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GEOLOGY OF
CAPE MAY COUNTY
IN BRIEF

by

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Topography

At the southern end of New Jersey is Cape May County, a relatively flat-lying area, composed largely of unconsolidated sediment, and included in the physiographic province of the eastern United States known as the Atlantic Coastal Plain, a province that reaches from Long Island, New York, south through Georgia, and as far west as the Piedmont. The boundary of the Coastal Plain Province passes through New Jersey in such a manner as to include all of the state south of a line running approximately from Perth Amboy to Trenton. Since Cretaceous times (70 million years ago), the rivers and the ocean have deposited and reworked the sediments that compose the New Jersey portion of the Atlantic Coastal Plain. The surface material in Cape May County is a relatively recent addition, having been deposited during the Sangamon Interglacial Age; that is, between the appearance of the last Ice Age (Wisconsin Glacial Age) and the disappearance of the previous ice sheet (Illinoian Glacial Age).

Most of Cape May County is a peninsula. On the east is the Atlantic Ocean and on the west Delaware Bay. The Tuckahoe River and Great Egg Harbor form a common boundary on the north with Atlantic County. On the northwest, where Cape May County borders Cumberland County, the county line is partly in West Creek and partly on dry land.

The surface of Cape May County is one of low relief; prodigious heights are lacking. Most of the land lies below altitudes of 25 feet above mean sea level. A few places north of Great Cedar Swamp may attain heights of a little more than 50 feet above mean sea level. In short, the county is rather low and flat.

Four barrier islands, separated from the mainland by a central lagoon filled by shallow sounds (called "bays" elsewhere) and salt marsh, characterize the county's Atlantic shore. Between the barrier islands are tidal inlets which not only separate the islands, one from the other, but also function as a means of exchanging tidal waters between the ocean and the sounds. The wide, gently sloping beaches for which Cape May is famous are found on these barrier islands.

Along the Delaware Bay shoreline, the beaches are narrower and steeper than those of the islands and are developed directly on the mainland, particularly in Lower Township. In Middle Township, the beaches become little more than narrow strips separating the bay from the wide expanses of salt meadows and freshwater marshes that flank the drier upland. In Dennis Township, beaches are virtually non-existent. The barrier islands and sounds of the eastern side of Cape May County are not present on the western shore. The immediate offshore region here is quite flat and shallow; extensive mud flats with sand bars and shoals are exposed at low tide.

In the northern part of the county, stretching between the salt marshes of the Tuckahoe River and Great Egg Harbor and the salt marshes of Delaware Bay, is the Great Cedar Swamp, the surface of which is about 5 to 10 feet above mean sea level. Said to have been a former channel of the Great Egg Harbor River, the swamp is now occupied by two streams: Cedar Swamp Creek flowing northerly, and Dennis Creek flowing towards the southwest.

Geologic History

Cryptozoic - At depths of 5000+ feet lie the oldest rocks that underlie the county - the "basement complex," a group of metamorphic rocks of Precambrian and Paleozoic Age consisting of gneiss, quartzite, and schist.

None of these rocks outcrop in Cape May County; consequently, our knowledge of their nature is limited to pieces brought up during the drilling of deep wells and from inferences provided by related rocks bordering the Delaware River in New Jersey and Delaware.

The Cape May region during Precambrian time was probably part of a larger area of deposition in which thousands of feet of sediments accumulated. Through time, these deposits were buried, metamorphosed, and, later, uplifted during mountain building activities. The former basins, having become mountains, then, in turn, served as a provenance area for sediments which were now carried into other basins.

Paleozoic - During the Paleozoic Era, Cape May County was part of a mountainous land mass that reached from as far north as the Arctic to as far south as Mexico. To the west was a shallow inland sea. Both the sea and the land mass altered their dimensions throughout these 400 million years. The land mass was deeply eroded while being uplifted and furnished many thousands of feet of sediments to the western sea basin which would become the site of the folded Appalachian Mountains. The specific happenings in Cape May County during Paleozoic times are not known; if any interpretable rocks were formed they have long since been removed.

Mesozoic - The Mesozoic Era was one of vulcanism and faulting in New Jersey which greatly affected the future of not only Cape May County but also most of the state. During the Triassic Period, erosion continued to wear away the land while the development of deep, rift-type valleys from Nova Scotia south to North Carolina provided basins in which sediments collected. By the end of the Triassic, a trend had begun with the land north and west of the Precambrian Highland Province being uplifted while that part east and south tended to be downfaulted. The Cape May section

was part of this latter movement. During Jurassic times erosion continued. During the Cretaceous Period, deposition of New Jersey's Coastal Plain was initiated and with it 3000+ feet of the subsurface of Cape May County.

The sediments of Cretaceous age indicate that the environment of the general region surrounding Cape May County varied from one of coalescing deltaic plains developing easterly from the exposed Piedmont and basement rocks of New Jersey, Pennsylvania, and Delaware, a marine environment in which the shoreline moved west of the Delaware River, covering and partially reworking the previous deposits. There were several times during the millions of years of the Upper Cretaceous Period when the Coastal Plain deposits were emergent as the shoreline moved many miles east. During these regressive stages of the sea, much of the previous sedimentary cover was eroded. When the sea returned, the old surface of the land was partially reworked and subsequently buried under new layers of sand, silt, clay, and pebbles brought in by rivers and marine currents. Cape May County and the rest of Coastal Plain New Jersey was in the path of a regressing and transgressing sea and subject to periods of deposition and erosion.

Cenozoic - The pattern of transgression and regression of the sea continued on into the Tertiary Period (approximately 70 million to 1 million years ago). During this period, about 2000 feet of sediment was left beneath the surface of Cape May County as a consequence of geologic activities.

From the beginning of the Paleocene Epoch (70 million to 60 million years ago) through the Eocene (60 million to 40 million years ago), Cape May County, as well as much of southern New Jersey, was under water. The fossils and sediments that accumulated during these 30 million years are indicative of an environment of marine deposition. At about the end of

Eocene times, there was probably a major withdrawal of the sea accompanied by a time of subaerial erosion. The shoreline for more than another 15 million years would be considerably east of Cape May. This was the Oligocene Epoch from which no formations have yet been found in New Jersey, giving rise to the thought that this was an epoch of continuous erosion over the state. This situation continued until the middle of the following epoch, the Miocene.

The Miocene Epoch began about 25 million years ago and lasted for about 14 million years. Toward the middle of this time period, the sea again encroached upon the Coastal Plain over an area from Raritan Bay to the Delaware River. During this episode the Kirkwood Formation was deposited.

The Kirkwood Formation, as it is found in the subsurface of Cape May County, has a maximum thickness of 780 feet and indicates deposition, through time, in both nearshore and inner continental shelf environments. The type of material deposited reflects a response to a relative rise and fall of sea level during middle Miocene time. Beneath Cape May, the formation can be divided into five separate units; from bottom to top they are:

1. The lowest unit. A tough, brown clay with a bottom layer of quartz-glaucinite sand. The sandy layer was reworked from the underlying formation. The entire unit of clay and sand has a thickness of between 77 and 173 feet.
2. Gray, medium to coarse sand with a middle layer of 20 feet of iron-oxide cemented sandstone and clay. The entire unit is about 140 feet thick.
3. Blue, silty, diatomaceous clay, 40 - 280 feet thick.
4. Medium to coarse sand layer with an average thickness of 50 feet.

5. The uppermost unit. A layer of blue, diatomaceous clay between 65 and 260 feet thick. Top of clay layer lies between 155 and 350 feet below mean sea level.

As Kirkwood deposition neared its end, the sea again withdrew from a point in the vicinity of western New Jersey or eastern Pennsylvania to somewhere east of Cape May County. The land surface was re-exposed to subaerial erosion as the rivers extended their courses easterly following the retreating shoreline. Much of the land's surface was removed and carried seaward by the eroding rivers and marine currents.

There is some uncertainty concerning the time when the shoreline again washed westward covering Cape May County and most of the New Jersey Coastal Plain.. During this recurrence of marine inundation, the Cohansey Formation was deposited, containing, unfortunately, no distinctive fossils by which the formation could be dated. It has been suggested, however, that it was late in Miocene time or early in the Pliocene Epoch (10 million to 1 million years ago), or even during both.

The Cohansey Formation contains sediments derived from eroded mountains to the west and north and from the exposed Kirkwood Formation. Carried eastward by rivers flowing across the coastal plain, these sediments were deposited in estuarine and deltaic environments. Although elsewhere in New Jersey the Cohansey Formation is exposed on the surface, in Cape May County the formation is entirely restricted to the subsurface, covered over by as much as 200 feet of sediments of Pleistocene (Ice Age) vintage. During the Ice Ages which followed, the sediments composing the Cohansey Formation were, in turn, eroded and carried seaward to be redeposited; between 50 and 225 feet of the formation remain in the subsurface of Cape May County.

The Quaternary Period (about the last 1 million years) covers the age

of the great continental glaciations. During the formation of the ice sheets, sea level was lowered between 300 and 400 feet, a condition which once again exposed the Coastal Plain to subaerial erosion. With the retreat of the ice sheets, melted water filled the ocean basins and sea level rose. Rivers carried sediment seaward and developed large alluvial deposits along their banks. In Cape May County there are two formations which were laid down during the interglacial high stands of the sea - the Bridgeton Formation and the Cape May Formation.

The Bridgeton Formation, a fluvial deposit, is the oldest of the Pleistocene formations in New Jersey. In Cape May County the sands and gravels with a large admixture of silt and clay of Bridgeton vintage form the hills and ridges in the northwestern sector between the Cumberland County line and Great Cedar Swamp. The maximum thickness of the formation in Cape May County is 60 feet. If there were any materials of Bridgeton age laid down south of Great Cedar Swamp, they were removed by fluvial and marine processes prior to the emplacement of the Cape May Formation.

There are probably many thousands of years separating the Bridgeton from the Cape May Formation. During this time span, the Illinoian glaciation took place, followed by an interglacial time called the Sangamon. While the continental ice sheet existed, sea level was lower by several hundred feet, subjecting the exposed land surface to erosion. This was a time when rivers cut their channels deeper into the Coastal Plain. With the waning of the ice sheet in response to a warming trend of the climate, the water previously locked up as glacial ice melted, filled the ocean basins and raised the level of the sea relative to the land surface. During this warming trend, the Sangamon interglacial, the sea encroached upon

the area known as Cape May County and deposition of the formation of the same name ensued.

There were three environments in which the Cape May Formation was emplaced: estuarine, marine, and deltaic. The source for sands, silts, clays, and gravels was the older, underlying formations of the Coastal Plain.

Sea level continued to rise, drowning both the estuarine deposits and the former beaches. By the end of the Sangamon interglacial sea level would be some 25 feet higher than it is today. Such was probably the setting for the last episode in the story of the Cape May Formation: the production of the Cape May delta.

Southward from the mainland a delta was developed by the ancestral Egg Harbor River. The original easterly flow of the river and dispersion of its sedimentary load was probably redirected towards the ancestral Delaware Bay by littoral currents from the north. As time went on, the delta increased in weight, length, and width so that all of the surface of the Cape May County mainland south and east of Great Cedar Swamp is composed of these deltaic deposits. The river's channel shifted west and reached the neighborhood of Great Cedar Swamp which was probably its westernmost location. Sometime after this event, the river cut through the delta re-establishing its former route to the sea near Ocean City. The development of the Cape May delta came to an end.

The sediment of the delta was probably derived primarily from the Bridgeton and Cohansey Formations. In some places the level of the sandy surface reaches 35 feet in height above present sea level. The thickness of the deltaic sands achieve 80 feet, with an average of about 50 feet. While the bulk of the delta is sand, there are layers of gravel present as

well as lenses of silt and clay.

Toward the end of the time in which the Cape May delta was being built, the climate became colder. This change is indicated by the fossil assemblage of the formation. Fossils typical of a warmer climate were replaced by those associated with colder temperatures, heralding the appearance of a new ice age - the Wisconsin, or the last, glaciation. Again the earth saw widespread continental ice sheets accompanied by a lowering of sea level as much as 430 feet below the present stand. Again, the Cape May County region was exposed to subaerial erosion.

About 14,000 years ago an improvement in the climate reversed the trend of widespread glaciation. The great ice sheet started to melt, releasing ice-locked water back into the ocean basins. Sea level rose and, in time, reached its present stand. The barrier islands developed during this time, probably as lines of dunes, breached spits or peninsulas retreating westward with advancing shoreline. The mouth of the Delaware River had been restricted to the south of Cape May by the bulk of the peninsula while sea level was lowering. The 200 foot valley cut by the river in the underlying sediments during lower sea level became a drowned valley when the shoreline advanced to its present level. The Cape May peninsula became subject to marine processes again.

Winds set up longshore or "littoral" currents which affect the Cape May shoreline. Generally, the strongest winds come from a northerly direction as "northeasters" from tropical storms and hurricanes, and as winter winds. This results in a net flow of the littoral currents and beach sediment from the northeast towards Delaware Bay. Likewise, there is a tendency for the barrier islands to elongate towards the southwest with an apparent southwesterly migration of the inlets.

The semidiurnal change of tide sets up currents in and out of Delaware Bay. Those currents associated with the flood tide tend to be stronger than the currents generated by the ebb tide. This discrepancy is caused, first, by the augmenting of the incoming tidal currents by littoral currents from the northeast and, second, due to the waves approaching the Cape May shoreline from the open sea. About 90% of the waves that approach Cape May from the Atlantic Ocean do so from the east, thereby adding to the strength of the currents of the rising tide. These waves may be generated by ordinary winds and storms occurring far out over the Atlantic Ocean.

The western shoreline of Cape May, washed by the waters of Delaware Bay comes under the influence of the forces acting upon those western waters. Winds from a westerly direction, more than those of the north, would control the waves and currents that gnaw at the bay shore. Extra high tides of either meteorological or celestial causes also affect the conditions of that part of Cape May.