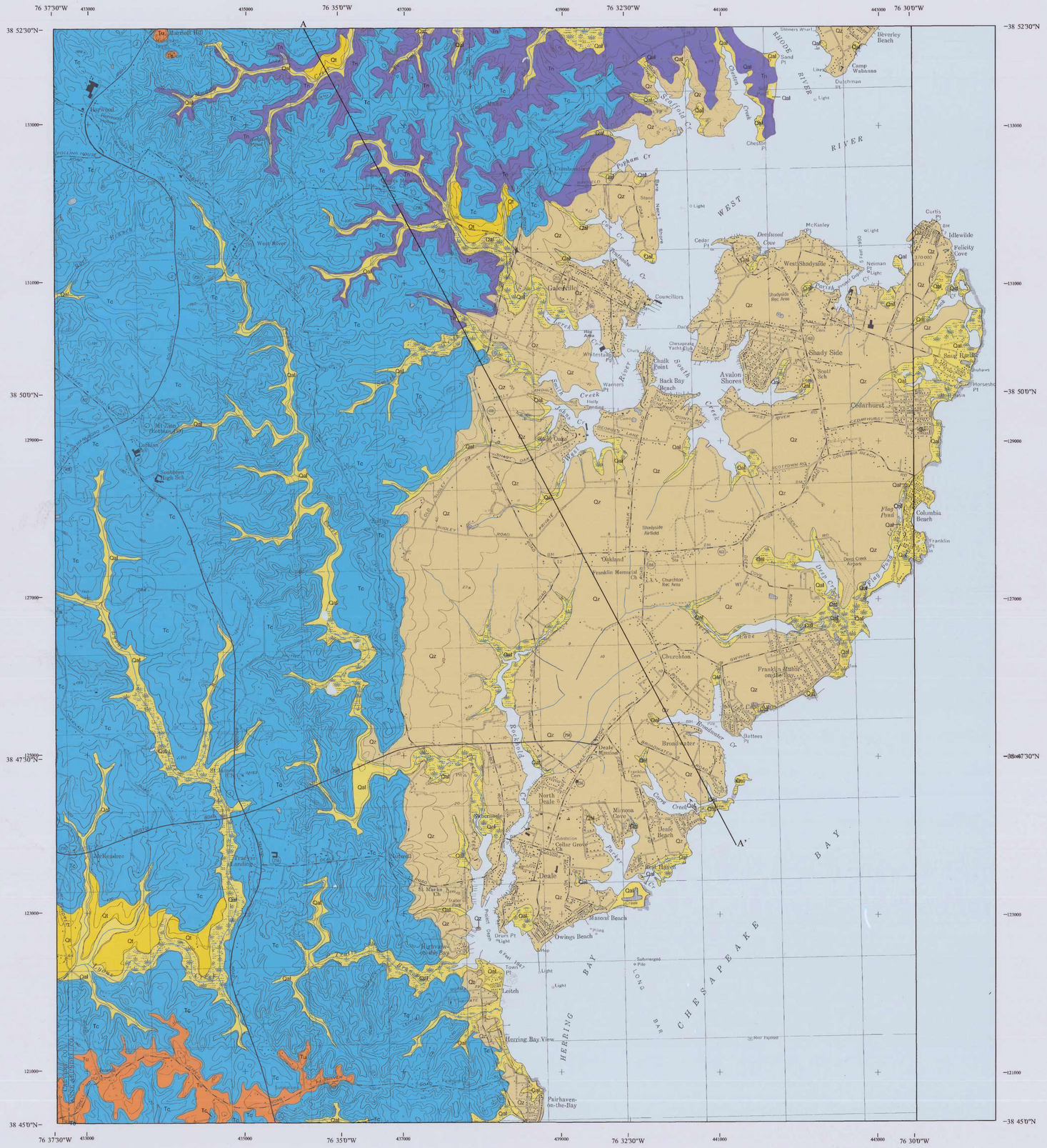


Base map from U.S. Geological Survey
7.5-minute Series (Topographic)
Deale, 1997
1999 magnetic north declination (center of sheet): 11 degrees west
(To determine current magnetic declination see: http://www.ngdc.noaa.gov/cgi-bin/seg/gmag/fldsnth1.pl)

Note:
Hydrology layer shown is from USGS digital line graphs (DLGs) for this quadrangle
Topography and cultural/transportation layers from USGS stable-base mylar separates

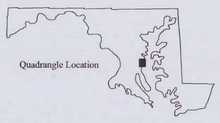
Current map projection (projection change from originals):
Maryland State Plane Coordinate System (1987) (meters)
(Projection: Lambert Conformal Conic, 1980 geodetic reference system)
(Horizontal Datum: North American Datum 1983)

State Plane (NAD83) 2000-meter grid tics and coordinates shown in black
Geographic coordinates (latitude-longitude) (NAD83) shown near corners and 2.5' intervals (in black)
Note: Black grid lines are the remnant UTM NAD27 lines from the base mylar. This layer has been rasterized and projected to State Plane NAD83 meters.

Geologic Map of Deale Quadrangle, Anne Arundel and Calvert Counties, Maryland

By
John D. Glaser
2002

Quadrangle Location



(State Plane Grid North)

Scale 1:24,000

1 0.5 0 1 Miles
1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 Feet
1 0.5 0 1 Kilometers

Adjoining 7.5' quadrangle names (This map is comprised of the Deale quadrangle and Deale oc portion of the Horseshoe Point quadrangle, shaded)			
1	2	3	1. Bowie 2. South River 3. Annapolis 4. Bristol 5. Deale 6. Horseshoe Point 7. Lower Marlboro 8. North Beach 9. East of North Beach
4	5	6	
7	8	9	

Contour Interval 20 Feet
Dotted lines represent supplementary contour interval of 10 feet
National Geodetic Vertical Datum of 1929
Shoreline shown represents the approximate line of mean high water
The mean range of the tide is approximately 0.9 feet
(To convert from feet to meters, multiply by 0.3048)

Copies of this map are available
in hard copy (paper) and digital form from:
MARYLAND GEOLOGICAL SURVEY
2300 Saint Paul Street
Baltimore, MD 21218
Ph: 410-554-5500
Fax: 410-554-5502
http://www.mgs.md.gov/

DESCRIPTION OF MAP UNITS

Quaternary — Holocene

Qal — Alluvium

Interbedded sand, gravel, and silt-clay.

Sand, very fine to coarse, interbedded with pebbly sand and fine to very coarse gravel. Unit contains beds and lenses of silt-clay, massive to laminated, bearing in places organic matter such as leaves, twigs, and logs. Rare thin peat beds occur. Color tan, brown, and gray.
Alluvium includes typically heterogeneous, generally poorly sorted sediments, which range from well-stratified to massive. Sandy lithologies are mostly quartzose where derived from the Calvert Formation, but contain variable amounts of glauconite where source materials are Nanjemoy or Aquia sediments. Alluvium underlies stream channels, floodplains, and adjacent low areas. The most extensive areas of alluvium in the quadrangle underlie the bed and floodplain of Lyons and Tracys Creeks and their tributaries as well as several marshy tracts bordering the Bay at Snug Harbor and Deep Creek.
Alluvium is largely the product of channel and overbank deposition within the last 10,000 years. The unit is as thick as 20 feet in places.

Quaternary — Pleistocene

Qz — Lowland Deposits

Interbedded sand, pebbly sand, and silt-clay.

Sand, generally silty or clayey, poorly sorted. Mostly siliceous, but contains variable amounts of glauconite in deposits in the northern third of the quadrangle. Gravel and pebbly sand is concentrated in the lower part of the unit. In places, thin peaty beds occur in the section, as do black, highly organic silt-clays rich in plant debris. Color mostly pale-gray, tan, or buff, varying to dark-gray. This unit underlies low flats bordering the Chesapeake Bay. Most of the flats lie at 20 feet or less in elevation, but rise to as high as 60 feet in places along their inner margins. The most extensive of these flats is the wide lowland between West River and Herring Bay. Much of the Qz here is poorly-drained muddy sand or silt-clay, representative of the upper portion of the bipartite, grossly-graded unit. Outcrops are scarce due to low relief and widespread shoreline protection. Radiocarbon dating of organic materials in this unit (former Talbot) elsewhere along the Bay indicates a minimum age of 35,000 years. The paleoflora suggests interglacial conditions; thus the Qz unit is probably Sangamonian or older, perhaps mid-Pleistocene. Qz strata are as thick as 40 feet in places.

Note: the informal unit name of Qz is used on this map for deposits previously mapped as the Talbot Formation (of McCartan, 1989a, 1989b; Owens and Denny, 1979) as well as some Quaternary terrace deposits are not unequivocally defined. Until further study reveals the correlation of these units, the informal identification "Qz" is applied to identify these former Talbot sediments in this quadrangle.

Qt — Terrace Deposits

Interbedded sand, gravel, and silt-clay.

Heterogeneous sediments comprising fine to coarse gravel, poorly-sorted sand containing glauconite where source materials include Nanjemoy beds, clayey sand, and thin lenses of silt-clay. Bedding is chiefly lenticular or massive. Color tan, buff, grayish-brown, or reddish-brown.
Terrace Deposits have a very limited distribution in the map area. Small patches of Qt flank several of the area streams, most notably along Lyons Creek in the southern part of the quadrangle. The deposits are as thick as 25 feet but average thinner.

Tertiary — upper Miocene - Pliocene

Tu — Upland Deposits (formerly Brandywine Formation)

Sand, pebbly sand, gravel, and sandy loam.

Sand, moderately well sorted, medium- to coarse-grained, with some clayey sand. Pebbles quartzose, maximum about 6 inches in diameter. Color tan to orange-brown. Bedding is chiefly lenticular and massive. Gravel concentrated in the basal beds; upper beds chiefly clayey loam.
The distribution of Brandywine strata in the Deale Quadrangle is limited to erosional remnants on ridge crests in the extreme southwest part of the area and a few hilltops in the extreme northwest part of the area.
The unit is fluvial in origin and is thought to have been deposited by the ancestral Potomac River in late Miocene time. Upland Deposits are maximally about 25 feet thick in the quadrangle.

Tertiary — lower and middle Miocene

Tc — Calvert Formation

Sand, silt, and diatomaceous silt.

Sand, very fine- to fine-grained, silty; silt; and minor clay. Unit includes a variable thickness of diatomaceous silt. Color olive-green to greenish-gray where unweathered; pale-gray, tan or brown in weathered sections. The basal portion contains, in places, a thin (< 5 ft.) bed of diatomaceous silt containing as much as 40 percent diatoms. Most of the unit consists of relatively homogeneous sand and silty sand with obscure bedding and pervasive burrow-mottling. Ghosts of mollusks are common in some strata, but intact shells are absent, having been leached from the sediment.
The lower contact is sharp and unconformable on the underlying Nanjemoy. All of the Calvert sediments in the map area belong to the lower Fairhaven Member. The upper member, the Plum Point, was not recognized in the area. Calvert strata are at the surface over most of the western half of the area.
The lower Calvert is a restricted-basin marine unit, deposited in relatively deep water. A maximum thickness of about 80 feet of strata is present in the Deale Quadrangle.

Tertiary — lower Eocene

Tn — Nanjemoy Formation

Glauconitic sand, silty sand, and silt-clay.

Sand, fine- to coarse-grained, variably silty or clayey, containing as much as 50 percent of glauconite. Grades to silt-clay in some places. Color medium-gray to dark greenish-gray where unweathered, mottled yellowish and pale-brown in weathered outcrops. Silt-clay is dark gray to chocolate brown. Bedding massive or thick-bedded with prevalent burrow-mottling. Fossiliferous in some beds, chiefly *Venericardia*.
Lower contact sharp marked by sand-filled burrows excavated in the underlying clay of the Marlboro. Indurated beds and concretionary bodies are present at some horizons. Sand generally coarsens upward in the section.
The Nanjemoy accumulated on the inner shelf in relatively shallow water. Unit thickness may be as much as 60 feet but generally much less.

Tm — Marlboro Clay (subsurface; cross-section only)

Clay and minor silt.

Clay, dense and brittle, beds massive and thickly-stratified ranging to finely-laminated. Beds lenticular to hummocky, with sparse partings and thin lenses of micaceous, lignitic, clayey silt, evenly laminated in places. Color pale-red to silvery-gray; silt yellowish-gray to reddish-gray. The lower contact is gradational over a few feet of interbedded glauconitic sand and thin clay beds.
This unit does not outcrop in the Deale Quadrangle. In Anne Arundel County, some of the best outcrops of the Marlboro are found in the Central Avenue corridor in the southern portion of the South River Quadrangle. The presence of the unit at the surface is commonly revealed by soils containing abundant small flat clay chips.
The precise depositional environment of the Marlboro is uncertain. The sparse faunal evidence and the sedimentary structures have been interpreted as representing deposition in very shallow water (e.g., intertidal). Recently, however, regional studies of the Marlboro Clay suggest a deeper water depositional environment. Gibson et al. (2000) indicate that the unit probably represents deposits from an inner to middle marine shelf area that received sediments from river drainage systems (e.g., Gibson et al., 2000). Regional microfossil studies indicate that the Marlboro Clay ranges in age from latest Paleocene to earliest Eocene (calcareous nannoplankton upper Zone 9 and lower Zone 10) (e.g., Gibson et al., 2000). The Marlboro is as much as 20 feet thick.

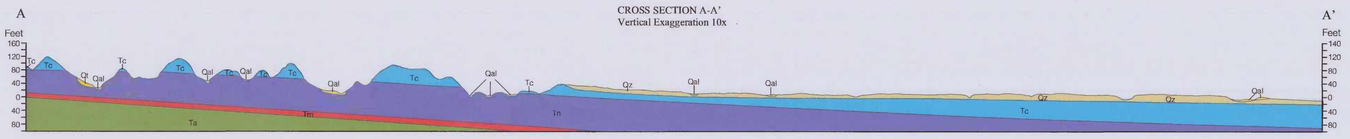
Tertiary — upper Paleocene

Ta — Aquia Formation (subsurface; cross-section only)

Glauconitic sand and calcareous sandstone.

Most of the Aquia consists of well-sorted, medium-grained sand that is variably glauconitic (rarely totaling more than 50 percent of the sediment). Some beds are fine or coarse grained. Color varies from dark gray-green to olive-green in unweathered sand, "salt and pepper" sand where moderately weathered, and rusty-brown with abundant limonite crusts where deeply-weathered. Bedding massive and thick-bedded with abundant burrow-mottling. Highly fossiliferous in places with large oysters and *Turritella* dominant.
This unit is not exposed at the surface in the Deale Quadrangle (shown in cross section only). In the South River Quadrangle, immediately north of the Deale Quadrangle, the Aquia is at the surface over most of the northern half of the area and outcrops are numerous, particularly in bluffs facing the lower Severn and South Rivers where as much as 80 feet of Aquia is exposed in continuous section. Below the South River, partial beds or irregular pods of shelly calcareous sandstone as much as 5 feet thick are commonly encountered in the South River Quadrangle.
The Aquia probably accumulated in very shallow marine water on the inner shelf and record a regressive cycle during the Paleocene. At its thickest, the Aquia totals nearly 180 feet of beds, but it is generally much thinner over the map area.

CROSS SECTION A-A'
Vertical Exaggeration 10x



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Supplemental Information

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