

Geol 104 Lecture 19
Death Valley

I. Introduction to Death Valley

- A. Located on the western margin of the Basin and Range Province
 - 1. Normal faulting exposes rocks from Proterozoic (1.7 Ga) through the late Cenozoic (~10 Ma)
 - 2. Geologic activity continues today with Basin and Range extension and San Andreas System strike-slip faulting
- B. Extreme topography! – Deepest place on NA continent
- C. Arid Conditions of the Mojave Desert

II. Relative Relief

- A. The deepest place in North America
 - 1. Near Badwater on the floor of Death Valley = 252 feet BELOW sea level
 - 2. This is also the hottest place (on average) in North America
 - Summer temperatures commonly reach 120°F
- B. The highest Peak in the Park is 11,049 feet
 - 1. So, local relative relief is >11,300 feet!
 - 2. This is among the greatest in conterminous US (think Tetons!)

III. Rain Shadow effect: Why is Mojave a desert?

- A. Moist air from the coast must first flow over
 - 1. Coastal range
 - a. Here it loses some moisture as fog
 - b. And then the air mass meets the huge Sierra Nevada
 - 2. Sierra Nevada > 10,000 feet in some places
 - a. Air flows over Sierra Nevada
 - b. Decompresses, cools and loses moisture as precipitation on the Sierra's
 - c. Air mass is now dry
- B. Mojave Desert
 - 1. Dry air mass must flow down the lee-side of the Sierra's
 - 2. Compresses and heats-up
 - Hot, dry air = desert
- C. Why is Death Valley as hot as Hades?
 - So deep, the hot dry air compresses even further and heats even more!

III. Why is Death Valley a valley?

- A. Death Valley NP is really a series of Valleys (basins) and Mountains (ranges)
 - 1. Inyo and Argus Ranges, Panamint and Saline Valley, Panamint Range, Death Valley. Black and Grapevine Mountains
 - 2. These are produced by Basin and Range extension (25 Ma to present)
 - Normal faults on the west side of the ranges leave the mountains high and drop the valleys low

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- B. Pull-apart basin structure is superimposed on the basin and range structures
 - 1. This makes Death Valley especially deep
 - 2. Pull-apart basin = basin caused by bend in strike-slip fault
 - a. Here the strike-slip fault(s) is part of the San Andreas System (transform boundary on west end of NA).
 - b. Right-lateral faulting moves west side of fault to the north relative to east side
 - i. i.e., NA is moving SE relative to Pacific Plate
 - ii. Actually, both are moving absolutely to the W-NW, but Pacific is moving faster and a little more to the North

IV. Geologic History

- The history of Death Valley/Basin and Range is long and complicated. I will abbreviate it and note how it parallels what we know of the history of NA continent.

A. Basement:

- 1. Proterozoic Metamorphic and Igneous Rocks ~1.7 Ga
 - These are similar to the Vishnu Schist and Zoroaster Granites (Grand Canyon) and formed during assembly of Nuna
- 2. Proterozoic sediments of the Pahrup Group (~1.3 to ~0.7 Ga)
 - a. These are likely produced during erosion of Mazatzal Mountains
 - b. Glacial sediments recognized in the latest of Pahrup Group – Snowball Earth events, where the entire Earth was covered in Ice! Massive glaciation events!

B. Rodinia Rifts (End of Proterozoic ~800 Ma into Cambrian ~550 Ma)

- 1. Passive margin sediments deposited on Western margin of Laurentia
 - a. In Death Valley, there are many formations and rocks that represent these passive margin sediments.
 - b. In Grand Canyon these are the Grand Canyon Super Group
- 2. Deeper Marine sediments of passive margin
 - a. From Cambrian (~550 Ma) through Pennsylvanian (~300 Ma)
 - b. Thick limestone units mostly
 - c. THIS IS THE OCEAN that transgresses and regresses onto the continent as observed at Grand Canyon!
 - i. Here it is further off-shore and less susceptible to changes in sea level.
 - ii. It does become progressively shallower until it is exposed in the Triassic (recall the Navajo Sandstone at Zion? – coastal desert)

C. Sevier orogenies (Jurassic – Cretaceous, 165 – 80 Ma)

- 1. Produces a Volcanic Arc (Sierra Nevada = plutonic portion) to the east of what is now Death Valley
- 2. Cause reverse faulting of rocks preserved in Death Valley

D. Laramide Orogeny (Cretaceous to Eocene, 80 to 40 M)

- 1. Uplifts Death Valley region, eroding much of the overlying rock
- 2. Thickened crust collapses and spreads => Basin and Range extension
 - a. This causes the faulting that produced the valleys and mountains of Death Valley
 - b. Superimposed is the pull-apart structure from the active San-Andreas system