**Great Basin National Park**

1. Great Basin National Park is one of our newest and least-visited national parks.
2. It is located both within the Basin and Range geomorphic province and the Great Basin hydrographic province. The two are often confused since they are related and cover similar areas. As we have seen, the Basin and Range is an area of extensional tectonics characterized by basin and range topography. The Great Basin is on the other hand is defined on the basis of drainage. It is a vast are of internal drainage where not one drop of rain that falls there will flow into the ocean. The two provinces are related because the extension that produced basin and range topography also thinned and lowered the crust so much that the Great Basin formed.
3. Mental images of central Nevada vary…
4. … but rarely does this come to mind. It’s hard to believe this is in Nevada. Stick a chalet in the picture and you’d think it was Switzerland! Spanning altitudes between 6,000 and 13,000 feet, the park contains diverse biological zones ranging from desert sagebrush in the lower elevations to mountain meadows and pine forests at higher elevation. Above the tree line there is an alpine zone containing low, delicate plants and rocky outcrops.
5. The park’s central landmark, Wheeler Peak, at 13,063 feet is the second highest point in Nevada. Note the vertical cliff here indicating that it must be made of very strong, durable rock. If you look closely you should be able to see regular, continuous layering indicating that this must be derived from some kind of sedimentary rock. This is metamorphosed quartz sandstone…
6. … or quartzite! Comprised of fused quartz sand grains, quartzite is the most durable rock I can think of, and I can think of a lot of rocks. The park contains a lot of quartzite. It’s found mostly at higher elevations due to its resistance to erosion.
7. Elsewhere in the park, like here at Lexington Arch, limestone is the dominant rock type.
8. What tectonic situation does this assemblage of rocks suggest?
9. Did you picture our old friend the divergent continental margin? I hope so. We see a lot more limestone compared to the Grand Tetons because Great Basin National Park is further west. That put it more offshore during the time period when western North America was a DCM.
10. Now try this question: In what geologic era was western North America a DCM? I’ve given you a stupid hint.
11. Yah, just like the Flathead Sandstone in the Grand Tetons, those in Great Basin National Park are also Paleozoic.
12. The geologic structure here is similar to the Tetons as well. Great Basin National Park lies in the southern Snake Range, which is asymmetrical. Note its steep western slopes…
13. … and less steep eastern slopes. Although the directions were reversed, we saw that the Tetons were also an asymmetrical range. Do you remember how that formed?
14. Here’s a scale model of the process done in layered sand. Once again displacement along curved normal faults contributes to the rotation. When the inclination (dip) of normal faults lessens with depth, such faults are known as “listric”, which means shovel-shaped.
15. Listric faults tend occur in the relatively cool and brittle, upper crust. At depth, where higher temperatures make the crust ductile, extension results in horizontal shearing. The brittle crust tends to separate from the ductile crust along great near-horizontal surfaces formed where the listric faults merge at depth.
16. The surface of separation here is known as a detachment fault. The term décollement can also be used, but it is more general, referring to all low-angle faults, including compression-produced thrust faults as well as extension-produced detachment faults.
17. Your book recognizes the normal faulting and décollement in the Snake Range, but they do not show the normal faults as listric. Furthermore, they have placed arrows along the décollement in such a way as to suggest thrust faulting, not detachment faulting. In detachment faulting, rock above the décollement should uniformly slide down, away from the highest portion of the décollement, because detachment faulting is gravity-driven.
18. The discrepancies are once again due to the less-than-cutting-edge references used by your text.
19. Although the detachment fault is poorly exposed in the southern Snake Range where Great Basin National Park lies, it is beautifully exposed in the northern Snake Range. The exhumed rocks below the detachment are known as core complexes. We will look at core complexes in greater detail we get to Saguaro National Park.
20. Core complex rocks near the detachment are highly deformed…
21. … and often exhibit disharmonic folding due to non-uniform stress patterns.
22. Looking west across the southern Snake Range you can see the basic structure tilting layers to the south such that the oldest rocks are to the north. That the grain (strike) of this structure is perpendicular to that of the Basin and Range suggests that it is related some earlier orogeny.
23. The basic structure is complicated by the intrusion of several Mesozoic and Early Cenozoic plutons. These generally lay below the detachment surfaces. Heat from such igneous intrusions helped metamorphose the Paleozoic quartz sandstones into quartzite. Quartzite’s resistance to erosion combined with the pluton-thickened crust here, …
24. … both contribute to Wheeler Peak’s status as the second highest peak in Nevada.
25. That altitude puts Wheeler Peak and a significant portion of Great Basin National Park above the tree line, where glaciers have formed on shaded northerly slopes.
26. The glacier at the base of Wheeler Peak contains an exceptionally large amount of rock debris along with the ice, qualifying it as a rare “rock glacier”.
27. Rock is added to the glacier from the extensive talus deposits here, which are formed by rock debris falling and accumulating at the base of the frost wedged slopes. The Thumb is a good example of the extremely angular topography that results from frost wedging.
28. Notice the rather circular basin surrounding the rock glacier, called a cirque. Cirques form the action of glacial ice frozen to the rocks of the surrounding valley, which are plucked away when the glacier moves. Since rock protrusions into the cirque are more susceptible to plucking than smooth surfaces, they tend to be removed and the basin becomes ever more circular and bowl-like.
29. If the glacier melts, then a circular lake will fill the cirque called a tarn. There are several tarns in the park including Lake Teresa,…
30. … and Lake Stella. Tarns usually form in cirques, but they can form anywhere along glacial troughs where plucking removes soft or fractured rocks.
31. At slightly lower elevations ice melts to provide just enough water to support Bristlecone pines.
32. Few other plants can survive under these harsh conditions, …
33. … but the Bristlecone pines, by virtue of their long life spans, can take advantage of long term variations in climate which eventually become favorable to growth.
34. Although certain cloning plants are older, Bristlecone Pines are the oldest single plants on earth. This one is 3500 years old.
35. But this one, dubbed “Prometheus”, was over 5000 years old when it was cut down in 1964 for dendrochronology studies. It was the oldest living single organism ever dated, and now it’s dead. Criticism over how permission to cut down the tree was granted contributed to the establishment of Great Basin National Park in 1986. So if you’re sad about the loss of the old tree, it might help to know that its sacrifice helped protect the rest of the grove and its rings have added greatly to our understanding of Holocene climatology.
36. Melt water eventually makes its way to lower elevations, …
37. … where it soaks into the loose gravel of low-lying valley sediments. The water table becomes especially high at the confluence of these groundwater sources and that’s essentially where Lehman Caves are. Notice that Lehman Caves are situated on an outcrop of Paleozoic limestone mostly surrounded loose gravel. Groundwater from the gravels permeated into fractures within the limestone, eventually dissolving it to form the caves.
38. Notice how nearly level the caves are in profile.
39. That’s because Lehman Caves formed at or very near the water table, probably during glacial ages when the climate was wetter and the water table was higher. Limestone dissolves in the presence of acidic water, which usually results from the reaction of atmospheric CO2 with H2O to form H2CO3 which is carbonic acid. The water in the saturated zone below the water table moves slower than water percolating down, so it is in contact with the rock for a longer period of time to dissolve it.
40. Limestone dissolves in the presence of acidic water, which usually results from the reaction of rain water with atmospheric CO2 to form H2CO3 (carbonic acid). Surface water that soaks into the ground is relatively acidic, but it does not dissolve much limestone above the water table because it only remains in contact with the rock for a short time. The water in the saturated zone below the water table moves slower than water percolating down, so it is in contact with the rock long enough such that significant solution can take place. Since the reaction of carbonic acid with limestone neutralizes the acid, the optimal conditions for dissolving limestone occur at and just below the water table where fresh carbonic acid is added.
41. Reduced precipitation following the ice ages lowered the water table, drained the caverns and exposed them to the conditions in which speleothems (cave decorations) could form.
42. The decoration process works like this: Limestone dissolved in the acidic water above the   
    cave, re-precipitates when the water’s acidity is reduced upon entering the air–filled cavern where CO2 can escape from the dripping water. Because acidity is most greatly reduced on the surface of a drop where the CO2 escapes, limestone precipitates on the edges of the drop, not the center. This results in hollow speleothems called “Soda Straws”.
43. Soda straws and other icicle-like speleothems on the ceiling of caverns are called stalactites whereas those on the cavern’s floor are stalagmites.
44. Columns are formed when the two join.
45. Lehman Caves is a fairly typical limestone cavern, except that it contains several roughly circular speleothems known as shields. These are apparently very rare in other caverns. I could find no explanation for why they are common here.