

Geol 104 Geology of National Parks
Lecture 12 Bryce Canyon

I. Location:

- A. Bryce is located ~50 mi. NE of Zion in southern Utah
- B. Located on Paunsaugunt Plateau
 - 1. Bounded by Sevier Fault to west and Paunsaugunt Fault to east
 - 2. Climate is different from Zion
 - a. Wetter and cooler because the Plateau is ~1000 feet higher than Zion
 - b. Very little soil and vegetation to prevent erosion
 - 3. Rocks exposed here are ~100 Ma older than at Bryce
- C. Geomorphic features: Compared to Zion (steep walled canyon), Bryce is 'open' amphitheaters with pillars.

II. Geomorphic Features

- A. Caused by Mass wasting of the plateau wall
 - 1. This wall is formed by the Paunsaugunt Fault
 - 2. Precipitation on the plateau washes down the wall
 - a. Sheet wash - i.e. not in channels
 - b. This water causes the mass wasting of the rocks – different from Zion
 - Recall at Zion the canyon walls were formed by Virgin River undercutting the Navajo Sandstone
- B. Features here are more open (not boxed in a canyon)
 - 1. Amphitheaters (large expanse/open area where rocks have wasted away)
 - 2. Pillars, pinnacles or hoodoos of resistant rocks stand as columns in the amphitheaters
 - Badlands topography
 - 3. The formation of these features is Joint Controlled
 - a. Water flows into joints in the flat-lying sedimentary rocks
 - b. Weathering occurs along these joints controlling the patterns of mass wasting
 - c. At Bryce, there are two joint sets that are perpendicular to each other
 - Weathering along these joints produces the column-like features

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- C. Weathering processes leading to mass wasting at Bryce Canyon
1. Weathering = Weathering is the physical disintegration and chemical decomposition (alteration) of rock in response to changing environmental conditions.
 2. **Mechanical weathering** = physical & biological forces break rock into smaller pieces
 - a. Frost wedging – water into cracks, freezes, expands and forces cracks open
 - b. Clay expansion = like frost wedging, but in warm humid environments
 - c. Granular disintegration = frost wedging/expansion between the grains of a permeable rock.
 - d. Sheetting or exfoliation:
 - i. Unload bedrock as it rises to the surface (tectonically)
 - ii. The bedrock expands (lower pressure), but the upper surface expands faster and breaks away from the bedrock mass.
 - e. Biologic activity – roots grow into cracks and wedge rocks apart
 3. **Chemical weathering** = inorganic & organic chemical reactions alter the mineralogy & composition of rocks. **Minerals out of equilibrium.**
 - a. Chemical reactions between atmosphere-minerals or water-minerals
 - b. Results of Chemical weathering
 - i. Accumulation of stable minerals in soils and sediments– Clay, quartz, feldspar
 - ii. Liberation of ions into aqueous solutions. Later, these become **cement!**
 - c. Oxidation = rusting (ferric to ferrous iron)
 - d. Hydrolysis = hydrating minerals (hematite to limonite)
 - e. Dissolution of soluble minerals (e.g., calcite in acidic water).
 - f. Chemical weathering is aided by physical weathering
 - Physical weathering increases surface area. Increased surface area increases rates of chemical reactions.
 4. Differential Weathering: Some rocks are more resistant to weathering processes. These remain while the less resistant rocks disintegrate. These different rates of weathering produce interesting features (e.g. Thor's Hammer in Bryce, Mesas in general)

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III. Geologic History and Formations

A. Cretaceous Seaway floods the continent (~150 Ma)

1. This deposits Dakota Sandstone (beach) and Tropic Shale (deeper water)
-Transgressive sequence
2. The Cretaceous Seaway regresses and overlying sediments are eroded
- This leaves an unconformity on which the Cenozoic sediments are deposited

B. Laramide Orogeny (late Cretaceous ~90 Ma) uplifts plateaus leaving basins between them.

C. Lakes fill the basins (Eocene ~50 Ma)

1. Claron Formation: Lake deposits – freshwater limestones, calcite-rich mudstones, sandstones and conglomerates.
2. These layered rocks are the main rock exposed in Bryce – weathering of the different layers produces the features described above.

D. Miocene (~15 Ma) extension and uplift of the Colorado Plateau and Basin and Range.

- Produced the Sevier and Paunsaugunt Faults, leaving the Paunsaugunt Plateau (horst block).