Geology of Western National Parks: Death Valley, CA

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Death Valley - 10 Geology Points

1. Fantastic fans. Beautiful examples of alluvial fans throughout the park. Sediment transported in arroyos deposited in a fan shape morphology from the mouth of canyons.
2. Classic Basin and Range geologic origin. Faults through the park make a pull-apart basin, essentially forming a hole in the earth. Also, rotation of crustal blocks raise Telescope Peak while lowering Badwater basin. Badwater is 282 feet below sea level and will continue to get lower.
3. Ice Age lakes. Death Valley proper was filled with a 100-mile long, 600 foot deep lake within the last 100,000 years (Lake Manley). A series of lakes in the Mojave desert region were connected by rivers at this time. The lakes have come and gone in sync with Ice Age climate change.
4. Extremely thick package of Precambrian and Paleozoic sediments. Mapping of these sedimentary rocks (mostly oceanic limestones, shales and sandstones) indicate a thickness >20,000'.
5. Furnace Creek Formation. Around 4-5 million years ago these rock layers were deposited by an ancient lake in the area. Extensive faulting in the Furnace Creek area has uplifted and tilted these layers (almost vertical in places). They are colorful and very soft rock, so are eroding quickly.
6. Young Volcanism. The ongoing Basin and Range extension provides cracks in the crust, allowing magma from the mantle to essentially "bleed" on the surface. Ubehebe Crater is one of a dozen craters formed about 6000 years ago when magma and groundwater interacted to cause explosive eruptions.
7. Modern sand dunes. These dunes exist due to the ample sand and prevailing wind conditions in the park.
8. Turtlebacks. Dome-shaped small mountains in the park have resulted from bizarre faulting, as younger sedimentary layers slid off from older metamorphic rocks during uplift.
9. Recent seismic activity. Throughout Death Valley there is evidence of recent earthquake events, where faults have breached the surface, offsetting the rock. Several alluvial fans in the park display linear fault scarps.
10. Mineral deposits. In particular borate and salt minerals mined from the valley floor.

Geologic Overview of Death Valley

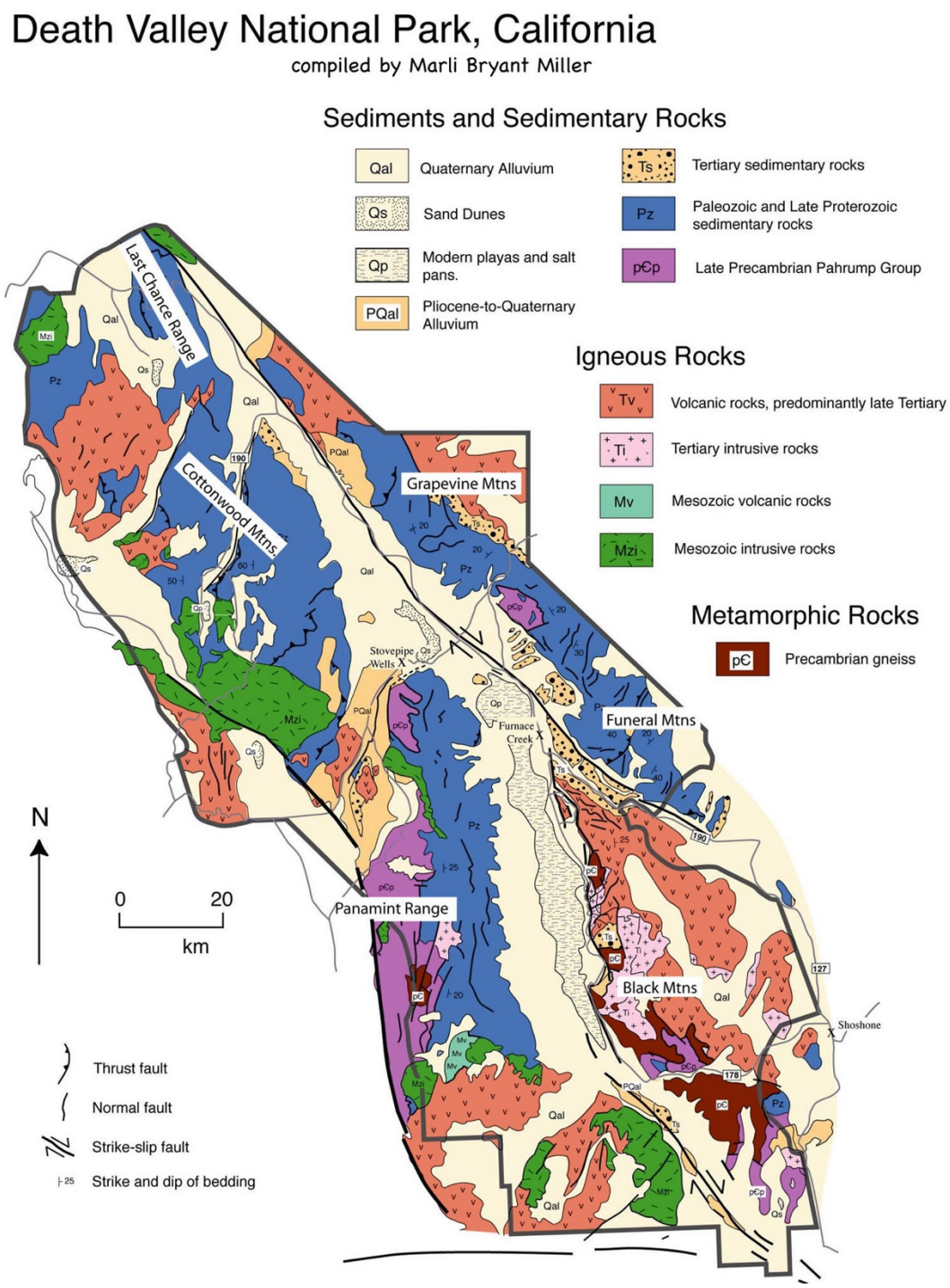
Death Valley's rocks, structure and landforms offer a wealth of information about what the area may have looked like in the past. It is apparent that there has not always been a valley here. Death Valley's oldest rocks, formed at least 1.7 billion years ago, are so severely altered that their history is almost undecipherable. Rocks dating from 500 million years ago, however, paint a clearer picture. The limestones and sandstones found in the Funeral and Panamint Mountains indicate that this area was the site of a warm, shallow sea throughout most of the Paleozoic Era (542 - 251 million years ago.)

Time passed and the sea began to slowly recede to the west as land was pushed up. This uplift was due to movement occurring far beneath the Earth's surface. Scientists have discovered that the Earth's crust is composed of inter-connected sections, or plates. Death Valley lies near the boundary between two of these plates. As the plates slowly move in relation to each other, compressional forces gradually fold, warp and fracture the brittle crust. This widespread rock deformation and faulting occurred through most of the Mesozoic Era (251 - 65.5 million years ago.) While the Rocky Mountains and the Sierra Nevada formed, active mountain building alternated with times when erosion prevailed, worked to breaking down the mountains that had formed.

The next phase in Death Valley's development was primarily influenced by volcanic activity that spanned much of the Tertiary Period (65.5 - 2 million years ago.) As fault movement and mountain building stretched the land surface, the crust was weakened. Hot, molten material beneath the surface welled up and erupted at these weak points. The seething volcanoes first appeared to the northeast, in Nevada, and blanketed the Death Valley region with numerous layers of ash and cinders. The topography then consisted of gently rolling hills, perhaps similar to the present-day Skidoo area. Over time, the center of volcanic activity moved progressively westward, finally producing a chain of volcanoes from Furnace Creek to Shoshone, burying the ancient rocks of the Black Mountains. Secondary results of the ash and cinder eruptions include the vivid colors of the Artist's Palette and Death Valley's famous borate mineral deposits.

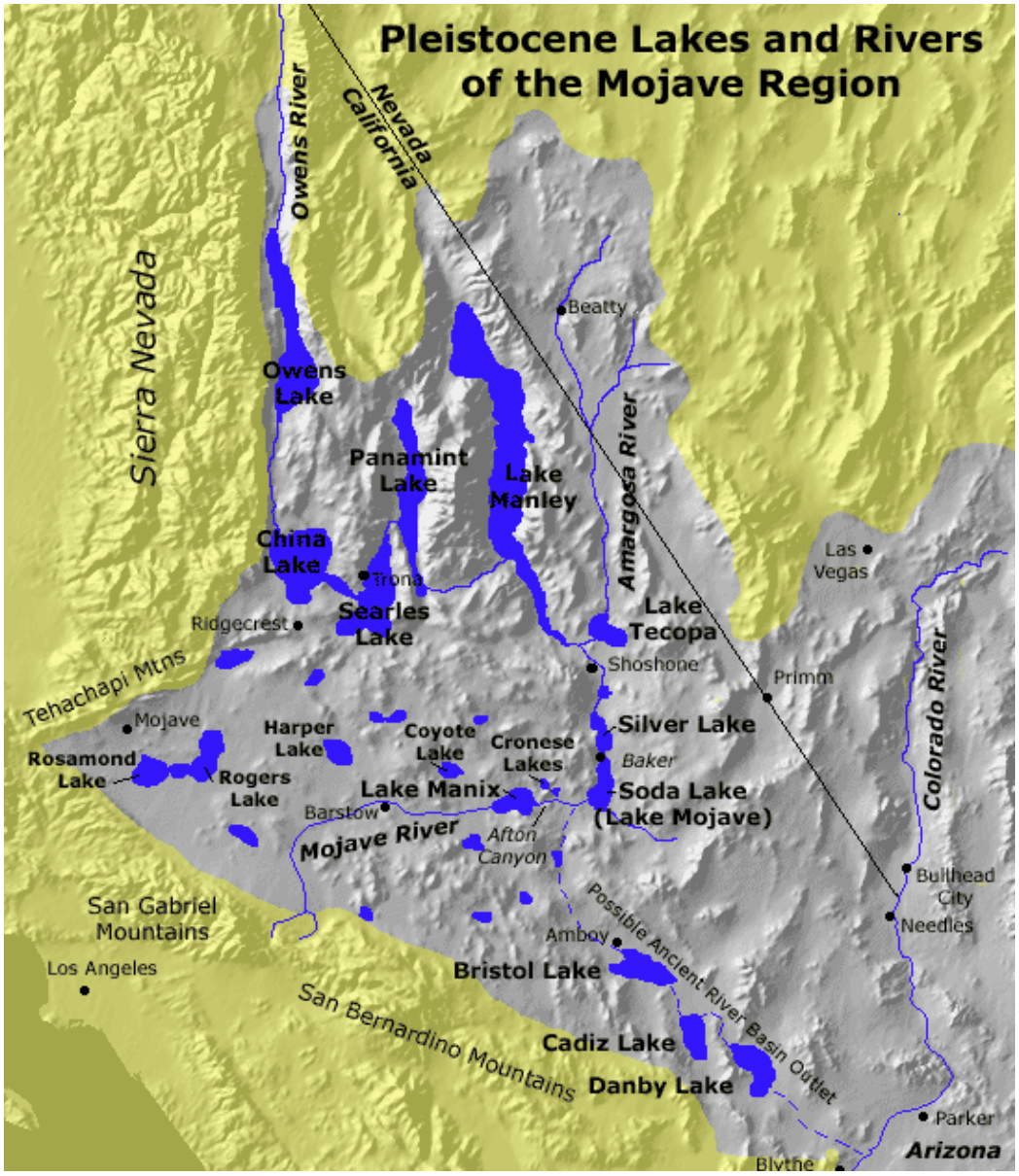
Approximately three million years ago, the dynamics of crustal movement changed, and Death Valley proper began to form. At that time, compression was replaced by extensional forces. This "pulling apart" of Earth's crust allowed large blocks of land to slowly slide past one another along faults, forming alternating valleys and mountain ranges. Badwater Basin, the Death Valley salt pan and the Panamint mountain range comprise one block that is rotating eastward as a structural unit. The valley floor has been steadily slipping downward, subsiding along the fault that lies at the base of the Black Mountains. Subsidence continues today. Evidence of this can be seen in the fresh fault scarps exposed near Badwater.

In addition to structural changes, Death Valley has been subjected to major climatic changes throughout the past three million years. During North America's last major Ice Age, the valley was part of a system of large lakes. The lakes disappeared approximately 10,000 years ago, evaporating as the climate warmed. As the lakes evaporated, vast fields of salt deposits were left behind. A smaller, now vanished, lake system occupied the basin floor about 3000 years ago.



Simplified geologic map of Death Valley National Park (by Marli Miller).

Note the exposures of Precambrian metamorphic gneiss rocks, which date to 1.7 billion years ago. Also, very thick packages of Precambrian and Paleozoic sedimentary rocks (pCp and Pz).



Pleistocene lakes in the Mojave Region.

During wet and cooler periods of the Ice Age (past 2 million years), numerous fresh water lakes fill basins in the Mojave region. As lakes fill, they eventually spill over topographic divides, flowing into an adjacent basin. Thus, Owens Lake spills into China Lake. Then to Searles, Panamint, Lake Manley, etc… At its peak, Lake Manley was ~600 feet deep.