Coastal Plain Building:
sea level changes shape the continent

Because the North American plate is still drifting away from the Mid-Atlantic ridges, the type of mountain building that dominated the eastern margin of North Americ during much of the Paleozoic era no longer exists. Instead, sediment eroded from the mountains was gradually deposited along what geologists call a ***passive continental margin*** *(Figure 1.33)*. The only area with continued volcanism through the end of the Cretaceous was ***Mississippi***. Despite minimal ***tectonic activity*** in the Southeast throughout the last 140 million years, the face of the land continued to change significantly due to erosion, deposition, sea level fluctuations, and the Ice Age.

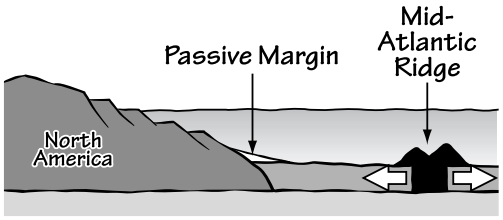
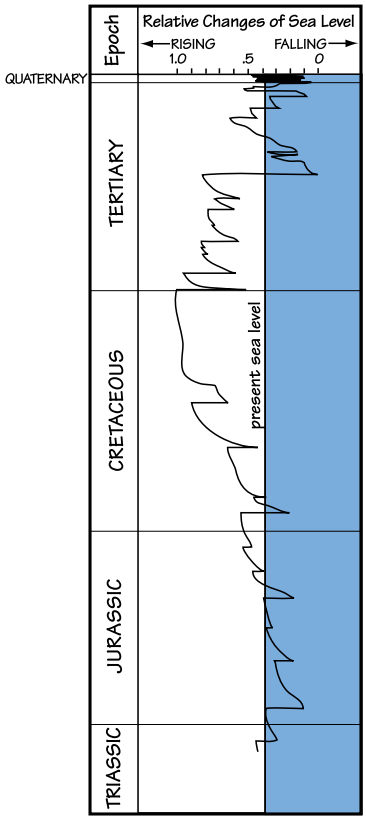


Figure 1.33: A modern cross section of the east coast of North America, which is now a "passive margin." The plates are now diverging at the Mid-Atlantic Ridge, where new oceanic crust is forming.

A **passive margin** *is tectonically quiet, meaning the margin is not at a plate boundary, where crustal collision or rifting is occurring.*

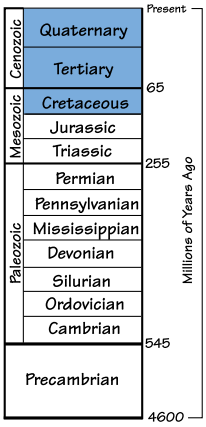
In the Gulf of Mexico region, from **Mississippi** *west to Mexico, there existed a rim of volcanic islands during the Late Cretaceous. These volcanoes are now extinct and their igneous cores are buried by thousands of meters of Coastal Plain sediment. However, the ash from the volcanoes is found in some of the Cretaceous Coastal Plain sediment in Mississippi.*

Although there was little **tectonic activity** *during the Cretaceous, Tertiary and Quaternary, there were periods of uplift and movement of faults.*



Following the break up of Pangea, a long period of erosion began that continued through the Cretaceous, Tertiary and Quaternary Periods and gradually built up the Atlantic and Gulf Coastal Plains. Sediment was transported from the mountains by rivers and streams to the coast, building up successive layers of sediment that fanned out onto the continental shelf. When sea level rose, deposition of marine sediment over the eroded Appalachian sediment also built up the Coastal Plain. The late Cretaceous Period was marked by very high sea level worldwide, in part due to the significant increase in plate tectonic activity that followed the break up of Pangea *(Figure 1.34)*. The splitting apart of Pangea changed the shape of the Earth's ocean basins and cre-

Figure 1.34: Sea level has risen and fallen numerous times in the last billion years. Many factors affect global sea level, including tectonic activity, climate and glaciation. During the Quaternary Ice Age, sea level underwent dramatic changes as continental glaciers repeatedly expanded and melted.



Geologic History

ated underwater ridges such as the Mid-Atlantic Ridge where new oceanic crust continues to form today. The subsequent displacement of ocean water contributed to higher sea level. The Mississippi ***Embayment*** also formed during the Cretaceous, as the ocean flooded the downwarped area above an ancient *rift* that is now the Mississippi River valley.

Def: Embayment

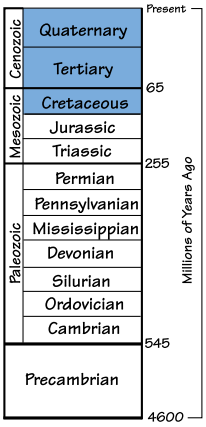
The Mississippi Embayment

Stretching from Illinois to Louisiana, the Mississippi Embayment actually originated as far back as the Precambrian. When Rodinia (the Precambrian supercontinent) was breaking up, many smaller rifts in the crust formed adjacent to the major rift that split away North America. One of these smaller rifts is located beneath the modern day Mississippi Embayment. During parts of the Paleozoic era, a proto-Mississippi Embayment existed above the rift. During the Cretaceous, the ocean flooded the embayment. When sea level fell, the Mississippi River was born. Thousands of meters of sediment were deposited in the river valley. Recurrent activity along faults associated with the deeply buried ancient rifts beneath the embayment caused the 1811-1812 New Madrid Earthquakes, one of the largest earthquakes ever recorded in North America.

The **Cretaceous-Tertiary** *boundary is most readily recognized by the great change in fossils from below to above the contact. Most microscopic marine life, including the exceptionally abundant and diverse foraminifera and coccoliths, were survived by only a few representatives, while entire groups of fossils, including the ammonities, became extinct.)*

The ***Cretaceous-Tertiary*** boundary marks one of the most significant physical and biological events in earth history. The boundary, which is about 65 million years old and marks the contact between the Mesozoic and Cenozoic Eras, represents a time during which most animals and plants, both marine and terrestrial, from the microscopic one-celled varieties to the massive dinosaurs, suddenly came extinct. Many scientists believe the Cretaceous extinctions resulted from the impact of a large comet or asteroid, perhaps from the Chicxulub impact crater along the northern coast of Mexico's Yucatan Peninsula. Others remain steadfast in their belief that the extinctions could have resulted from climatic change associated with the breakup of Pangea, or from intense volcanism in India, or perhaps from increased oceanic temperatures resulting from expanding rates of sea-floor spreading. Regardless of its cause, there are few events in earth history to rival the dramatic changes associated with the Cretaceous/Tertiary boundary.

Throughout the Tertiary Period a warm, humid climate and an overall lowering of sea level promoted chemical weathering and rapid erosion of rocks of the Southeast. Limestones were forming along the Gulf Coast and in the Carolinas. During this time, the Florida peninsula finally emerged from the ocean. Although the



foundation of Florida (as well as southern Georgia, Alabama and Mississippi) became a part of North America when Pangea came together, the Florida peninsula was under water until 24 million years ago! Atop the ancient Florida bedrock foundation, a *carbonate platform* developed similar to the modern Bahama Banks.

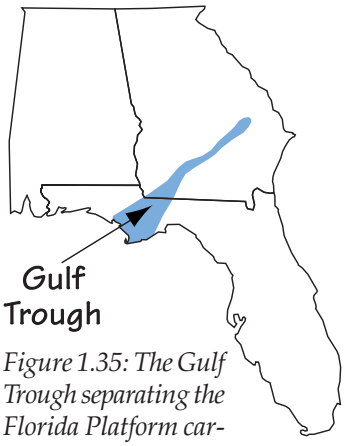


Figure 1.35: The Gulf Trough separating the Florida Platform carbonate bank from the shores of early Tertiary North America.

A trough existed across northern Florida, known as the Gulf Trough (or the Suwanee Straits), which separated the carbonate bank from the shores of early Tertiary North America *(Figure 1.35)*. During the Tertiary, sediment from the eroding Appalachian Mountains gradually filled the trough and sediment reached the Florida platform, extending the Coastal Plain across what is now Florida. The modern peninsula of Florida is the above-water section of the entire Florida platform. Thick Tertiary age Coastal Plain deposits across the Southeast are evidence of high rates of erosion of the Appalachian Mountains during this time.

Just before the beginning of the Quaternary period, about two and one half million years ago, the Earth's climate got colder and ice began to build in the northern and southern hemispheres. Approximately the northern half of North America was periodically covered during this time by ***continental glaciers***, which originated in northern Canada *(Figure 1.36)*. The Quaternary period is divided into two epochs: the Pleistocene and Holocene. During the Pleistocene, interglacial or warming intervals existed when each of the ice sheets retreated north. The Holocene is the most recent (and current) interglacial interval. Since the beginning of the Quaternary, there have been several dozen intervals of glaciation separated by warmer intervals not unlike the present. The most recent glacial advance reached its maximum extent 21-18,000 years ago and lasted until 10,000 years before the present.

Figure 1.36:Continental glaciers originating in Canada spread across North America during the Quaternary (but not the Southeast!)

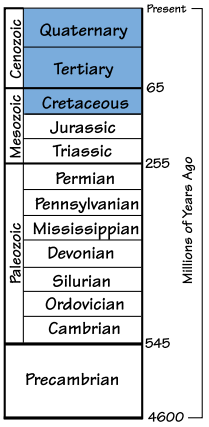
Although the entire Southeast region was affected by the cooling climate during the most recent advance of the ice sheet, the continental glaciers did not

The **foundation of Florida**, *south Georgia, Alabama and Mississippi was originally part of North Africa that was attached to North America during the Permian. When Pangea began to break apart, part of North Africa stayed with North America.*

Def: CARBONATE PLATFORM

Throughout the Earth's history, the continents have been periodically plunged into an ice age, dependent upon the climate and position of the continents. Over the last million years, North America has experienced glaciation approximately ***once every 100,000*** *years and once every 40,000 years during the previous two million years.*

Several **continental glaciers** *built up in Canada and spread southward to about the Ohio River on the northern edge of the Southeastern United States.*



Geologic History

Of all the states in the Southeast, **sea level** *changes have most dramatically affected the shape and sedimentary deposits of Florida. When glaciation was at its maximum, and sea levels were at their lowest, the peninsula has been almost 482 kilometers (300 miles) across at its widest.*

Def: SCARPS AND RIVER TERRACES DEFINED

extend into the Southeast. The predominant effects of the Pleistocene Ice Age on the Southeast were the rise and fall of ***sea level***, subsequent erosion and deposition, changes in weather and in the distribution of plant and animal species, and changes in drainage patterns. At the peak of the last glacial advance (25-20,000 years ago) sea level dropped over 100 meters (328 feet) below the current level! Widely fluctuating sea levels drastically affected the erosion and deposition of sediment on the Coastal Plain, creating ***scarps and river terraces***, and steepening stream gradients, which resulted in more rapid erosion of the streambeds. Today, the Earth is technically in an interglacial time, as the ice sheets have retreated for now.

Why was there an Ice Age?

Scientists continue to debate the advent of large continental glaciers in the Northern Hemisphere 2.5 million years ago. Movement of the Earth's plates may have been a direct or indirect cause of the glaciation. As plates shifted, continents moved together and apart, changing the size and shape of the ocean basins. Decreased transport of heat from equator to poles by ocean currents and sufficient precipitation in northern Asia and North America enabled continental glaciers to grow and flow outward. The presence of continental landmasses over one or more poles is also a major factor in the development of continental glaciers.

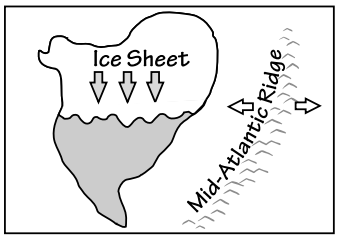


Figure 1.37: Coastal Plain Building
-East Coast of North America is now a passive margin
-Erosion of Appalachians and fluctuating sea level build coastal plain
-Florida peninsula emerges
-Ice Age sea level changes and climate affect the Southeast, though continental glaciers did not extend into the region