California Rocks!
Deserts

- Desert landforms
- Climate
- Desert resources
The Basin & Range province

- East-west extension
- Series of long, linear valleys and ridges
- Region stretched by 100% - widened by 250 km in 40 m.y.
California part of the Basin & Range

Extension began about 16 Ma
Death Valley probably the Most well-known Basin & Range valley
World deserts
Global air circulation

- Polar High
- Polar Easterlies
- Subpolar Low
- Subtropical High (Horse Latitudes)
- Intertropical Convergence Zone (Doldrums)
- SE Trade Winds
- Tropic of Capricorn
- Subtropical High (Horse Latitudes)
- Westerlies
- Subpolar Low
- Polar Easterlies
- Polar High

- 90°N
- 60°N
- 30°N
- 0°
- 30°S
- 60°S
- 90°S

- Dry air sinking
- Moist air rising

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A desert is defined as a region that receives less than 10 in. of rain annually and is devoid of significant vegetation.
Rain shadow - orographic effect

- Pacific Ocean
- Sierra Nevada
- Basin & Range
- Evaporation from compression and warming
Series of ridges and valleys
Normal faults are formed during extension and crustal thinning.
Horst and graben topography

Sierra Nevada - Tilted Fault Block

Inyo-White Mountains - Horst

Owens valley graben

Figure 32. The Basin and Range Geomorphology Province is a tectonic region that consists of normal and reverse faults that result in topographic basins on the Earth’s crust. Mountain ranges formed over uplifted blocks of crust.
Ranges bounded by normal faults

“Range-front faults”
Alluvial fans
Bajada - a skirt of alluvial fans
Arroyos or canyons

Mosaic Canyon Narrows
Flash floods
See p. 97 & 99
in California Geology
Mosaic Canyon breccia

Mosaic Canyon mudflow

Mosaic Canyon breccia
Elizabeth Miller on Virtual Death Valley
Virtual Death Valley
Sand dunes

Conditions for dune formation

- High wind speed to lift and transport sand grains
- Little or no vegetation
- Sand-size sediment (1/16 mm to 2 mm)
Where dunes form...

p. 96 in *California Geology*
Saltation

Wind direction

Current

Sand grains moving along bed by saltation

Stream bed
How do dunes form?
How do dunes form?

- Grains saltate up windward slope.
- Sand drops down lee face & forms layers.
- Slip face (~34°)
- Layering effect within dune.

Wind Direction

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Migrating dunes
Ripplemarks
Racetrack playa

Playas are temporary shallow lakes that cover the basin floors.

Water evaporates leaving behind evaporite minerals or salts.
What moves these rocks?
Badwater salt flats
Devil’s golfcourse

These lumpy salts are the residue of Death Valley’s last significant lake, which had evaporated 2000 years ago.
Mud cracks & dry river beds
Desert varnish

- Black iron oxide and manganese oxide
Desert pavement

Wind removes fine sediment and larger rocks are coated with desert varnish...
Bimodal volcanism began 16 to 22 Ma

Mafic and high-silica lavas
- Mafic lavas from the mantle
- Silicic lavas from melted crust

Ubehebe crater, Death Valley
Mono Craters
Pleistocene lakes of the eastern Sierra

Extensive network of ancient lakes from the Great Salt Lake to the eastern Sierra

Lakes present during the Pleistocene (1.6 Ma) until about 11,000 to 13,000 y.a.

Sometime before 100,000 y.a. Mono Lake spilled into Adobe Valley then Owens Lake
Lake levels reflect climatic changes over the last 1 to 3 m.y.; lake deposits, volcanic ash, shells, wood, and tufa are used to date these climatic fluctuations.
Mono Lake tufa towers

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Tufa formation
p. 104 in *California Geology*
Borate mining

Volcanic vents → Groundwater → Evaporites

Tincal or Borax
Na$_2$B$_4$O$_7$•10H$_2$O

Ulexite or "Cottonball"
NaCaB$_5$O$_9$•8H$_2$O

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