**Joshua Tree National Park 2**

1. West coast subduction peaks in the Mesozoic as represented by the intrusion of numerous Triassic, Jurassic and Cretaceous aged plutons into the Proterozoic rocks.
2. Many of these Mesozoic plutonic rocks, like the Granite porphyry of Upper Music Valley …
3. … and the 29 Palms “Granite”, contain very large alkali feldspar “megacrysts”, indicating that as the magma cooled, temperatures must have lingered at the crystallization temperature of alkali feldspar for a very long time, giving those crystals time to grow to enormous sizes. I’m unaware of any tectonic significance indicated here, but they are unusual granites and therefore interesting. While we’re on the topic, let’s practice using the ternary QAP classification of plutonic igneous rocks, from whence we’ll see why this is not really *true* granite.
4. I’m going to give you a problem like this on the test, so make sure you know how to use the QAP diagram. Let’s say the 29 Palms “Granite” contains 15% quartz and a ratio of plagioclase feldspar to alkali feldspar of 40:60.
5. All rocks with 15% quartz would plot somewhere along the red line, so you can see right off the bat that this rock can’t be granite.
6. All rocks with a ratio of plagioclase feldspar to alkali feldspar of 40:60 would plot somewhere along the white line, so you can see that this “granite” is actually quartz monzonite. Don’t worry about memorizing the diagram. It will be provided. Just be able to use it to come up with a rock name given its percentage of quartz and the plagioclase to alkali feldspar ratio like we’ve done here.
7. Let’s try one more. What kind of plutonic rock is this if it contains 25% quartz and the P:A ratio is 50:50?
8. That would make it granite. This, by the way, is the Granite of White Tank,…
9. … - a rock type that makes up many of the boulder piles for which the park is famous.
10. Alright, now let’s get back our story. During the Mesozoic, Joshua Tree lay at the southwestern edge of Laurentia where subduction orogeny was building the mountains that will become the Cordillera.
11. Mesozoic subduction emplaced plutonic rocks throughout the park, but those that form the beautiful boulders are more common in the central and eastern provinces. Apparently, the plutons in the western province were emplaced as a vast network of thin, sill-like masses. Such plutons would cool too rapidly to form the regular fracture patterns required of boulder formation.
12. Plutons in the central and eastern provinces are much larger and more diapiric in shape – like the blobs in a lava lamp. Can you identify the metamorphic and plutonic igneous rocks in this photo? Hint: Boulders form on the plutonic igneous rocks.
13. This should help. Now can you imagine how long it would take such a large mass of magma to cool? The formation of boulders starts with slow, uniform cooling of a relatively large pluton like this.
14. This is just a gorgeous Google Earth view of a highly jointed pluton in Joshua Tree. Can you recognize the oval shape of the eroded diapir? The joints here are nearly vertical and formed by thermal contraction roughly parallel to the margins of the pluton.
15. Split Rock is a particularly good example of vertical jointing.
16. Rock-climbers love vertical joints. Does that make them *crack* addicts?
17. There are also joints which are more horizontal which may have formed by thermal contraction parallel to the tops of the plutons or by expansion when the weight of miles of overlying rock was removed by erosion.
18. Either case will, in combination with the vertical joints, break the plutonic rock into blocks. Now all that’s needed to turn these blocks into boulders is to remove the corners.
19. That happens via a process known as spheroidal weathering, which is a little like what happens to an ice cube in a glass of water. Ice cube corners melt fastest because they have more exposure than edges and faces. Similarly, the corners of granite blocks decompose faster upon weathering than edges and faces, leaving unweathered granite “core stones” surrounded by decomposed granite. Eventually the decomposed rock erodes to leave only the core stone.
20. Well that’s the general idea anyway. What happened at Joshua Tree is just a tad more interesting.
21. It appears that most of the spheroidal weathering took place within a relatively thick soil blanket during the Pliocene Epoch when a more humid climate promoted relatively rapid weathering and soil formation. Later, more arid conditions slowed weathering rates to the point that soil formation could not keep up with soil erosion. The Pliocene soil is eventually washed away leaving the boulders behind.
22. “Skull Rock: at Jumbo rocks campground …
23. … is one of the more striking places that illustrates the cavernous weathering and undercutting by subsurface notching.
24. The eyes probably formed near the water table where groundwater is most acidic. Remember, the same was true for Lehman Caves.
25. Similar subsurface weathering also shaped “Arch Rock”…
26. … and thousands of other shapes…
27. … for which your imagination can surely find names.
28. Soil develops fastest where joints are more closely spaced. Eventually areas of deeper soils preferentially erode leaving areas of fresh rock exposed where joint spacing was greater.
29. Such landforms are known as inselbergs. They’re like rock islands surrounded by a sea of soil.
30. Actually that sea of soil is pretty shallow. It’s called a pediment, which really just amounts to a vast but thin veneer of soil covering the partially disintegrated bedrock.
31. Speaking of bedrock …
32. … could Joshua Tree be where the Flintstones’ creators got their inspiration?
33. OK, OK, I know what you’re thinking. Boulders schmolders, give me something Basin and Rangey! Where are the normal faults, core complexes, mylonites and bimodal volcanism? What about a nice décollement?
34. Well, for the most part you won’t find blatant Basin and Range features here. I suspect we’re too close to the San Andreas Fault and Peninsular Ranges Batholith for that. The best I can do is point out the various outcroppings of largely Pliocene basalt which formed by decompression melting associated with extension.
35. The most visited of these is Malapai Hill…
36. … where basalt flows poured out directly on top of …
37. … a pediment developed on Mesozoic granite.
38. Here’s a collection of extension-related Miocene and Pliocene basalts from several areas around the park.
39. And one more thing that I suppose is Basin and Range-like. Extension has thinned and lowered the crust so significantly in the eastern part of the park that it qualifies as the Colorado Desert.
40. Joshua trees are more common in the higher, Mojave Desert portion of the park.