Full Exhibit Text

INTRODUCTION ~ 500 Million Years of Florida Geology

The Florida we are all so familiar with is a relatively new phenomenon, geologically speaking. This distinctive peninsula of land we live on, and the gently sloping, sandy shorelines we're drawn to for recreation and renewal, have not always existed as they appear today. In fact, Florida was a very different-looking place not so long ago, and over the past 500 million years it has had quite a unique and surprising geological history.

African Origins
To start with, the deep bedrock that underlies Florida was originally a part of Africa. The igneous and metamorphic rocks that constitute Florida's foundation formed about 500 million years ago on the northwestern edge of the Paleozoic megacontinent of Gondwana. These rocks resided for much of their early history wedged between other masses of rock that would eventually separate, through the activity of plate tectonics, into the continents of Africa and South America.

Gondwana + Laurasia = Pangea
As it happened, over 250 million years ago, the Florida-containing megacontinent called Gondwana, very slowly, but at times very violently, collided with another megacontinent, Laurasia, to form the supercontinent Pangea. After millions more years, the tectonic plates (giant pieces of the earth's crust and upper mantle) that made up Pangea broke apart again, beginning the transformation of the earth's surface into the familiar world globe we recognize today. During that split, the triangular chunk of Gondwanan rock that would be Florida rifted from its African parent plate and remained attached to the block of Laurasian rock that became North America.

200 Million Years of Undersea Calcium Carbonate Deposition
It is upon these very old, African-born basement rocks that the sedimentary rocks of the Florida Platform would start to accumulate. Deep layers of carbonate rock—predominantly limestones and dolostones composed of the mineral *calcium carbonate*—built up over the next 200 million years to create Florida's flat-topped, "carbonate platform" structure. These rock layers, two to three miles thick in some places, are a result of the near-constant deposition of calcium carbonate ($CaCO_3$) that occurred in the warm ocean shallows that surrounded and very often completely submerged ancient Florida. As marine organisms lived and died in the shallow seas, their skeletal remains became concentrated, compacted, and gradually hardened (lithified) into a complex subsurface stratigraphy of sedimentary rock formations, whose differences in depth, location, and composition reflect Florida's fascinating formational history.

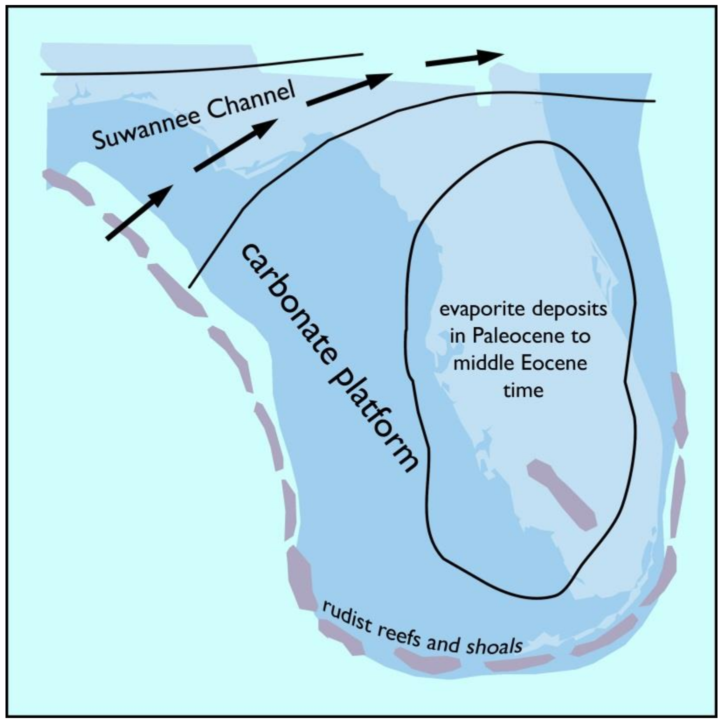
Beauty is in the Eye of the Informed
So beyond its African origins and its thin veneer of surface sand, this point of land we know as Florida was constructed primarily underwater, and its resultant array of carbonate rocks has an enthralling story to tell us about past environments and past climates. The allure of these Florida Formations may not be readily obvious—particularly when compared to some of the other specimens in the museum—but upon closer inspection, subtle, even revealing distinctions emerge. Florida's geological formations are a physical representation of dynamic regional and global changes in oceanic, climatic, ecological, and geological conditions over the past several hundred million years. The unassuming rocks you see in this exhibit help us better understand how global atmospheric

shifts, massive sea level fluctuations, and ongoing geological processes, have yielded our current landscapes and impacted life on earth and in Florida.

A Story, and Shoreline, Still in the Making

The information in these pieces of pale stone, supported and expounded by a wealth of science from around the world, convinces us that Florida was rarely the same for long, and is undoubtedly still continuing to change. Indeed, many scientists believe that we are entering a new period of much more rapid change (sometimes called the Anthropocene because of the increasing influence of humans) with accelerated sea level rise due to human-induced global warming. Though the present configuration and associated environments of this finger of land we know so well seem very permanent and stable, these most recent conditions constitute only about 0.001% of Florida's geological history. Let's now, with the help of some of Florida's formations, take a look at the rest of its still-unfolding story.

FLORIDA SUBMERGED
The Cretaceous, Paleocene, and Eocene (145 to 34 million years ago)



(Adapted from *Roadside Geology of Florida*; Bryan, Scott, & Means; 2008; Kosche)

GLOBAL CONDITIONS
- Earth is in a global "greenhouse" state, with warm climates and extremely high sea level because of an absence of continental glaciers.

FLORIDA PLATFORM CONDITIONS
- The Florida Platform is all or mostly submerged under a shallow sea. By the Late Cretaceous, a seafloor channel develops (the Suwannee Channel), isolating most of Florida from the siliciclastic sediments (quartz sand and silt, and clay) discharged by mainland North American rivers, and allowing for the formation and buildup of carbonates.

FLORIDA BIOTA
- Florida exists as an underwater home to a diversity of marine flora and fauna.

FLORIDA GEOLOGY
- Reefs and shoals form around the margins of the submerged Florida Platform, restricting water circulation and creating an evaporative lagoon. Sands, clays, shales, and conglomerates are deposited at the outflows of the mainland rivers, and evaporites and carbonate rocks—limestones and dolostones—form in the warm shallow seas. *(MAJOR FLORIDA GEOLOGICAL FORMATIONS: Avon Park Formation, Ocala Limestone)*

Florida Sinks Into the Sea

After the supercontinent Pangea broke up about 230 million years ago, and the larger continental plates began migrating apart, Florida started to become slightly more recognizable. When Pangea rifted apart, Florida's basement rocks split from their surrounding African source strata and remained sutured instead to the trailing edge of the North American Plate. With the cooling of the crustal rock after the rift, the continental plate margin gradually subsided into the sea, taking the foundational bedrock of Florida with it. Florida would enter the carbonate-building phase of its geological story as a submerged peninsular projection off the southeastern end of the slowly drifting North American continent.

During the time spanning from the Cretaceous Period through the Eocene Epoch, the earth saw some of its hottest temperatures and highest sea levels. The world was in what scientists call a "greenhouse" state, with an absence of continental glaciers, higher carbon dioxide levels, and warmer oceanic and atmospheric temperatures.

Because of the high sea levels, coupled with the post-rift subsidence, Florida during this time period existed primarily underwater.

Building Up the Underwater Platform

Being awash in warm shallow saltwater made ancient Florida a prime candidate for carbonate rock formation, but to be a good "carbonate factory" it also needed clear, sunlit waters protected from influxes of clastic sediments. Eroded sand and rock material (called *siliciclastics* because they are rich in the mineral quartz, SiO_2) were constantly being deposited by mainland North American rivers into the waters above Florida, and this deposition might have prevented Florida's carbonate platform from forming had it not been for the protective effects of the Suwannee Channel.

The Suwannee Channel was the first major manifestation of the Georgia Channel System, a fluctuating prehistoric waterway between Georgia and Florida. Opening in the Late Cretaceous over the depressed suture zone where Florida became welded to North America during the formation of Pangea, the Channel was a current-swept seafloor depression cutting across the top of Florida. It provided a protective current barrier that blocked siliciclastic sediments eroding from the southern Appalachian Mountains from reaching Florida's developing carbonate platform. While sands, clays, shales, and conglomerates built up where these mainland rivers discharged into the sea (primarily in what is now north Florida and the panhandle), the rest of the submerged Florida peninsula, isolated as it was by the Suwannee Channel, was able to accumulate thick layers of carbonate rocks such as limestones and dolostones (dolostone, or dolomite, is similar to limestone, but contains the element magnesium).

Biology Becomes Geology

During the Cretaceous, unusual and abundant oyster-like bivalves called *rudists* were responsible for the construction of extensive carbonate reefs and shoals along the continental shelf edges and on the shallower inner shelf of the Florida Platform. These reefs and shoals continued to build, and where they surrounded the submerged peninsula, they served to restrict water circulation across the Platform, creating a central evaporative lagoon which allowed for the formation of salts and other evaporite minerals (like anhydrite and gypsum) from Paleocene to middle Eocene times.

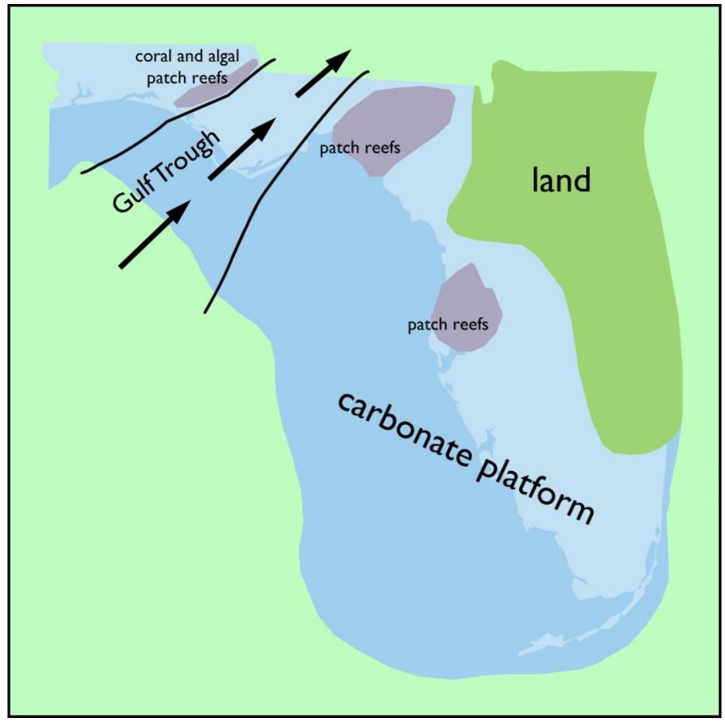
Carbonates continued to accumulate across the Florida Platform, and two major rock units—or *formations*—that were deposited during this time are the Avon Park Formation and the Ocala Limestone. The middle Eocene Avon Park Formation limestones and dolostones are the oldest rocks that can be found exposed at Florida's surface, and they sometimes contain well-preserved seagrass fossils indicative of their shallow water formation. The upper Eocene Ocala Limestone was deposited during the late Eocene, and is a widespread Florida formation that is rich in invertebrate fossils, including the single-celled foraminifera—some of which were quite large. It also contains echinoids and mollusks, including some unique "Tethyan" species related to similar-age Mediterranean region forms. During this time, the westerly currents of the ancient Tethys Sea swept the globe between the, then-unconnected, northern and southern continents, and had the effect of spreading similar biota across places as far-flung as Europe and Egypt, the Indian and Pacific oceans, as well as Florida and the Caribbean.

Other species of the Eocene, represented in the fossil record of these formations, include sea turtles, sea snakes, primitive dugongs (manatee-like creatures), toothed archaeocete whales, fish, sharks, and rays. The earlier Paleocene and Cretaceous-age formations have their own distinctive fossil fauna. Remains of ammonites and crinoids, bryozoans, brachiopods, bivalves, and larger foraminifera have been recovered from deep wells that penetrate these much older strata. During the vast span of time from the Cretaceous through the Eocene—over a hundred million years!—Florida was a rich underwater environment of both shallow and deeper water marine habitats, which supported a diversity of animal and plant life.

[**Feature**: *FLORIDAN AQUIFER SYSTEM*]

The Floridan aquifer system is one of the most productive aquifer systems in the world, and is the source of most of Florida's drinking and spring water. Limestone's porosity and its susceptibility to dissolution by permeating groundwater are what enable the Floridan aquifer to hold so much water. The Eocene-age Avon Park Formation and Ocala Limestone are the main rock formations that make up our Floridan aquifer system, with earlier evaporite sequences forming much of its base.

PARADISE ISLAND
The Oligocene
(34 to 23 million years ago)



(Adapted from *Roadside Geology of Florida*; Bryan, Scott, & Means; 2008; Kosche)

GLOBAL CONDITIONS

- Earth enters a global "icehouse" state, in which climates cool and sea level generally falls (by over 300 feet in the late Oligocene) as continental glaciers grow over Antarctica.

FLORIDA PLATFORM CONDITIONS

- Much of the Florida Platform is exposed as a large island or islands. The intercepting currents of the Gulf Trough keep Florida largely separated from mainland North America's sediment discharge.

FLORIDA BIOTA

- By the late Oligocene, the first land animals appear in Florida's fossil record, while the surrounding shallow seas continue to diversify with life.

FLORIDA GEOLOGY

- Erosion and karstification start to act upon the soluble carbonate rock of Florida's exposed land areas; but limestone continues to form among patch reefs and in other underwater marine environments. *(MAJOR FLORIDA GEOLOGICAL FORMATIONS: Suwannee Limestone, Marianna Limestone, Bridgeboro Limestone)*

From "Greenhouse" to "Icehouse"—Land at Last!

The start of the Oligocene Epoch was marked by a significant global cooling event, in which the warm, high carbon dioxide, high sea level "greenhouse" conditions of the prior 250 million years or so gave way to the variable "icehouse" conditions that still prevail today. When in an "icehouse" state, the earth has continental ice sheets present, and these glaciers advance (grow) and retreat (melt) in recurring intervals that scientists call "glacial" and "interglacial" periods. The cooling temperatures, growing Antarctic ice sheets, and falling sea levels of the Oligocene had profound effects on the evolving Florida Platform. It was during this time that parts of Florida emerged from the sea and became land.

Toward the end of the Eocene, the Suwannee Channel narrowed and diverted northeast to form the Gulf Trough. Though this new configuration of the Georgia Channel System did not cut all the way to the Atlantic Ocean, it still served to isolate Florida from eroded sediments being discharged by North American rivers. This protection from mainland-derived siliciclastics allowed limestone to continue to form in submerged areas of the Florida Platform throughout the Oligocene. Though the dropping sea levels probably resulted in much of the northeastern peninsula gradually becoming exposed as a large island, or islands, there was still a lot of carbonate-building that occurred across the various and shifting underwater portions of Florida during this period.

The primary carbonate rock formation of the Oligocene is the Suwannee Limestone, which shows evidence of having formed in much shallower water (and even coastal settings) than earlier Eocene limestones. Small coral patch reefs grew across widespread areas of the Platform during this time, and deposits like these are the source of much of Florida's agatized, or silicified coral (formed when silica from groundwater replaces fossil corals over time). A stretch of coral and algal patch reefs that developed along the northern edge of the Gulf Trough, in what is now the western panhandle, formed the Bridgeboro Limestone; and a deposit of muddy calcium carbonate that accumulated across much of the greater panhandle became the Marianna Limestone formation.

Come to Our Island—Life Finds Florida

This Marianna Limestone has yielded fossil remains of many marine vertebrates, including bony fish, dugongs, sharks, and a rare species of sea turtle. Oligocene-age carbonate layers contain larger foraminifera and other marine invertebrates as well. It is notable that this epoch saw the first appearance of terrestrial vertebrate species in Florida's fossil record. Fragmentary faunal remains found in central Florida sinkhole deposits indicate that in middle and later Oligocene times land mammals somehow found their way out onto the newly emerged dry ground, perhaps for the first time. This migration is thought to be related to a major mid-Oligocene sea level fall of over 300 feet, which likely created land corridors between North America and parts of Florida. Saber-toothed cats, oreodonts, primitive horses, and other large and small land-dwelling mammalian species roamed ancient Florida by the late Oligocene, and their presence represents the onset of a new chapter in our geological story, with the introduction of terrestrial processes to the ongoing evolution of the Florida Platform.

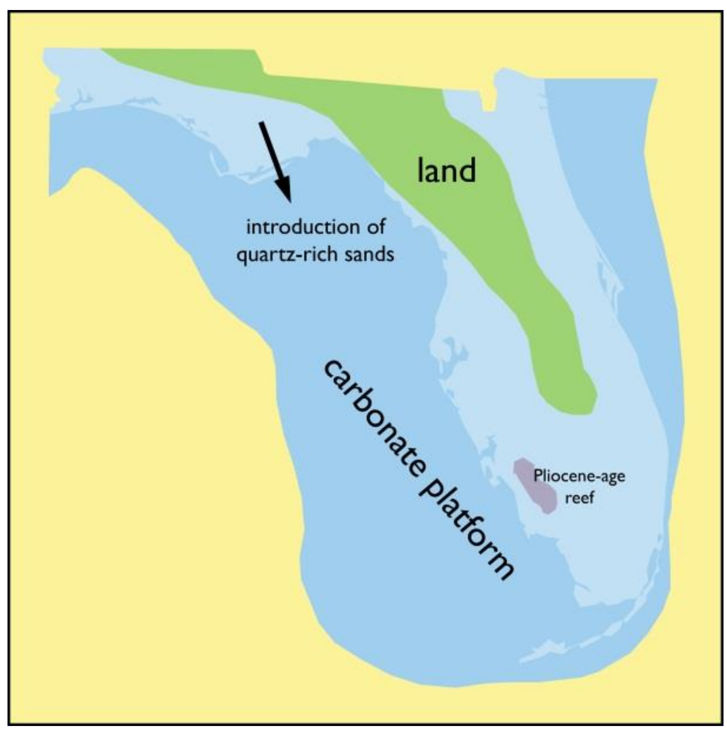
Eroding the Emergent Landmass

As parts of Florida became land in the Oligocene, the exposed carbonate rocks of the drained platform began to weather and erode in a process called *karstification*. In this process, acidic rain and groundwater percolate into the rock and actually dissolve the porous limestones and dolostones, enlarging holes and fractures in the stone, weakening the crystal structure, and creating cavities and fissures in the surface and underlying rock layers. Karst landscapes are those formed of this eroded limestone, and here in Florida they are often characterized by sinkholes, depressions, springs, underground streams, caves, and caverns.

[**Feature**: *KARST TOPOGRAPHY - SPRINGS, CAVES, SINKHOLES*]

The karst topography of northern and central Florida is famous for its artesian springs, caves, and sinkholes. Water from the Floridan aquifer system flows up and out of dissolution fissures in the eroded karst limestone of the Florida Platform, discharging large volumes of crystal clear, cool water into lakes, rivers, spring runs, and even occasionally marine environments. The remarkable blue-green spring pools that surround some springhead "boils" can form when underground karst cavities collapse from above and form surface depressions, or sinkholes, that intersect with the aquifer.

FLORIDA CONNECTED
The Miocene and Pliocene
(23 to 2.6 million years ago)



(Adapted from *Roadside Geology of Florida*; Bryan, Scott, & Means; 2008; Kosche)

GLOBAL CONDITIONS
- Earth remains in a global "icehouse" state, with climates continuing to cool, sea level still low, though fluctuating, and continental glaciers generally advancing.

FLORIDA PLATFORM CONDITIONS
- The Florida Platform's exposed land area varies in size with sea level changes (entirely submerging at times in the early and middle Miocene). The Florida peninsula finally becomes fully connected to the rest of North America when siliciclastic sediments coming from the eroding Appalachian Mountains completely infill and overtop the Gulf Trough.

FLORIDA BIOTA
- The uplift of the Panamanian Land Bridge joins North and South America for the first time, setting off a major biotic exchange that brings South American land animals to Florida, while at the same time isolating and altering Atlantic and Pacific marine communities.

FLORIDA GEOLOGY
- Limestone continues to form where Florida is submerged; but after the Gulf Trough infills, large volumes of quartz-rich sediments flow onto the Florida Platform for the first time, producing a varied mix of

siliciclastic, phosphatic, and carbonate deposits. *(MAJOR FLORIDA GEOLOGICAL FORMATIONS: Alum Bluff Group, Hawthorn Group, Miccosukee Formation, Intracoastal Formation, Tamiami Limestone)*

Bridging the Gap—The Invasion of the Clastics
In the early Miocene Epoch, tectonic uplift occurring in the southern Appalachian Mountains had a tremendous impact on the remainder of Florida's geological history. Increased erosion as a result of the uplift produced exceptionally high levels of sediment influx in areas downstream of the mountains, and these quartz-rich sediments (siliciclastics) being deposited with renewed intensity above Florida would eventually fill the Gulf Trough. The Gulf Trough was part of the evolving waterway known as the Georgia Channel System, which angled across the bottom of present-day Georgia and had been protecting the carbonate-building environment of the Florida Platform from being disrupted by too much introduced clastic sediment. When this insulating ocean cut finally infilled, fully merging Florida with the rest of North America, the result was the arrival of large volumes of quartz-rich sediments onto the Florida Platform.

With global temperatures continuing to cool, and continental glaciers generally advancing, earth remained in an "icehouse" state. Sea levels were still relatively low, but they would continue to fluctuate. There were even times in the early and middle Miocene when water completely covered the Platform. By the late Miocene, though, a significant fall in sea level left much of Florida exposed as land, and it would remain a sizable, if at times narrow, peninsula throughout the Pliocene Epoch.

Enter, the Sand
Where and when the Florida Platform was underwater, carbonates continued to form, but they tended to be mixed formations, containing quartz-rich clastic sediments such as clay, sand, silt, and gravel, introduced by rivers flowing down from the north. Formations in the Miocene-age Alum Bluff Group and Hawthorn Group are examples of these mixed deposits that formed across the state during higher sea levels, and some of these formations have yielded economically important minerals such as fuller's earth clay (or attapulgite clay, used in cat litter) and phosphorite (used in fertilizers and detergents). In the Pliocene, when only the flanks and southern peninsula of Florida were submerged, some reef formation occurred, but more notably, the extensive shell beds of South Florida's Tamiami and Caloosahatchee formations were deposited. These fossiliferous strata of mixed carbonates and siliciclastics are among the world's most species-diverse fossil shell beds.

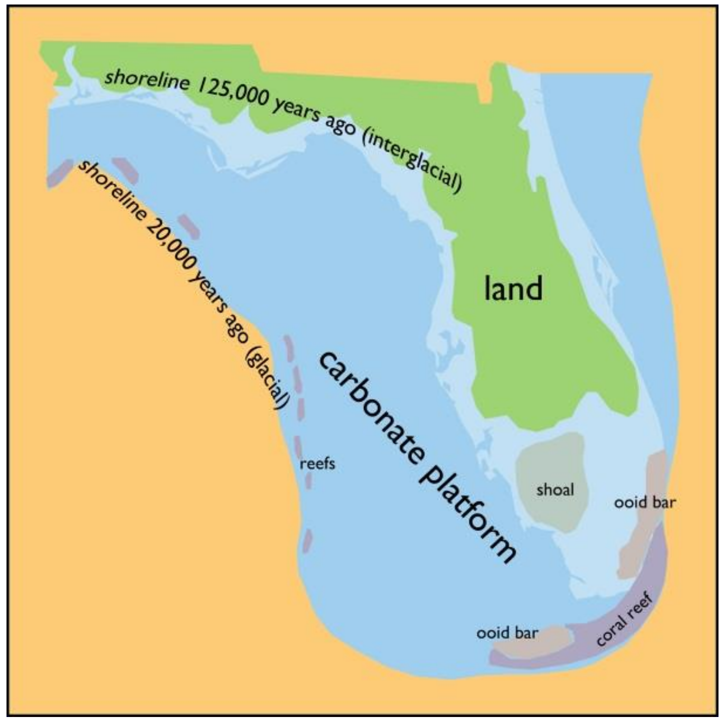
By the end of the Pliocene, the quartz-rich siliciclastics arriving from the north became the dominant sediment type across Florida. Sandy beaches and barrier islands began amassing along Florida's fringes. Late Pliocene formations in the panhandle included the Intracoastal Formation, and delta deposits such as the Miccosukee Formation and the unconsolidated Citronelle Formation. Peninsular formations were mainly unconsolidated marine sand deposits like the Cypresshead Formation.

Bridge to South America—Llamas for Terror Birds
Changes in the occurrence of various mollusks and other marine invertebrates during Miocene and Pliocene times indicated cooling water temperatures and shifting ocean currents. The infilling of the Gulf Trough increased water circulation in the Gulf of Mexico, but perhaps an even more significant event effecting Florida's marine environments was when North and South America became connected for the first time in the Pliocene. When tectonic uplift created the Panamanian Land Bridge, this narrow strip of land connecting the continents not only isolated marine communities on both sides of the isthmus, but it also drastically altered tropical Atlantic Ocean circulation, intensifying currents in the Gulf of Mexico as well as Gulf Stream flow along Florida's east coast.

The land bridge also impacted Florida's terrestrial communities, setting off what has been called the Great American Biotic Interchange, where animals that were endemic (native) to South American migrated into North America—many making their way into Florida—and vice versa. Some South American immigrants found in Florida's fossil record are glyptodonts (giant armadillo-like creatures), giant flightless carnivorous birds known as terror birds, giant ground sloths, porcupines, armadillos, and opossums. Other Miocene and Pliocene land animals included camels and llamas (both of which are actually thought to have originated in *North* America!), pronghorn antelopes, shovel-tusked elephants and other gomphotheres, giant tortoises, tapirs, rhinoceros, hyena-like bear-dogs, three-toed horses, and saber-toothed cats. Whales, sharks, rays, and dugongs were common in marine environments of this time period, as well as the giant shark known as *Megalodon*.

[**Feature**: *SAND BEACHES*]
The beaches of Florida and its sandy soils are derived from clastic sediments eroded from the Appalachian Mountains. The sediments came down from the north, transported by rivers, and spread across the Florida Platform starting in the Miocene. They were mostly made up of quartz (silicon dioxide, SiO_2), so are also called siliciclastics. Beach deposits vary in color depending on their ingredients. Northwest Florida's white sand beaches are made of mostly pure quartz (or silica) sand, while some of the state's southernmost beaches are white because of calcium carbonate derived from limestones. The brownish to grayish sands of the Atlantic coast are a mix of quartz sand and shell fragments, with striking orange sands found from Daytona to Matanzas because of coquina shell fragments that have absorbed iron oxide. The unusual blackish-gray sands of the Venice area beaches on the Gulf Coast are a result of dark fossil fragments intermixed with the quartz grains.

ICELESS ICE AGE
The Pleistocene
(2.6 million to 11,700 years ago)



(Adapted from *Roadside Geology of Florida*; Bryan, Scott, & Means; 2008; Kosche)

GLOBAL CONDITIONS
- Earth enters "The Great Ice Age" of recurrent, periodic, and widespread glaciation, with cooler and drier global climates, and fluctuating sea level that ranges from higher than present to a record low. Huge continental glaciers form across Eurasia and North America and reach their maximum sizes near the end of the Pleistocene.

FLORIDA PLATFORM CONDITIONS
- The Florida Platform was never glaciated, but as a result of glacial-interglacial cycles within the larger "ice age," the Florida landmass ranges from a narrow peninsula to nearly twice as large as its present size.

FLORIDA BIOTA
- Florida is home to a wide array of ice age mammals such as horses, mastodons, mammoths, saber-toothed cats, bison, wolves, bears, and giant beavers. The Bering Land Bridge is exposed by low sea level, temporarily reconnecting Asia with the Americas and allowing humans to enter North America and Florida.

FLORIDA GEOLOGY
- Quartz sand deposition dominates across the state, but shallow marine realms continue to develop limestone formations around reefs, shoals, and shell beds in southern Florida and along the coasts. *(MAJOR FLORIDA GEOLOGICAL FORMATIONS: Anastasia Formation, Miami Limestone, Key Largo Limestone, Fort Thompson Formation)*

Land Booms and Snow in the Forecast
Though the earth had been in a global "icehouse" state for the past 30 million years since the Oligocene, the Pleistocene Epoch was characterized by a dramatic intensification of these cooler climatic conditions, and is sometimes even called "The Great Ice Age." Average global temperatures became even colder during this time, precipitating substantial advances of continental ice sheets, and as a result global sea levels reached new lows.

In North America, a massive continental glacier stretched from Canada to as far south as present-day Kentucky, and record-setting low sea levels would drain the breadth of the Florida Platform, exposing twice as much land as is uncovered today. Florida itself was never glaciated, but it grew cooler and drier with the rest of the world, developing greater expanses of semiarid savannah amongst thinning woodlands. Smaller patterns of temperature flux—between colder (glacial) and warmer (interglacial) periods—within the larger "ice age" prompted the periodic advance and retreat of the ice sheets; and sea level, though generally low, fluctuated in response. The extent of sea level variation in the Pleistocene was between almost 100 feet higher than present levels, to nearly 400 feet lower than today's shoreline at the peak of glaciation about 20,000 years ago. These relatively recent, higher than current sea levels demonstrate the potential for modern anthropogenic global warming to submerge the Florida peninsula again.

The Keys, Coquina, and Ever More Sand

Most of the Florida Platform was still under the influence of the now-dominant, quartz-rich clastic sedimentation patterns established in the Miocene, which brought quartz sand and other imported sediments onto the Platform from the north. Still there were some areas that were conducive to carbonate formation. When sea level was higher during Pleistocene interglacial periods, southernmost Florida was under water, and remained warm enough and protected enough from introduced clastics, to build carbonate rock. The fossilized reef that we know as the upper Florida Keys formed during this time period. Coral reefs, oolitic shoals (made of spherical, egglike, calcium carbonate ooid grains), and deposits of shells and bryozoans all contributed to Florida's Pleistocene-age carbonate formations.

The Fort Thompson Formation, and the Key Largo and Miami limestones, were formed in marine environments across submerged South Florida about 125,000 years ago. The Anastasia Formation, which grades south into the Miami Limestone, was formed from a mixture of coquina shell and sand deposited overtop sections of the submerged Atlantic coast during probably the same high sea level interval. The Anastasia Formation's coquina limestone makes up the underlying spine of the Atlantic Coastal Ridge, a major topographical feature that runs along Florida's east coast. Blocks cut from this formation were used for building construction in Florida's history. St. Augustine's old Spanish fort, the Castillo de San Marcos, is built from Anastasia Formation coquina rock.

Giant Lions, Saber-toothed Cats, and Short-faced Bears, Oh My!

Fossils recovered from Pleistocene-age deposits in Florida represent a wide range of both terrestrial (land) and aquatic (water) species, but this time period is perhaps best known for its variety of large exotic land mammals, many of which have now become extinct. Some of these unusual "Pleistocene megafauna" were the elephant-like mammoths and mastodons, short-faced bears, bison, antelopes, camels, llamas, horses, dire wolves, giant lions, saber-toothed cats, giant armadillo-like glyptodonts, giant beavers, and giant ground sloths.

Some other remarkable mammals that roamed Florida in the Pleistocene were humans. During the low sea levels resulting from the extensive glaciation of the late Pleistocene, a land connection was created between present-day Russian Siberia and northern Canada. This Bering Land Bridge in combination with an ice-free corridor down western North America, and perhaps progress by boats along the coasts, brought *Homo sapiens* from Asia into the Americas, and eventually to Florida by around 15,000 years ago. These Paleoindian people were hunter-gatherers, and their artifacts and remains are often found in association with other Ice Age mammals that the human groups utilized for food and resources. At the end of the Pleistocene many of these great Ice Age creatures would become extinct. The exact cause is still debated, but it likely involved a combination of factors including warming Holocene climates, and perhaps human interaction.

[**Features**: *CHERT, CALCITE CRYSTALS, (and ANCIENT MASTODONS OF FLORIDA - separate panel)*]

Chert is a variety of very fine-grained (crypto- or micro-crystalline) quartz, which forms when silica from percolating groundwater replaces the calcium carbonate in limestone. Chert fractures like glass, conchoidally, and yields sharp cutting edges, so it was used by Native Americans to make tools and weapons.

Calcite Crystals—Limestone is composed primarily of calcite ($CaCO_3$), a carbonate mineral and the most common form of natural calcium carbonate. Calcite crystals form when dissolved calcite, present in percolating groundwater precipitates out under the right conditions. Calcite can vary in color from white to yellow, orange, and gray, and is found in a variety of different forms in Florida, occurring massively, or needle-like and block-shaped in open cavities or limestone seams. The Fort Drum area is famous for calcite crystals that have formed inside the shells of clams and other mollusks from Pleistocene-age formations. In natural solution caves, like Marianna Caverns, calcite can form stalactites and stalagmites, and rarely anthodites, or "cave flowers."

The ancient American mastodons of Florida (*Mammut americanum*) belong to the order Proboscidea, which also includes mammoths and other elephants. The mastodon family evolved in Africa about 27 million years ago and spread throughout the northern hemisphere, changing very little through time. American mastodons lived in North America from about 5 million years ago until their extinction around 10,000 years ago. American mastodons became widespread in North America, especially during the "ice age" conditions of the Pleistocene epoch. They ranged from Alaska to Florida, but were most abundant in eastern forests. (*This interpretive panel includes further information on mastodons and other proboscideans in prehistoric North America, the overlap of mastodons and humans in North America and Florida, and the eventual extinction of the American mastodon*.)

Acknowledgements

We are indebted to the Florida Geological Survey for many of the specimens in this exhibit; to John Sacha for Florida fossil specimens; to John Rimel, Mountain Press Publishing Company, for permission to include and to adapt maps and formation charts from *The Roadside Geology of Florida*; to Jonathan R. Bryan, Thomas M. Scott, and Guy H. Means, whose scholarship in *Roadside Geology of Florida* has informed the exhibition, especially organization of time periods and its narrative; and to the Florida Museum of Natural History's exhibit, "Florida Fossils: Evolution of Life and Land."

If You Want to Discover More about Florida's unique geology, unusual rock formations, and fascinating fossils, you will find much to explore with these excellent sources.

Books and Publications

Roadside Geology of Florida, Jonathan R. Bryan, Thomas M. Scott, & Guy H. Means, Mountain Press, 2008

A Brief Geologic History of Volusia County, Florida, Edward German, USGS, 2009 (https://pubs.usgs.gov/fs/2009/3101/)

Florida's Geological Treasures, Iris Tracy Comfort, Gem Guides Books, 1998

Geological History of Florida: Major Events That Formed the Sunshine State, Albert Hine, University Press of Florida, 2013

Guide to Rocks and Minerals of Florida, Ernest Bishop, & Lawrence Dee, Jr., Special Publication No. 8, Florida Bureau of Geology, 1961, *out of print—available in pdf version online* (http://www.dep.state.fl.us/geology/geologictopics/rocks/rock_minerals.pdf)

Exhibits

Florida Fossils: Evolution of Life and Land, Florida Museum of Natural History, Gainesville

Prehistory of Florida Gallery, Museum of Arts and Sciences, Daytona (http://www.moas.org)

Walter Schmidt Museum, Florida Geological Survey, Tallahassee (http://www.dep.state.fl.us/geology)

Websites

United States Geological Survey, Florida— https://www.usgs.gov/science/regions/southeast/florida

Florida's Rocks and Minerals, identification & photos (Florida Geological Survey)
http://www.dep.state.fl.us/geology/geologictopics/rocks/florida_rocks.htm#Rocks of Florida

Florida Geological Survey— http://www.dep.state.fl.us/geology

STETSON UNIVERSITY
Gillespie Museum