



Maddie and her younger sister, Amelia, are in the front seat, having a halting phone conversation with their mother. Amelia is spunky, clever and level-headed beyond her years, and still very much a teenager. Especially with her parents, whole experiences and opinions are distilled down to monosyllabic adjectives delivered in monotone.

“So how has your weekend been?”

“Fun”

“Oh that’s so great! Did you guys do anything fun last night?”

“Yeah. We played games. It was good”

Awkward pauses on the other end of the line. I can see Maddie fidgeting in a little in the driver's seat, trying to maintain a good natured facade to her exasperation. She’s been bending over backwards to make sure that Amelia has fun while she’s here visiting for the weekend. Would it be unreasonable for Amelia to come up with some more creative descriptors?

I zone out of the phone conversation and look out the window, watching the squat beige buildings of Twentynine Palms slip by, the jumbled piles of rocks stacked into high hills in the distance.

“Take me away, USGS” I think, as I pull my phone out my pocket and pull up a webpage about the geologic history of Joshua Tree. Even though I’ve learned the basics of this place a dozen times, I always like to refresh, and add the finishing touches to the rich backstory I like to imagine under the surface of these rocks.



High on the rock pile, I leap from boulder to boulder. Each time I fall I reach around to my lower back to cradle the base of my momentarily weightless backpack and cushion it from the jolt of landing. My camera and lenses are used to this kind of beating by now, but no reason to test my luck. My sandals smack the granite, and grip it snugly, my knees absorb my weight with a small flex. This mound of granite is one of the tallest in Joshua Tree, jutting out of the desert floor in a disorganized jumble of rounded cubes.

These rocks are the weathered remains of magma chambers known as plutons, which formed under the crust a quarter-billion years ago. These great globs of melted rock intruded into the bedrock, fracturing and consuming the overlying rock as they forced their viscous glowing

tendrils upward. The source of all this magma was another tectonic plate diving beneath our own, bringing its seawater-altered minerals down to melt into the furnace of the mantle. The water bound up in the chemical structure of these rocks was cooked out as they descended, and the volatile water was forced into the rock above. Much like salt spread on a sidewalk causes ice to melt by introducing impurities to the crystals, added water acts as an impurity in the superheated rock of the crust and causes melting on a massive scale. This liquid magma gathers and grows, and rises up with the lifting power of its own heated expansion.

Cooling as they rose, the magma chambers solidified into masses of granite, their liquid minerals self-assembling into crystals according to their melting points. The first to freeze were the opaque and cream-colored feldspars, followed by the sharp, clear grains of quartz. These rocks cooled quickly, giving little time for similar molecules to seek each other out and coalesce in ordered ranks. Instead of the chunky texture of your average granite countertop, the result is the sharp sand-sized crystals that define Joshua tree granite.

I work my fingers around the course lip of a boulder, crimping my finger pads and grinning with grim pleasure as the razor edges of quartz crystals dig into my skin, providing excellent grip. I place my foot against the wall and hoist my body upward, trusting the my soft rubber soles to cling to the savage sandpaper surface.

Now solidified into bulbous fingers of tan rock, the plutons lay in waiting. Over hundreds of millions of years the kilometers of rock above them slowly eroded away, bringing them closer and closer to the surface. As the rock above them was removed, millions of pounds of pressure bearing down on them started to ease, and the monoliths fractured as they expanded in every direction, filling the new space, splitting into assemblages of approximate cubes. Higher and higher the fractured plutons rose, until groundwater seeped from the surface down into their cracks, chemically altering the edges into clay and soil. Plant roots followed, prying and dissolving with their own excreted acids. Still the erosion continued. The soils and clays washed away, and the first tips of the plutons broke onto the surface.

I pause for a breather at the top, and look out across the desert. The slight overcast is bringing out the colors of the desert that are normally drowned in blinding sunlight-- the mountains on the horizon are increasingly purple with each layer of distance, the palette of earth tones on the valley floor ranges from the burnt grey-brown of desiccating cacti to the creamy tan of salt-flats. From up here you can start to see the fabric of the place, the way vegetation clusters around narrow winding bands of drainages, the way the whole valley sweeps upward at the sides, funneling towards a low point where a river once ran during an age when Joshua Tree was a verdant, temperate place. In my periphery I see Maddie and Amelia crown the ridge behind me, and I turn around to give a whoop.

The plutons might have never come to protrude so prominently if that river still existed, but the drying climate kept them from being cloaked in vegetation and rainfall that would have broken them down into soil. Instead, what erosion does occur in the desert carries sand away from their base with flash floods and high winds, and the rocks protrude higher and higher. But in the absence of water and foliage, another kind of process chips away at the edges of these rocks.

Summer temperatures in Joshua Tree fluctuate from 115 degrees in the day to 50 at night, warming and cooling the rocks and causing them to expand and contract like great breathing mounds.

All materials have a property called the *coefficient of thermal expansion*, which describes how much their size changes with temperature. In some materials, like mercury, this precise relationship between temperature and volume can be harnessed in glass tubes to create thermometers. For the rocks of Joshua Tree, this expansion only creates problems. Granite is primarily made of Quartz and Feldspar crystals, inter-grown to anchor each other into a solid mass. Unfortunately for granite that finds itself in rapidly fluctuating temperatures, quartz and feldspars have a different coefficient of expansion, with quartz swelling and shrinking far more rapidly than its soft creamy companion. Throughout Joshua tree, these fluctuating quartz crystals are constantly wriggling their way out of the surrounding matrix as the desert flits from day to night. This temperature flux is most extreme on the edges and corners of rocks, and so the constant exfoliation of quartz crystals rounds the cubic boulders, and fills the valley with their liberated coarse quartz sand.

We're sitting in that coarse sand now, a layer of insulation on the natural rock shelf where we've stopped to cook dinner and watch the sunset. The sky is verdant turquoise behind the thin horizontal lines of fire in the clouds. The mountains that spent all day as layers of soft purple are now layers of brilliant gold. The wind always picks up during sundown at this spot, perhaps because the air currents change to accommodate the loss of convection in the valley. For now, it's still warm enough to be comfortable, but we're being buffeted by the wind and the camp stove is struggling to heat our pasta. I lift the lid off the pot and see the water isn't even simmering. I wrangle a piece of penne onto a fork tine and bite into it with a distinctly un-promising crunch. Maddie and Amelia fish out their own noodles, and we laugh at the situation. We decide that culinary standards are arbitrary, and waste no time pouring in a whole tub of pesto and going to town. It's hard to view anything as misfortune when you're basking in a scene this radiant. No matter that Amelia might only describe this as "good" later, she's grinning unabashedly, looking just like her sister.