GEOLOGY 25 - LECTURE 3A

COLORADO PLATEAU: Arches NP

(Textbook: browse Ch 7)

Five great national parks in southern Utah, strung out along scenic highways – Zion, Bryce, Capitol Reef, Arches & Canyonlands . . . the "Mighty Five"
- plus Dinosaur NM, Bears Ears NM, Colorado NM, Black Canyon of the Gunnison NP, Mesa Verde NP, and Petrified Forest NP elsewhere on the Colorado Plateau

Arches National Park

The south boundary of Arches NP is a section of the Colorado River. Many visitors to the tourist town of Moab raft this easy stretch of the river and there's lots to do in the region.
Arches notable for its abundant (>300) **natural arches** - erosional remnants left behind after all the surrounding rock has been eroded away . . .

Rocks composing the Arches landscape

Rock at Arches dominantly composed of reddish Mesozoic sedimentary rocks, mainly Navajo Sandstone and the overlying, younger, salmon-colored **Entrada Sandstone** formation (all arches are developed in the Entrada)
Formations are commonly composed internally of distinct, recognizable units called 'members.'
- the Entrada Formation is composed internally of three members: the lowest Dewey Bridge Member, the middle Slickrock Member and the uppermost Moab Member (no need to memorize these member names)

Natural arches develop at Arches NP along the horizontal contact between a less resistant, shale and siltstone unit (~100' thick) forming the lower part of the Entrada Sandstone (Dewey Bridge Member) and an overlying more-resistant sandstone (Slickrock Member).

Entrada sandstone deposited ~170 m.y.a. in an area of broad tidal flats, beaches, low islands and coastal dunes near an ancient, fluctuating shoreline that extended essentially north-south through Colorado Plateau country (prior to uplift of the Plateau, of course).
- the region that would become the Colorado Plateau later in time, was near sea level during deposition of the Entrada Sandstone

How do arches form?

Natural arches are erosional products of physical and chemical weathering acting along vertical joint planes and horizontal bedding planes that cut through the body of rock.
The sandstones and siltstones at Arches are marked by a dominant vertical set of **joints** that formed as the rocks were gently stressed in response to regional forces (more about these 'regional forces' later on)
- joints are natural fractures that form loosely parallel to each other that become sites of preferential weathering and erosion.

- rainwater and snowmelt preferentially attack the rock where the waters can infiltrate along joint planes. Hardy plants establish themselves along the joints where water collects, physically pushing apart the rock with their roots and adding their organic acids that further break down the grains. Water freezes in the cracks at night and during the winter – the ice expands and physically pushes the rock apart along the joints (freeze-thaw cycling). (all forms of weathering we discussed in the class on Bryce Canyon)
- thus the rock along joints weathers away from the combination of rainwater, snowmelt, plants, and freeze-thaw cycling formed during seasonal freezing.
- in Arches, preferential weathering and erosion along joint planes leaves behind a pattern of elongate, slender **fins** or rock and intervening grooves perhaps 10-20' wide (i.e., a widened joint plane).

In general, the Slickrock Member is a permeable sandstone cut by joints – "permeable" means that water can slowly percolate through the sandstone. In contrast the Dewey Bridge Member is an impermeable stack of thin beds of clay-rich shale and siltstone – water doesn't easily move through these rocks. (this text won't make much sense unless you correlate it with the appropriate images)

1 - In arid regions, much of the surface drainage seeps into the rock, migrating downward along joints until it hits the impermeable, clay-rich, thin-bedded siltstones & shales of the Dewey Bridge Mbr
- the water travels laterally along the bedding plane between the more-resistant sandstone of the Slickrock Mbr and the less-resistant, thinner bedded shales and siltstones of the Dewey Bridge, emerging as a **water seep** or **spring** when the water hits the open ground. (There is little difference between a seep and a spring. Generally, if the rate of flow is rapid and continuous, it is called a spring. If the flow is slow and intermittent, it is called it a seep.)
- the emerging groundwater weathers the rock along the contact between the two units, creating loose sand and silt grains and weakening the rock
- eventually enough weathering and erosion occurs by seeping water at the base of the sandstone cliffs that an **alcove** (a shallow recess) forms.
- as the supporting lower rock of the Dewey Bridge is worn away, overlying slabs of weakened rock of the Slickrock collapse, enlarging the alcove. The alcove progressively grows upward in size.

2 - If a vertical joint set in the sandstone is roughly parallel to the cliff face with the alcove, the rocks along the vertical joint are removed by weathering and erosion which separates the vertical slab containing the alcove from the main body of rock.

3 - an arch is created as the rock along the joint behind the alcove weathers away, isolating the alcove as an arch.
- arches may enlarge upward as slabs of rock on the underside of the arch break off and collapse to the ground

The ultimate fate of all arches is that they progressively erode & eventually collapse
- 43 arches have collapsed in the park since 1970
- weird landforms like 'balanced rocks' are the eroded remnants of arches that have collapsed and partially weathered away

To see a list of the top five hikes in Arches based on popularity, go to:
https://www.visitutah.com/Places-To-Go/Parks-Outdoors/Arches/Adventure-Guide