

GEOLOGY 25 - LECTURE 7B
National Parks of the Basin and Range: *Death Valley NP*
Textbook Ch. 24

Death Valley National Park (DVNP)

Death Valley is a land of extremes - it's the hottest (up to 134°F), driest (~1" rain per year), and lowest (-282 feet below sea level) place in North America

- like the rest of the Basin & Range, DVNP is marked by elongate, north-south oriented ranges and intervening deep basins. The mountains and basins are parts of tilted fault-blocks and reach elevations of over 11,000'.
- the Amargosa River flows intermittently into the Badwater Basin, the lowest point in North America (the Badwater basin is what most people consider to be "Death Valley.")

The highest point in the contiguous U.S. (14,505' Mt. Whitney in Sequoia NP) is only about 100 km (60 mi) from the lowest point in North America (-282' in Death Valley) (Both places are in California)

- so almost 15,000' (~2.8 mi) of relief over those 100 km (60 mi)

The region around Death Valley NP (and the Basin and Range Province in general) is a desert, where evaporation exceeds precipitation.

- exists due to a **rain shadow effect** caused mainly by the Sierra Nevada to the west that captures moist air masses that move in from the west & northwest.
- as moist air rises over the western slopes of the Sierra Nevada and other mountains, it cools. Colder air cannot hold as much moisture, so the water condenses out as snow or rain. By the time the air mass reaches the east side of the state, it is usually dry.

Rocks, Mountains & Basins of Death Valley

The **topography of Death Valley NP** is formed by tectonic extension that created tilted fault blocks of basins and ranges, as addressed in the previous notes on the overall Basin & Range.

Rocks in the surrounding **ranges** span ages from very old (~1.7 b.y.) to very young (<1 m.y.) and consist of sedimentary, igneous, and metamorphic

- the very old Precambrian rocks are igneous and metamorphic, equivalent to the basement in the lower Grand Canyon (In the Grand Canyon the Precambrian rocks are exposed in the deepest gorges, but in Death Valley the Precambrian rocks have been lifted upward to the highest peaks.)

Rocks and sediments in the Death Valley **basin** are mostly sedimentary and are derived from the erosion of the surrounding mountains. Rock and sediment in the Death Valley basin is younger than about 16 m.y. (marking the beginnings of extension in the Basin & Range and the uplift of mountains to supply the sediment through erosion – see notes/images 7A)

- as the surrounding tilted fault block mountains began to rise about **16 m.y. ago**, they began to shed sediment into the adjacent basins (even though the rocks in the range may be Paleozoic or PC, once

they are eroded into sediment and eventually deposited in the adjacent basins they are considered Cenozoic in age. i.e., the age of the original rocks is not the age of their eroded sediments)

- as an aside, in the Basin and Range the term “valley” is typically used for the landscape feature, whereas the term “basin” is used to describe the thick pile of sediments beneath the valley floor. The terms are commonly used interchangeably.

Death Valley Desert Landforms

Much of Death Valley is bare rock or a thin veneer of poorly developed soil with scant vegetation - actual sand dunes only cover ~2% of the surface.

- because rainfall is minimal, **Wind** acts as a key agent of sediment transport in the area. In places it moves sand grains around to create small regions of **sand dunes**.
- more commonly, wind picks up fine particles of silt and sand, leaving behind gravel plains of larger pebbles and cobbles – over time, the fragments of gravel align themselves into a relatively flat surface called a **desert pavement** which is very common in windswept desert environments

Water also plays a role in moving sediment around in desert environments. Infrequent but intense rains cause flash floods in narrow, steep mountain canyons

- during intense rains (the most common type of precipitation in deserts), loose sediment is washed off steep, unvegetated mountain slopes. This rapidly moving sediment-choked water (called a **debris flow**) fills the narrow canyons and violently flows down-channel. (Debris flows are a serious hazard for desert hikers! - pay attention to weather reports if you plan to hike steep desert canyons.)

As the debris flow of sediment-choked, turbid water meets the open valley at the mouth of the channel, it spreads out laterally, depositing its sediment load, and forming a cone-shaped **alluvial fan**.

The valleys in the Basin & Range have no outlet (internal drainage), so water from flash floods collects on the lowest part of the basin floor where it commonly forms shallow lakes called **playa lakes**.

- the normally dry Amargosa River flows into Death Valley from the south. The river only flows during rare, episodic rains, filling the playa floor with a thin sheet of water maybe a meter deep.
- the river and flash floods carry elements in solution that were derived from the weathering of rock in the surrounding mountains (these elements will eventually crystallize to become evaporite salts)
- the lakes dry up quickly in the semiarid environment. As the water evaporates, light-colored salty minerals (aka ‘**evaporites**’) crystallize on the basin floor, creating a flat, white, reflective surface called a **playa**.

Badlands are a characteristic type of erosional topography noted for their rounded, gullied appearance – they are a common landform of DVNP (and many other national parks such as Badlands NP in South Dakota and Petrified Forest NP in Arizona)

- badlands are common where volcanic ashes are present (volcanic ashes are remnants of Cenozoic volcanism in the area)
- occasional rains penetrate into the easily eroded volcanic ash, turning the ash into clays that swell up with moisture. When they dry out again, these layers become puffy, cracked, crumbly and easily eroded into distinct rounded landforms.

- the combination of swelling volcanic clays and the ease of erosion make it difficult for vegetation to take hold on badland landscapes, enhancing the unconstrained erosion.
- in places, the ash beds contain elements that combine with rainwater to transform the badlands into multi-colored splotches (e.g., Artist's Palette area)

Racetrack Playa in DVNP is a relatively remote locale notable for its mysterious '**sliding stones**', boulders of rock that leave behind furrows in the playa surface that mark their path of travel

Best hikes in Death Valley NP

<https://embracesomeplace.com/best-hikes-death-valley-national-park/>

A few websites with relevant material if you're not using the textbook

Wikipedia – Geology of Death Valley NP

http://en.wikipedia.org/wiki/Death_Valley_National_Park

National Park Service – Geology of Death Valley NP

<https://www.nps.gov/deva/learn/nature/geology.htm>
