

Outline - Stratigraphy of the Colorado Plateau

I. Archean – not continental crust in the Colorado Plateau region – only ocean crust and sediments

II. Proterozoic – emplacement of:

- a. Mojave Province (2.5-1.2 Ga) – possible rift basin
- b. Yavapi Province (1.9-1.7 Ga) – plate collision, accretionary event (Vishnu Schist, Farmington Metamorphic Complex). This is part of the Proterozoic assembly of the supercontinent Rodinia.
- c. Around 1 Ga the Unkar Group was deposited in the Grand Canyon area as part of the Grenville Orogeny (1.4-1.0 Ga) – possibly representing an extensional marine basin.
- d. The Chuar Group (0.9-0.7 Ga) – deposited in the Grand Canyon area as part of the rifting of Rodinia.

During the Proterozoic the Colorado Plateau was on or south of the equator.

III. Paleozoic – mostly marine deposition:

- a. Cambrian – the continent is transgressed by the ocean – deposits the Tapeats Sandstone (= Tintic quartzite), Bright Angel Shale (= Ophir Shale), and the Mauv Limestone.
- b. Ordovician-Silurian – as the ocean regresses rocks are eroded and an unconformity develops for this interval.
- c. Devonian – the Antler Orogeny occurs in the west (a collision of a volcanic arc) and marine limestones are deposited on the Colorado Plateau area (Elbert and Ouray formations in the area of Capitol Reef).
- d. Mississippian - Ouachita orogeny begins – the Redwall Limestone is deposited on the Colorado Plateau
- e. Pennsylvanian – a Ouachita Orogeny progresses – the Paradox Basin forms and 29 cycles of evaporites (formed when the open marine is closed) and shales (represented clastic sediments from the rising Uncompahgre Uplift). At the end of the Pennsylvanian there is a return to more normal marine deposition (Hermosa Fm.).
- f. Permian – the supercontinent Pangaea forms, the Sonoman Orogeny begins in the west near the end of the Permian, and clastic rich marine rocks are deposited on the Colorado Plateau (Elephant Canyon Fm., Cedar Mesa Sandstone, Organ Rock Shale, and the White Rim Sandstone). At marine transgression at the end of the Permian deposits carbonate rocks (the Kaibab Limestone in the Grand Canyon, the Black Box Dolomite in the Capitol Reef area).

IV. Mesozoic – Dominated by terrestrial rocks and periodic epicontinental seas that come in from the north due to the Sonoman Orogeny (rather than transgressions from the west).

- a. Triassic – begins with coastal margin deposits of the Moenkopi Formation which become nonmarine upsection. The late Triassic deposits include the floodplain deposits of Chinle Formation famous for its early dinosaurs (*Coelophysis*).
- b. Jurassic – Pangaea begins to break up. At first dominated by eolian deposits of the Wingate and Navajo sandstones, which are separated by a wetter phase – the Kayenta Formation. In the middle Jurassic, seas come in from in from the north (the Carmel Sea) and deposits of shallow marine and evaporite rich rocks dominate the section (Page Sandstone, Carmel Formation, Entrada Sandstone, Curtis and Summerville formations). In the late Jurassic the Nevadan Orogeny is fully underway to the west and the Morrison Formation, famous for its sauropod dinosaurs, is deposited the floodplains of the Colorado Plateau.
- c. Cretaceous – the Sevier Orogeny to the west is well under way in the Early Cretaceous. The orogeny results in a unconformity and most of the Early Cretaceous is absent on the Colorado Plateau. At the end of the Early Cretaceous the Cedar Mountain Formation is deposited – famous for dinosaurs like *Utahraptor*. The Late Cretaceous on the Colorado Plateau is characterized by the presence of the Western Interior Seaway (caused by

Sevier Orogenic subsidence of the foreland basin). As such marine shales are deposited (Tropic and Mancos shales), and coastal (Straight Cliffs Formation) and continental deposits (Wahweap and Kaiparowits formations). The seaway withdraws from the region at the end of the Cretaceous and the continental North Horn Formation is deposited. This deposition continues into the Cenozoic and the North Horn contains the layer making the impact that defines the end of the Mesozoic and the extinction of dinosaurs.

- V. Cenozoic – entirely terrestrial depositional controlled in large part by the rise of the Rocky Mountains (the Laramide Orogeny)
 - a. Paleogene – deposition restricted to Laramide basins like the Uinta Basin – deposits representing lakes, rivers and floodplains in ascending order; Flagstaff Limestone, Wasatch (Colton) Formation, Green River Formation (famous for its fossil fish), and the Uinta and Duchesne River formations – both famous for their fossil mammals.
 - b. Neogene – Basin and Range rifting begins in the west, much later (7-5 mya) the Colorado Plateau begins to rise – both representing increased heat flow. This begins the modern phase of erosion and great canyons on the plateau. A stratovolcanic center develops in the Marysvale area and intrusions form the laccoliths of the Henry and La Sal mountains.