**Appalachia 1**

1. In this lesson we tackle perhaps the greatest geological story of the entire course – the geological evolution of the Appalachian Mountains. The Appalachians may not be as topographically striking as the much younger mountains of the western states …
2. … but like the face of an old man, they record a *lot* of history. The long, complex history of the Appalachians is made especially difficult to interpret because unlike the generally arid parks of the west, …
3. … the Appalachians receive quite a bit more precipitation.
4. So deep soils form …
5. … and rock outcrops are rare. I once spent a summer working as a geologist on a gold prospect in the Blue Ridge of Virginia. Typically I’d only come across two or three outcrops a in a whole day of mapping!
6. So it just amazes me that geologists were able to work out the details of how these mountains evolved.
7. Because rock exposures are so limited (stupid plants!), …
8. … and the three National Parks in the region – Acadia, Shenandoah and Great Smokey …
9. … each fall within a different tectonic province and thus record only a portion of the Appalachian’s history, we are not going to study each park separately like we have done thus far in the course. We will instead take the discontinuous rock records from each park (and a few neighboring areas) and weave them together into a nearly continuous tapestry of time for the entire region.
10. The story will cover almost two complete Wilson Cycles ...
11. … each of which consisting of two phases – an opening phase where a supercontinent rifts apart to form an ocean basin; …
12. … and a closing phase where continental fragments move towards one another, destroy an ocean basin and ultimately collide to form a new supercontinent.
13. In the opening phase, rifting produces two divergent continental margins, on top of which thick sequences of sediment accumulate.
14. In the closing phase the intervening ocean basin subducts (often accompanied by the accretion of one or more terranes) and eventually the rifted continents reunite in collision orogenies that build Himalayan-scale mountains that ultimately erode to a form a vast peneplane. Appalachian rocks record a complete Wilson Cycle like this …
15. …preceded by the end of the closing phase of an older Wilson Cycle …
16. … and followed by the opening phase of a younger Wilson Cycle.
17. Each Appalachian park tells different portions of the story and with varying detail.
18. Acadia National Park will receive special mention for recording Quaternary glacial and coastal processes. Let’s begin with Shenandoah National Park since it has the best rock record of the initial collision orogeny.
19. Located in Northern Virginia, Shenandoah National Park stretches-out along a 75 mile long portion of the Appalachian’s backbone – the Blue Ridge.
20. Recall that the Blue Ridge represents the “hard” igneous and metamorphic basement of North America thrust over the folded and thrust faulted DCM sediments of the Valley and Ridge province.
21. By some estimates, thrust faulting moved these rocks about 150 miles westward from their pre-thrust location. Thrust faults are formed by compression, and so are folds, so it should make sense that Blue Ridge rocks are folded as well as well as faulted.
22. In Shenandoah National Park, the thrusted block of hard crust is bent into a giant overturned anticline.
23. Anticline because the sloping layers tilt away from (or anti) the center of the fold, …
24. … and overturned because younger rocks on the fold’s western limb have been folded under older rocks in the core of the anticline - in flagrant disregard of the principle of superposition!
25. The oldest rock is the 1.3 billion year old Pedlar gneiss. It is intruded by the Old Rag granite which radiometrically clocks in at about a cool billion years old. Resting nonconformably above these Proterozoic crystalline basement rocks lie the late Proterozoic Catoctin Formation (mostly metamorphosed basalt) and folded Paleozoic sedimentary rocks.
26. Rocks of similar ages and types occur in Great Smokey National Park, where they form a much larger and more highly deformed syncline…
27. … with a different and much thicker sequence of Proterozoic sedimentary and metamorphic rocks in its core. Notice, however, that the Proterozoic gneiss and granite basement has limited exposure in the Smokey's, but is relatively well exposed in Shenandoah.
28. The Shenandoah Blue Ridge exposes these rocks on several of its peaks – such as Mary’s Rock and Old Rag Mountain. Just below Mary’s Rock is Mary’s Rock Tunnel where motorists on famous Skyline Drive….
29. … are greeted with an official park service sign proclaiming the 1.3 billion year age ….
30. … of the Pedlar Formation.
31. The Pedlar Formation is a granite gneiss, which is a compositionally-banded metamorphic rock formed by the intense compression and heating of granite (A). In this case the gneiss records the grand Proterozoic collisions between North America and Africa that created the supercontinent of Rodinia.
32. Known as the Grenville Orogeny, this “event” first involved various subduction orogenies that produced granite batholiths. The orogeny culminated in the thrusting of Africa onto North America, which compressed and buried the granite batholiths, metamorphosing them into granite gneiss.
33. Grenville rocks outcrop discontinuously along a belt that extends from southern Scandinavia, to Great Briton, Labrador, throughout Appalachia, portions of the southern and southwestern states and possibly into Australia and Antarctica. They are the oldest rocks along the east coast and have had a long, complex history that culminated in the Grenville orogeny about 1.1 billion years ago.
34. After the bulk of the Grenville compressional deformation had ended …
35. … the Old Rag granite was intruded. Notice that it is not foliated like the Pedlar Formation - clearly indicating that it was intruded into the previously deformed Grenville crust.
36. Old Rag Mountain is the type locality for the Old Rag Granite and is one of the most popular hikes in all of Appalachia.
37. Not only does the summit provide a wonderful eastward vista across the Piedmont and Coastal Plain, …
38. … but the exceptionally clean outcrops here offer rock lovers of all types….
39. … a rare respite from the usual east-coast “tyranny of green”.
40. Recall that the Blue Ridge rocks where thrust up and over the Paleozoic sedimentary rocks of the Valley and Ridge province.
41. The thrust fault, known as the Blue Ridge fault, lies at the base of the “Blue Ridge Overthrust" – a massive complex of Blue Ridge basement rocks and various tectonostratigraphic terranes in the Piedmont Province.
42. As the Blue Ridge Overthrust pushed westward along the Blue Ridge Fault, it folded into a great overturned anticline with younger sedimentary and volcanic rocks flanking its sides. In Virginia these are represented by the Lynchburg, Swift Run and Catoctin Formations and the Chilhowee Group. Because these rocks were deposited directly atop the Pedlar Formation and Old Rag Granite which where once buried deeply under a Grenville-age mountain range of Himalayan scale, we know that there must have been a period of deep erosion that took place after these rocks formed. Since the oldest of the post Grenville surface rocks deposited about 600 million years ago, those mountains had about a half a billion years to wear down.
43. Since it only takes about 20 million years for a mountain range to be eroded after orogeny ends, there was more than enough time for the Grenville Mountains to be replaced by a vast peneplain.