**Everglades, Biscayne Bay and Dry Tortugas 1**

1. In this lesson we will start our examination of divergent continental margins by looking at a modern example – the South Florida National Parks. Our study will focus on the Everglades, but Biscayne and Dry Tortugas National Parks will also contribute to our understanding. An important goal here is to understand the depositional processes that have built this modern divergent continental margin so that the formation of ancient DCM’s, as are preserved in the Grand Canyon, will be make more sense.
2. I have to admit that I was skeptical about presenting a lesson on south Florida’s geology, because frankly I didn’t think it had any. After all, this is apparently some of Florida’s “best rock” for climbing! Kind of like surfing in Oklahoma I suppose.
3. Anyway, it turns out that the nation’s most topographically-challenged state has some surprisingly important geologic principles to teach precisely because it is so flat. You see, when sea level changes on such landscapes, shorelines and corresponding depositional patterns shift tremendously. Florida is a carbonate platform that has been alternately exposed and almost completely covered by low and high sea level stands respectively.
4. The peninsula’s status as a carbonate platform starts some 200 million years ago when Pangaea first underwent rifting. Note that Florida will form on the southeastern corner of North America in the little nook between South America and Africa.
5. As rifting progressed, the associated global rise in sea level combined with the tropical climate to produce the perfect conditions for reef growth and the formation of carbonates in ancestral Florida.
6. Because ancestral Florida stayed in the tropics following the break-up of Pangaea, …
7. … reef growth continued largely uninterrupted throughout the Mesozoic, …

10. … and Cenozoic …


14. … until the Pleistocene glacial episodes intermittently interrupted reef growth during intervals when sea levels dropped due to sea water being bound-up as glacial ice.
15. The present interglacial period has risen sea level and promoted reef growth.
16. It’s important to keep in mind that sea level has been both higher and lower than the present level.
17. We will focus on carbonate deposition during the Holocene and the later part of the Pleistocene. During a particularly warm interglacial period 120,000 years ago, global sea levels where 20 feet higher than today. That promoted the deposition of two major south Florida carbonate units – the Key Largo and Miami Limestones.
18. Most of the Florida Keys are made of Key Largo Limestone.
19. … which contains abundant coral fossils …
20. … from patch reef builders like this brain coral. Patch reefs are small isolated reefs that grow between the main barrier reef and the shore.
21. The position of the shoreline 120,000 years ago is represented by the western edge of the Miami Limestone.
22. The Miami Limestone consists of two facies, one of which is oolitic. Oolites are much like pisolites only smaller and less irregular.
23. Like pisolites, oolites form in back reef environments where the warm water drives dissolved carbon dioxide from solution, reducing acidity and promoting the inorganic precipitation of calcium carbonate. Wave action rolls sand grains around …
24. … so that an even coating of calcium carbonate shapes each grain into BB-sized spheres.
25. In calmer parts of the back reef the Miami Limestone is represented by a bryozoan facies.
26. Bryozoans usually form smaller and more delicate colonies than do corals. You may have seen them growing on kelp.
27. The bryozoan facies is highly porous and permeable …
28. … which after deposition allowed groundwater to flow through it and cause extensive solution pitting.
29. Most of that pitting took place about 20,000 years ago during the Wisconsinan glacial period when sea level dropped more than 300 feet.
30. That exposed the entire carbonate platform to carbonic acid-bearing rain, …
31. … which as can be seen in this Florida quarry, just dissolved the dickens out of the limestone such that much of the state is underlain by a veritable limestone honeycomb.
32. During drought years when the water table is very low, the solution cavities are clearly visible in the Everglades as are numerous vein-like channels where the limestone has been dissolved by water flowing across the surface.
33. Beneath the surface there are abundant caverns dissolved in the limestone. As these enlarge and/or the water table drops, their roofs become unstable and many eventually collapse forming sinkholes. Erosion of the sinkhole’s sides broadens and eventually fills-in the sinkhole.
34. Sinkhole formation is common in Florida, especially during drought years when the water table is lower.
35. Sinkhole formation is critical to understanding the geologic processes that have shaped southern Florida’s national parks …
36. … especially the features of Florida Bay …
37. … where a chaotic lacework of islands and shoals formed around channels and sinkholes that were mostly eroded some 20,000 years ago when this area was exposed by low sea level.
38. The rise in sea level following the Wisconsinan ice age had three main depositional consequences. First and foremost is active reef formation, where three important depositional environments developed – the outer reef, the back or patch reefs and the inshore shoals.
39. The outer reef is located several miles seaward of the keys.
40. It is on the outer reef where the water is clearest and therefore sunlight penetration greatest. These are the ideal conditions for Elkhorn coral.
41. The rapid and shelf-like growth of Elkhorn Coral shades the outer reef, inhibiting the growth of other species.
42. In deeper parts of the outer reef, where sunlight is not sufficient to support Elkhorn coral, species like Staghorn coral can gain a foothold.
43. And in the deepest levels of the photic zone, where the water is calmest, fragile sea fans grow.
44. Patch reefs grow between the outer reef and the keys.
45. Typical patch reef builders include brain coral …
46. … and star coral.
47. Because several fish species eat coral, the back reef seabed becomes littered with chewed-up coral skeletal fragments.
48. Currents transport the coral sand and sweep it into shoals, …
49. … where about the only coral that can grow is the sediment and salinity tolerant finger coral.
50. Inshore shoals can become covered with finger coral colonies.
51. Apparently the upper keys are patch reef relicts from the high sea level periods of 120,000 years ago …
52. … whereas the lower keys are relict shoals from the same period.
53. Dry Tortugas National Park circumscribes a group of the most westerly of the relict shoals.
54. The most notable landmark in the park is Fort Jefferson. Built in the mid-1800’s, initially to guard shipping routes in the Gulf of Mexico, the fort’s primarily use ended-up being as a prison.
55. But because the fort was built on unconsolidated coral sand, …
56. … the massive weight of the masonry structure could not be supported and the fort suffered serious cracking shortly after it was built.