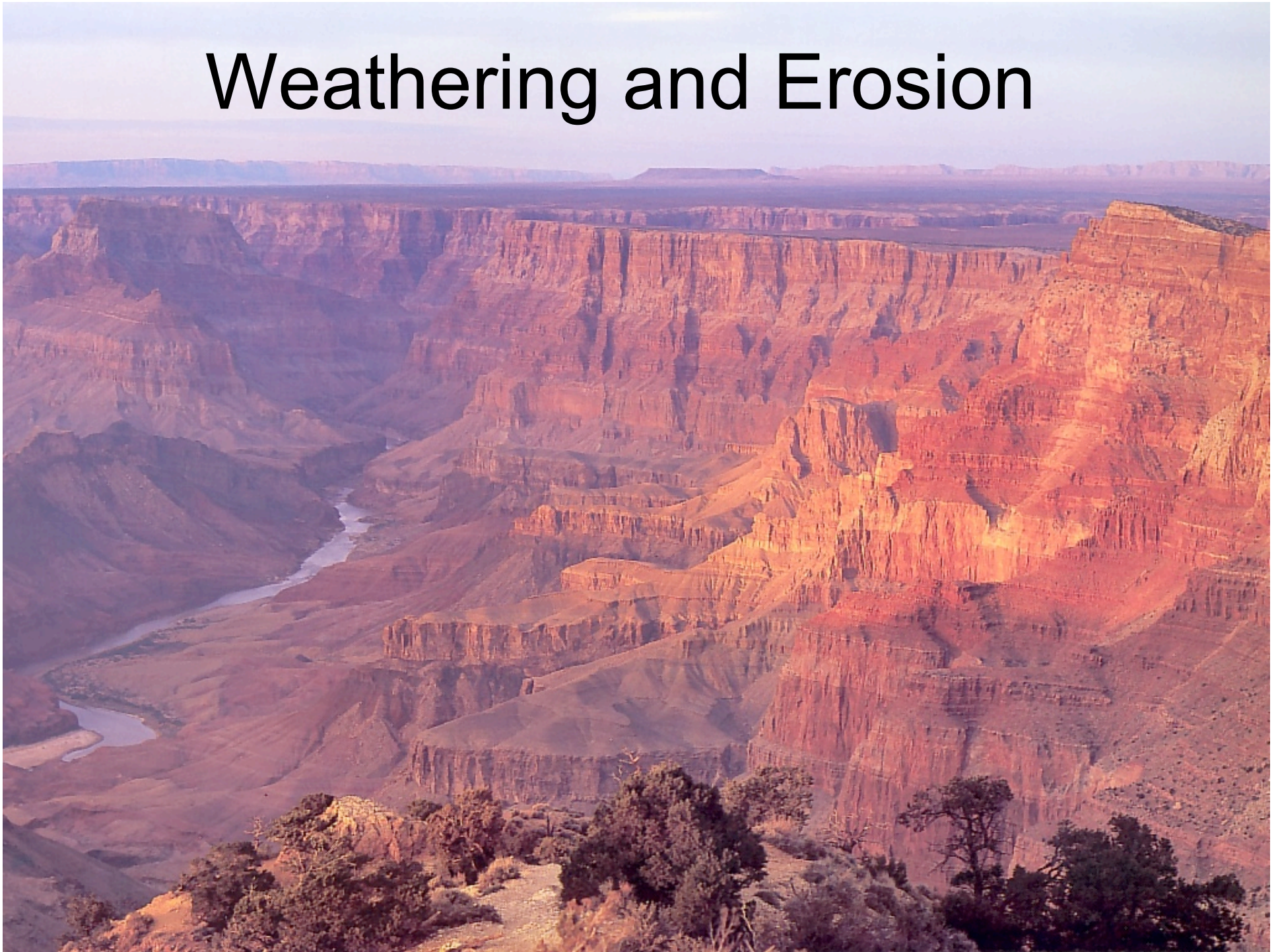


# Weathering and Erosion



# Weathering

- The breakdown of the materials of Earth's crust into smaller pieces.... (SLOWLY!!!)

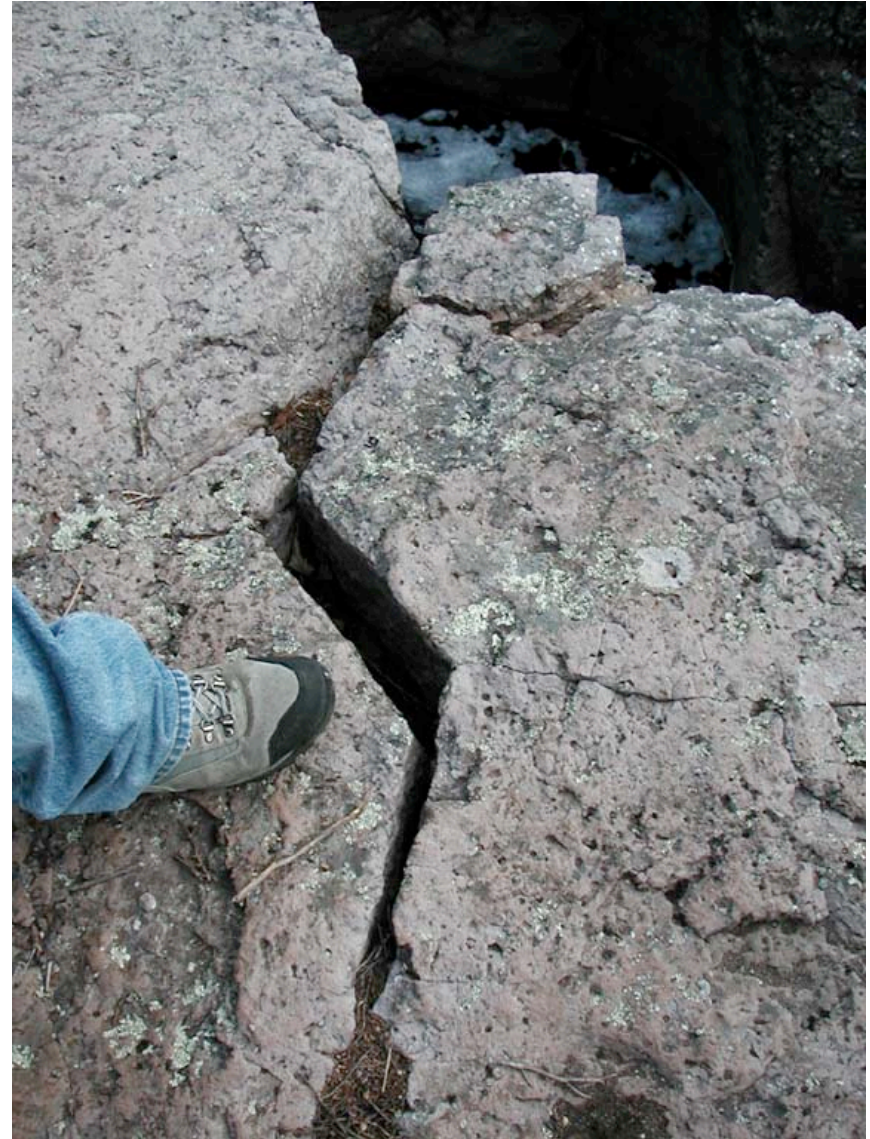


Arches National Park, Utah

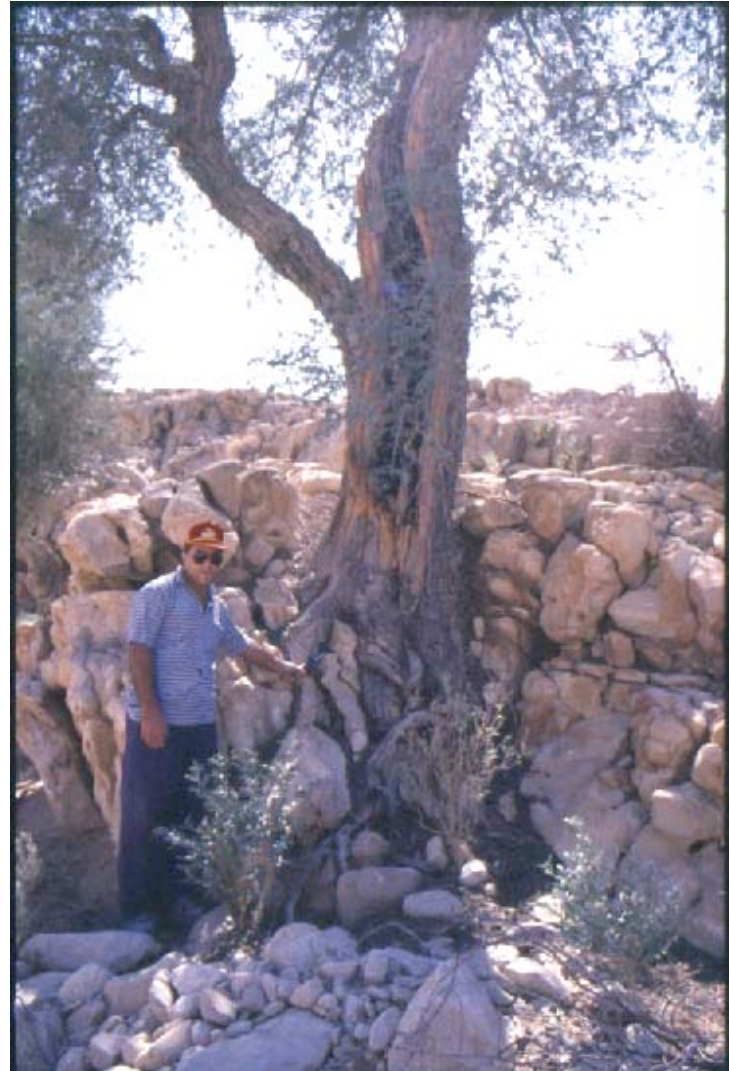
# Physical Weathering

- Process by which rocks are broken down into smaller pieces by external conditions.
- Types of Physical weathering
  - Frost heaving and Frost wedging
  - Plant roots
  - Friction and impact
  - Burrowing of animals

# Frost Wedging



# Plant Roots





# Burrowing of Animals



# Chemical Weathering

- The process that breaks down rock through chemical changes.
- The agents of chemical weathering
  - Water
  - Oxygen
  - Carbon dioxide
  - Living organisms
  - Acid rain



# Water

- Water weathers rock by dissolving it



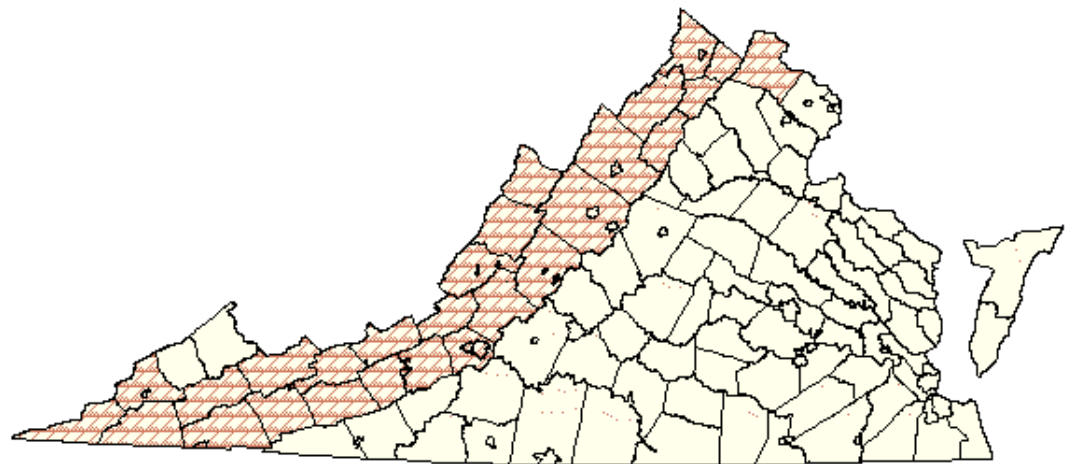
# Living Organisms

- Lichens that grow on rocks produce weak acids that chemically weather rock



# Karst Topography

- A type of landscape in rainy regions where there is limestone near the surface, characterized by caves, sinkholes, and disappearing streams.
- Created by chemical weathering of limestone



# Features of Karst: Caves



# Features of Karst: Sinkholes



# Water Erosion

- Rivers, streams, and runoff



# Erosion

- The breakdown of the materials of Earth's crust into smaller pieces.... (FAST!!!)

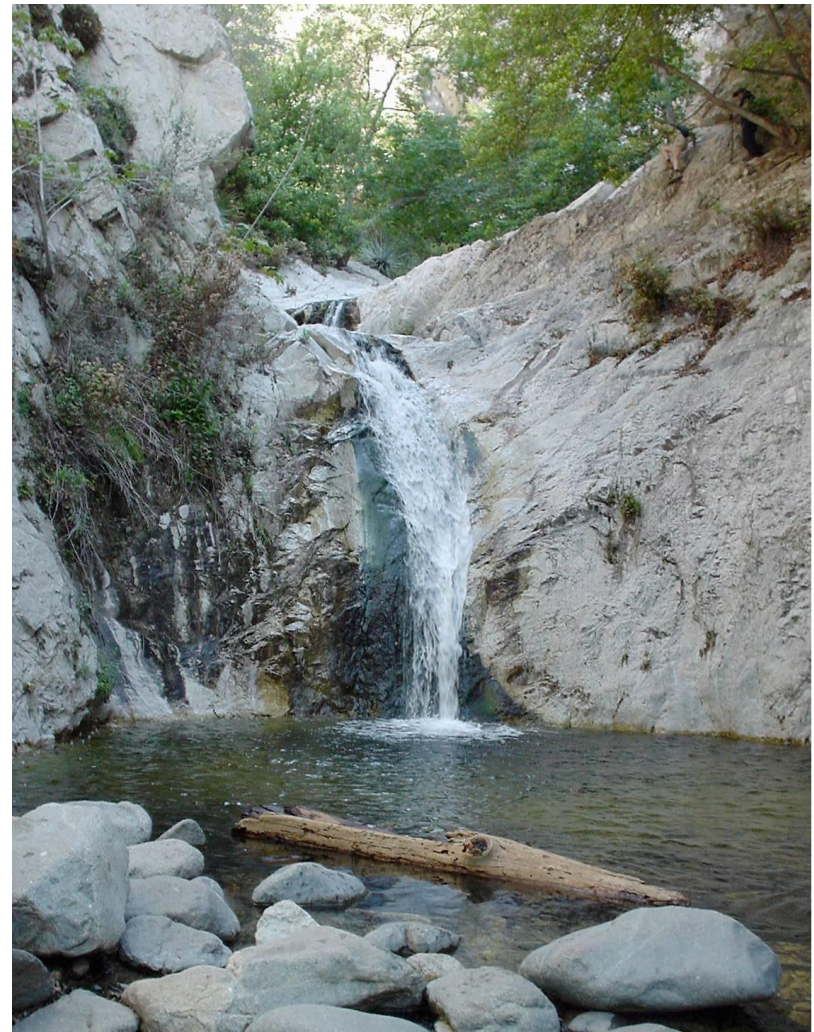


**Kali Gandaki River, Nepal**

- Rivers erode by rolling boulders across hard bedrock
- As smaller pieces are created, they are transported downstream



**Taroko Gorge, Taiwan**



**Switzer Falls, Pasadena, CA**



- Sometimes rivers don't have enough energy to move all the rock
- Rock can be temporarily deposited in gravel-bars until large spring floods roll them further along



**South Island, New Zealand**



**Jasper National Park, Canada**

- Rivers usually cut “v-shaped” valleys that can be very narrow
- Steep canyon walls can collapse by landslides



**Arun River, Nepal**

# Glacial Erosion

- Snow falls in the high mountains and turns to ice
- Ice flows downhill (due to gravity)
- Ice erodes rock at base and sides of glacier

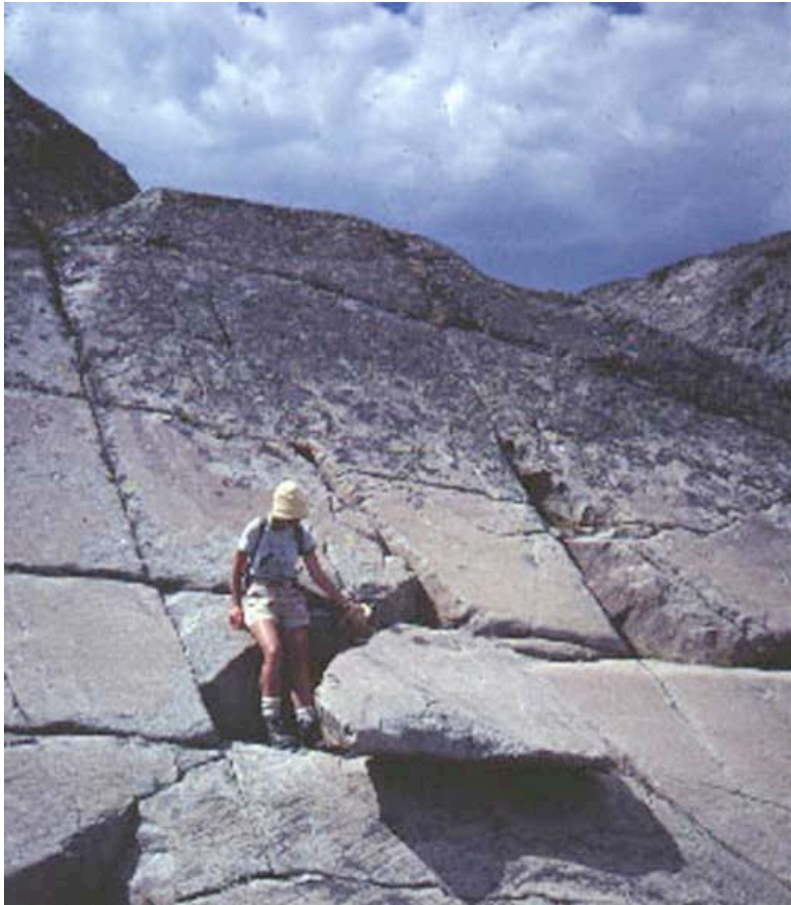


- Glaciers are a FAST process.
- Glacial ice flows like a river, reaching maximum speeds of 20-30 meters/day!!!
- Glaciers erode



**Patagonia Ice Cap, Chile**

- Glaciers erode by grinding rocks against each other, often leaving scrape marks
- Glaciers also erode by “plucking” boulders from cliff faces



**Beartooth Mountains, Montana**



**Sierra Nevada, California**

# U-shaped valleys

- Because glaciers are wide they often erode flat-bottomed “u-shaped” valleys
- Thick ice can support very steep-walled valleys that collapse when ice melts



**Kings Canyon, California**



**Sierra Nevada, California**

# Glacial Moraines

- Glaciers erode rock from cliffs and push it into big piles called moraines
- Moraines are self-supporting (not attached to hillside or mountain)
- Often shaped like a snake, with lots of curves. Steep sides.



Durango, Colorado



Chugach Range, Alaska

# Wind Erosion

- In dry areas, sandstorms can blow sand at up to 70 miles per hour!!
- Literally “sandblasting!!”



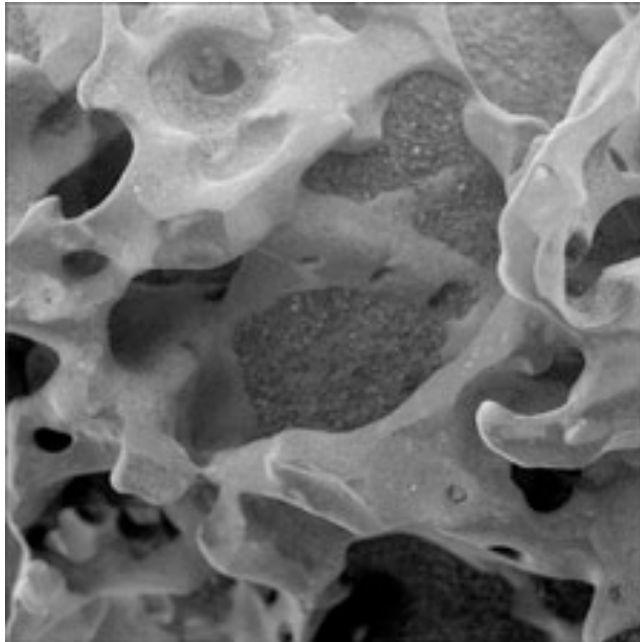
US military base, Iraq



Soldier in Iraq



- Wind erosion can create distinctive patterns of interconnected holes



**the planet Mars**



**Seminole Canyon State Park, Texas**

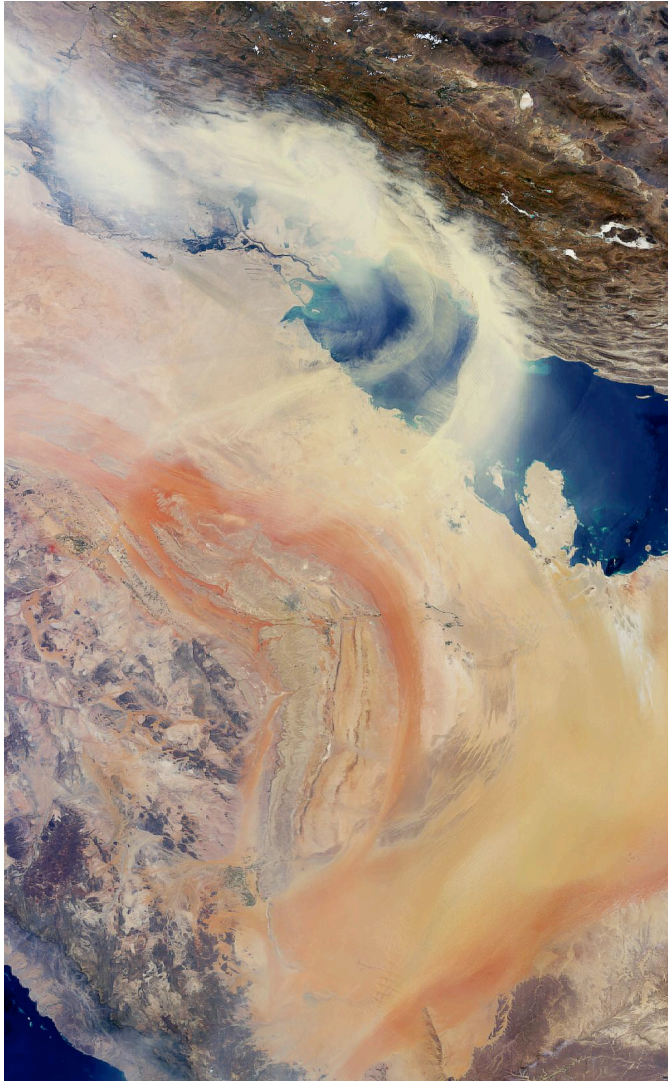
- “Hoodoos” are created by wind erosion
- Soft layers of rock erode more easily than hard layers of rock
- Eroded columns of rock are often attached at the base



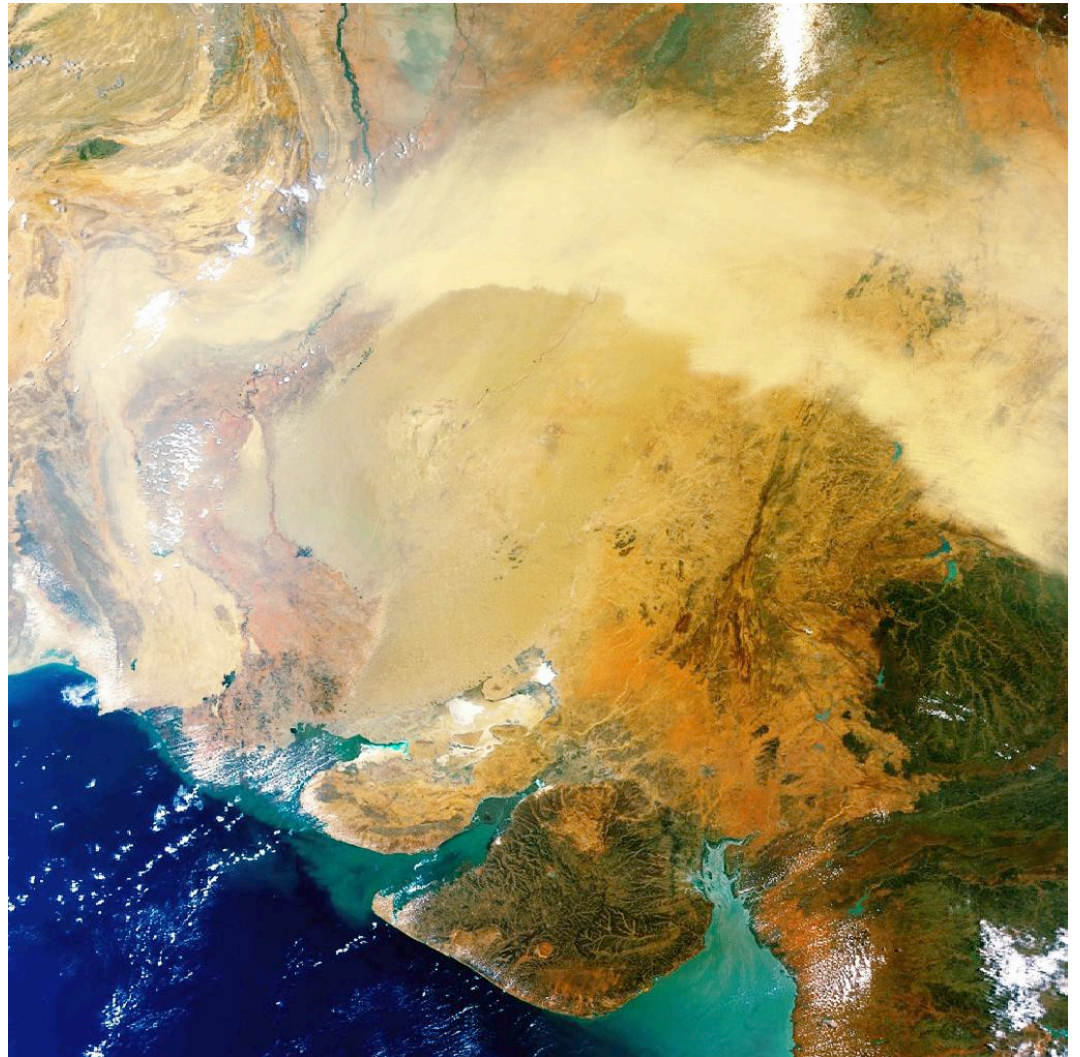


**Bryce Canyon National Park, Utah**

- Big sand storms can be viewed from space!!



**Persian Gulf**



**West Africa**

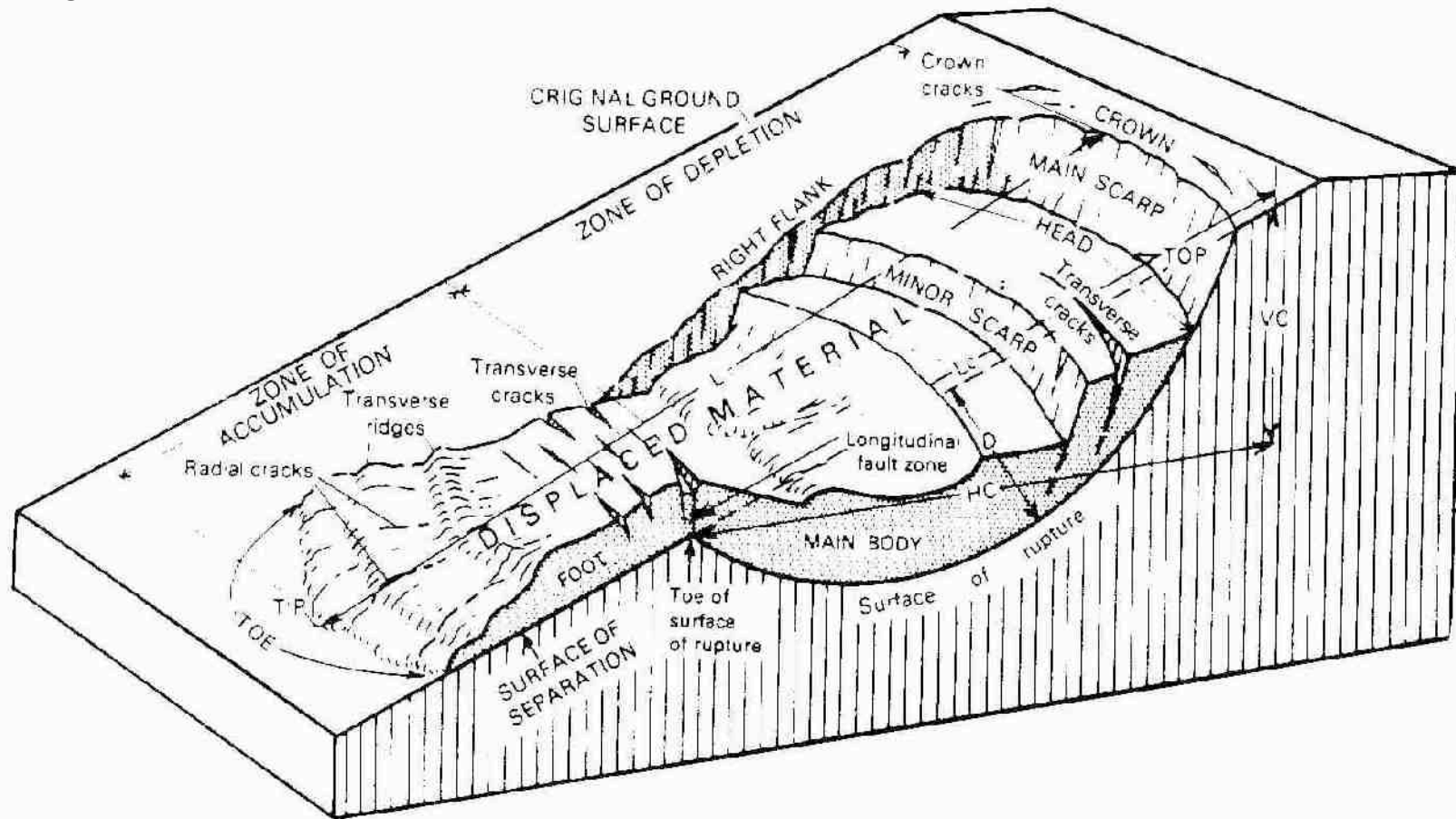
# Mass Movements

- Landslides, mudslides, slump and creep



[landslide clip.mpeg](#)

- Landslides often produce scoop-shaped “scarps” at the top
- Angle gets shallower at deeper depths
- Large runout area



<http://www.youtube.com/watch?v=W4KWxglDL3o>

- Rockfalls occur when very hard bedrock has been oversteepened by rivers or glaciers
- Rock breaks off in slabs, rather than the scoops typical for landslides



**Yosemite National Park, California**

- Landslides often occur in soft rock or thick soils
- Landslides can be triggered by heavy rain or earth quakes



**La Conchita, California (highway 101 between Santa Barbara and Ventura )**



# Coastal Erosion



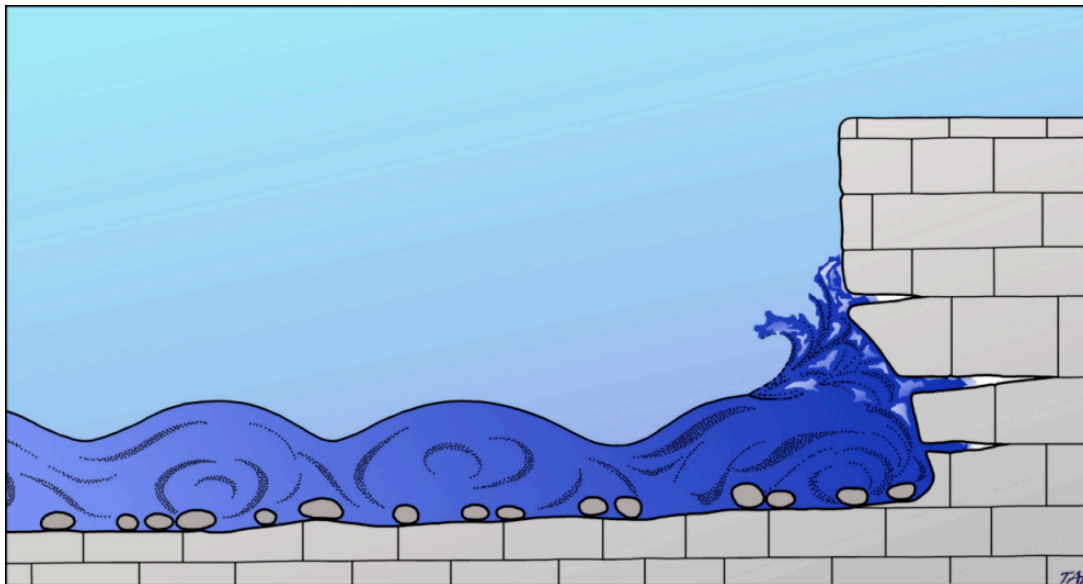
Ireland



Pacifica, California



- Pressure from waves and rocks creates cracks in rock
- Overhanging cliffs collapse
- Rolling rocks create flat “wave-cut terraces”



- Wave cut terraces can be tectonically uplifted and preserved
- New ones are being formed at the base of the old ones!!
- Look for these all over southern California!!



**Montagne de Oro, California**



**Santa Barbara, California**