part of CMM’s lecture and performance series “Freedom Voyagers: African-American Mariners and Their Legacy.” As part of the same series, Mr. Bagley appeared again on March 6, and maritime historian Quentin Snediker from Mystic Seaport lectured about the schooner Amistad on February 20. The series will conclude on April 3 with a lecture about African-American seamen by author W. Jeffrey Bolster.

Photo by Bob Hall

The Discovery Room is in dire need of more sharks’ teeth for the fossil box, a very popular attraction for the museum’s young visitors. Please bring any donations to the education department.

Corporate Caper

The 1998 Waterside Music Series title sponsors were introduced during January’s Corporate Caper reception. Pictured are (left to right) Ron Walton and Monica Bradley of 97.7 The Bay, Ralph Eppard of Ralph’s Dodge, CMM director Doug Alves, and development director Lee Ann Wright.

Photo by Bob Hall

New corporate members from Veda Systems enjoy themselves at the January reception held at Calvert Marina.
Winter Lights

CMM celebrated Chesapeake Bay lighthouses on January 17 during “Winter Lights” with numerous activities that attracted many members and visitors. In these photos a visitor studies a special exhibit on the history of the Cedar Point Lighthouse, demolished in 1996; lighthouse historian F. Ross Holland signs copies of his recent book, Maryland Lighthouses; and CMM interpreter Bob Boxley discusses sharks’ teeth with budding paleontologists. Other activities included a book signing by lighthouse authors Patrick Hornberger and Linda Jurbyville, a gingerbread lighthouse judging contest, a raffle for a lighthouse throw, and special foods.

Photos by Bob Hall

Warrior’s Rest: An Artist’s Perspective

During December and January the museum hosted an exhibit of more than fifty pieces of varied art in a show entitled “Warrior’s Rest: An Artist’s Perspective.” Supported by the Calvert County Cultural Arts Council and the American Chestnut Land Trust, the art was inspired by the beautiful 230-acre area at the mouth of Parkers Creek and the bay, now owned by the state of Maryland and managed by ACLT. Parkers Creek is the largest, most diverse watershed remaining on the bay’s western shore.

Photo by Bob Hall
SOUTHERN MARYLAND IN DEEP TIME

Jurassic sediments at all under Southern Maryland, and extensive parts of the Cretaceous and Cenozoic are missing. That is to say, no sediments of those ages are present, either because they were never deposited or because they were subsequently eroded, just as Miocene and Cretaceous sediments surviving to our time are presently being eroded in the outcrop areas. Times of high sea level, sinking land, and low sediment input favored landward advances of the ocean, sometimes almost to the Fall Line itself. This happened in our area, for example, from eighty-six to seventy million years ago and again during the middle Miocene, twenty to ten million years ago, the time during which our Calvert Cliffs fossils were laid to rest. During extreme sea level lows, the ocean retreated out to the shelf edge, most recently just twenty thousand years ago during the last great ice age. Rising land or increased sediment delivery could also send the seashore into retreat.

Looking at the slightly inclined layers that can be seen in the Calvert Cliffs, one might suppose that the sediments below Southern Maryland are simply a tilted “layer cake.” This is in some cases a good approximation: for example, some of the shell beds in the Miocene Calvert Cliffs sediments do continue for many miles in the subsurface and have been identified under parts of the Eastern Shore. Although generally spread out as tabular bodies, however, our subsurface sediment layers eventually thin and pinch out or change in composition, age, or fossil content. In present-day Southern Maryland, moreover, sediment is accumulating in the deeper parts of the Chesapeake and Patuxent, while most of the land areas are being worn away. Present-day sedimentation is scarcely making a layer in the “cake”!

The mostly still unconsolidated “post-break-up” sediments (including those exposed in our Calvert Cliffs) start at the Fall Line which runs northeast through Fredericksburg, Richmond, Washington, Baltimore, and Wilmington, and then heads out to sea under the New England continental shelf. The post-break-up sediments thicken eastward and thus form a wedge-shaped mass under Southern Maryland, the Eastern Shore, and the rest of the Atlantic margin. In general, the sediments tend to be coarser, and the stratigraphic record less continuous from the ocean toward the land areas.

A more informative but much more expensive method is to drill boreholes down to basement. Of the many wells drilled in Southern Maryland, however, almost all are water wells that stop in productive aquifers in the upper part of the sediment wedge. Commercial drillers keep logs of the small chips (called “cuttings”) rinsed out of the hole as it is deepened, and this gives a rough idea of the layers being penetrated and their suitability as aquifers. (High porosity and permeability of sands make them the best aquifers, while clays like those in our familiar Miocene beds are useless “confining beds.”) Commercial drillholes, however, have limited geological value. The proper (and even more expensive) way to study our subsurface is to recover a continuous thin cylinder of sediment by the use of core liners repeatedly lowered and retrieved through the inside of a continuous drill string, which is rotated from the ground surface to deepen the hole.

The two primary aquifers underlying our area are the Paleocene-aged “Aquia” and the late Cretaceous-aged “Magothy” formations. The Aquia, called a “greensand” because it is up to 50 percent composed of the green mineral “glauconite” I wrote about in the first installment, is a lens-shaped sheet typically 100 feet thick (175 feet under Kent Island) that underlies all of Southern Maryland and the adjacent part of the Eastern Shore. To tap into its water your well has to reach at least 650 feet below sea level at Cambridge, 450 feet at Solomons and Lexington Park, 320 feet under Prince

(From drawing by Peter Vogt. Data on plate tectonics will appear in a later part.)
Frederick, and 75 feet at La Plata. (Actual wells will be deeper according to the elevation of the well and the distance into the aquifer where the well is screened.) The Aquia is recharged where the formation crops out in a belt from Accokeek through Annapolis to Chestertown. Occasional marine turtle and crocodile fossils suggest that the Atlantic waters that covered our land at the time were semi-tropical.

Most local readers of this newsletter probably get their water from these “greensands,” fifty-five to fifty-seven million years old. Of course, the seawater originally in the sediments is long gone, flushed out by younger waters. The actual water you drink probably fell as rain or snow in what is now Prince George’s County during the last Ice Age, about twenty thousand years ago, when mastodons browsed local conifer forests.

The deeper Magothy Formation underlies a triangular area from Cove Point to west of Waldorf, and thence north to Annapolis. This aquifer, which is heavily pumped in the Waldorf area and at the Chalk Point PEPCO power plant, is absent in the southern parts of the tri-county area. The Magothy is of late Cretaceous (i.e., “dinosaur”) age, and is recharged in a small area between Annapolis and Baltimore.

Of more limited extent is our youngest usable aquifer, the Piney Point, which provides well water to eastern Calvert County and southwest into southern St. Mary’s County. In a Lexington Park drillhole this sand layer occurs between 225 and 300 feet below sea level. The Piney Point is the upper part of the lower-to-middle-Eocene-aged Nanjemoy Formation, which is the oldest outcropping sediment in Calvert County, being exposed just above tidewater along Lyons Creek and nearby parts of the Patuxent shore where it underlies the oldest sediments of the Miocene-aged Chesapeake Group. The easily recognizable contact between the two sediment units is an “unconformity” representing some twenty million years of “missing” time, from about forty to twenty million years ago. The Nanjemoy, like the deeper Aqua greensand, also contains the greenish-black mineral glauconite, and was once mined there as a low-grade fertilizer (a source of potassium) and soil conditioner.

The Miocene sediments exposed in the Calvert Cliffs are too impermeable to be useful as water sources. Many areas along the Patuxent and Potomac rivers, however, and in the higher elevations of Southern Maryland are the Miocene clays are overlain by up to one hundred feet of commonly sandy-gravely, younger sediments that I will discuss in a later installment. These estuarine terraces and fluvial (river-deposited), unfossiliferous sediments were sources of shallow water (in dug wells) from Colonial times until recent years. This water source, however, is now largely contaminated from septic field drainage and other pollution sources and is not considered a usable source of water for Southern Maryland.

No borehole has ever been drilled all the way to basement in Calvert County, but the pattern is obvious from the few basement holes that have been drilled in our region — in earlier years in hopes of finding oil, and in recent years to assess the potential for groundwater production deeper in the pile. From northwest to southeast, here are a few holes and the depths below sea level at which hard basement rocks were first encountered (in all cases the driller continued just a few feet more into the hard rocks):

- Oxon Hill, 734 feet;
- Route 301 at Rosaryville, 1,538 feet;
- Lexington Park, 2,515 feet;
- just east of Salisbury, 5,428 feet;
- and 10 miles west of Ocean City, 7,100 feet.

Beyond Ocean City the basement descends more abruptly, reaching depths up to 45,000 feet (more than eight miles) in the “Baltimore Trough” under the shelf edge, not yet penetrated by any borehole. Even there, however, the basement is a deeply subsided former land surface. All the sediments from the Fall Line out to this trough were deposited in shallow water as sedimentation more or less kept up with subsidence. Thus the seaward tilt (called “dip” by geologists) of each sediment layer in the wedge was acquired AFTER the sediments were deposited, and does not represent the gradual filling of an original trough. The deeper in the wedge, and the farther east of the Fall Line, the steeper the angle of dip. Still farther out into the deep Atlantic Basin the sediments thin gradually. Those sediments were deposited in the deep ocean, however, and the basement there (black in the cross-section) is composed of a volcanic rock called basalt.

More on what all this means will be discussed in later parts about how we fit into the story of plate tectonics, the presence of asteroid impact craters, the extinction of the dinosaurs, and the record of these events in the Coastal Plain wedge.
YEAR-END APPEAL DONORS FOR 1997

The boards of the Calvert Marine Museum and the Calvert Marine Museum Society, the director, and the museum’s staff thank the following 179 donors to the 1997 Year-End Appeal for their contributions of nearly $15,500 – a significant increase over the 1996 appeal. This support will add measurably to the museum’s ability to carry on educational and other important programs.

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