**Collision Overview**

1. At this point in the course we are nearing the completion of the Wilson Cycle. Long-time rifted continents will smash together in spectacular slow-motion collisions that affect more rock than any other plate tectonic event. This lesson will give you an overview of the most important changes produced by these collisions and introduce you to their physiographic counterpoints …
2. …along the Atlantic and Gulf coasts of the United States.
3. The Appalachian Mountains will figure prominently in our discussion, …
4. … but the structurally and temporally connected Ouachita and Marathon Mountains will also contribute to our understanding. Although once connected, the three old mountain ranges are now disconnected …
5. … by the cover of younger foreland basin sediments in Texas and still younger sediments along the Mississippi River Valley.
6. Ultimately we will cover five national parks along this great mountain system: Acadia, Shenandoah, Great Smokey, Hot Springs and Big Bend, but for now let’s have a look at the overarching principles.
7. First up, collision intensity can vary. In a relatively “soft” collision between continents, …
8. … only the DCM sediments on one side …
9. … and the accretionary wedge material on the other …
10. … will be affected at the suture.
11. The thick accumulations of sediment become folded and thrust-faulted into mountains, but of relatively low relief.
12. More intense, “hard” collisions will *also* affect the continental basement atop which the DCM sediments are deposited.
13. The old, “hard” igneous and metamorphic rock basement is thrust over DCM sediments along with accretionary wedge material to form much higher mountains.
14. The Ouachita Mountains in Arkansas, with their low relief and folded sedimentary rocks are good examples of “soft” collision mountains …
15. … while “hard” collisions are exemplified by mountains like the towering Swiss Alps where the scale of folding and thrust faulting is much greater and often involves formerly deep-seated igneous and metamorphic rocks as well as their sedimentary covers.
16. In both types of collisions, but to a greater degree in hard collisions …
17. Rocks that were buried deeply during collision …
18. … are later exposed during erosion and isostatic rebound, which is like a boat exposing its hull when it is unloaded.
19. Thus not only will “hard” crust be exposed in “hard” collisions, but eventually erosion and isostatic rebound will expose rocks that where carried to much greater depths and therefore subjected to higher grades of metamorphism.
20. Today the Himalayas represent the very high mountains formed during the initial collision, …
21. … the Brooks Range in northern Alaska represents a range of moderate height after some erosion and rebound …
22. … and the Appalachians represent a much lower mountain range after extensive erosion has occurred. Correspondingly great amounts of isostatic rebound in the Appalachians have now exposed the once deeply buried high-grade metamorphic rocks at the surface.
23. In order to understand the formation of the Appalachians it will be helpful to bear that great depth of exposure in mind and that they once were as high as the Himalayas.
24. In overview, the tectonic development of the Appalachians is seemingly simple.
25. We enter the drama at the end of the Proterozoic about 600 million years ago. North America is separated from Eurasia and the then-joined southern continents (Gondwanaland) by the Iapetus Ocean.
26. Towards the end of the Paleozoic, about 300 million years ago, the Iapetus becomes completely subducted as the continents collide to form Pangaea. The Marathon, Ouachitas, Appalachians, Atlas and Caledonian Mountains represent the sutures of Pangaea.
27. The breakup of Pangaea has left the fragments of Gondwana in North America (Florida, Cuba and the Yucatan Peninsula in Mexico) and divided the sutures between North America, Africa and Northern Eurasia.
28. In cross-section, note that the first sediments to deposit on the supercontinent of Pannotia were deposited in rift valleys.
29. Continued rifting opens the Iapetus Ocean while thick sequences of DCM sediments begin to accumulate over the rift valleys.
30. Subduction in the Iapetus begins in the early Paleozoic forming a volcanic arc and accretionary wedge in Gondwanaland while DCM sediments continue to thicken in North America.
31. The collision that occurs about 300 million years ago between the two massive continents (North America and Gondwanaland) in the Southern Appalachians is of the “hard” type. It thrusts a portion of the North American basement, as well as wedge and arc rocks from Gondwanaland, over folded North American DCM sediments.
32. As Pangaea rifts and the Atlantic Ocean opens, the components formed by the great collision become distinct tectonic provinces while modern DCM sedimentation covers the coastal plain.
33. This arrangement is most clearly seen in the Appalachian Mountains between Shenandoah and Great Smoky National Parks …
34. … where if we construct a cross section …
35. … we can identify the collision-formed elements.
36. The Valley and Ridge Province is largely made of folded and thrust-faulted Paleozoic sedimentary rocks deposited on the old DCM of North America.
37. The Valley and Ridge Province is a fold and thrust belt …
38. … formed by compression much like pushing on a rug. Importantly, there will be a significant amount of detachment that occurs between the relatively soft DCM sediments (the rug) and the relatively hard continental basement (the floor).
39. Compression also breaks and shoves the rock layers along thrust faults.
40. The valley and ridge province has numerous folds and thrust faults.
41. Since the amount of uplift due to folding and thrusting varies along the Appalachians, it is typical for one end of a fold to be higher than the other, producing what are known as “plunging” folds which erode into elongated “V” or “U” shapes.
42. Satellite photos of the Valley and Ridge Province …
43. … reveal numerous eroded plunging anticlines and synclines. The name “Valley and Ridge Province” is derived largely from the effects of differential erosion on the plunging folds. Ridges form where erosion-resistant rocks occur along the folds while valleys develop within the softer rocks.
44. Remember that the Valley and Ridge Province is a fold *and* thrust belt.
45. So along with the folds, thrust faults will complicate the structure.
46. So the VALLEY AND RIDGE PROVINCE is comprised of sedimentary layers of the North American continent that were compressed, faulted and folded like a carpet.
47. The BLUE RIDGE is the hard crust of North America that was deformed and uplifted as the continents collided.
48. The PIEDMONT is made of sedimentary layers and hard oceanic crust that lay between North America and Africa, as well as oceanic islands and various accreted terranes. Relatively young granite also intrudes the older rocks.
49. The COASTAL PLAIN is covered with sedimentary layers deposited along the divergent (passive) continental margin that subsided as the Atlantic Ocean opened.
50. Shenandoah National Park lies on the Blue Ridge while Great Smoky Mountains National Park extends from the Blue Ridge into the Valley and Ridge Province.
51. Parks in the Ouachita and Marathon Mountains lie along the western extension of the deformed sedimentary strata that comprise the Valley and Ridge Province.