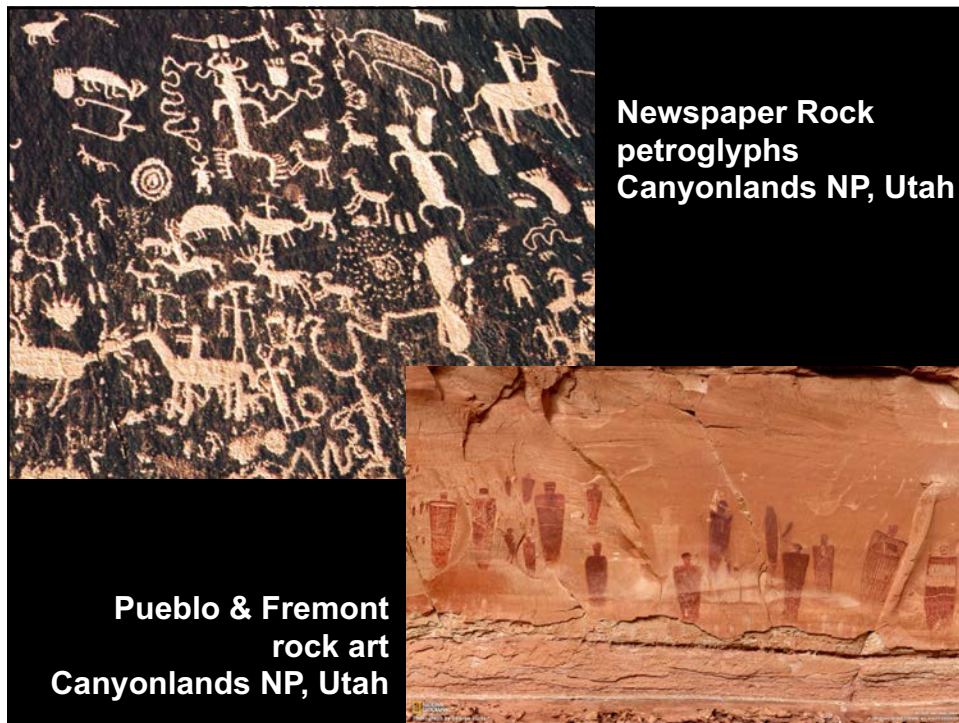


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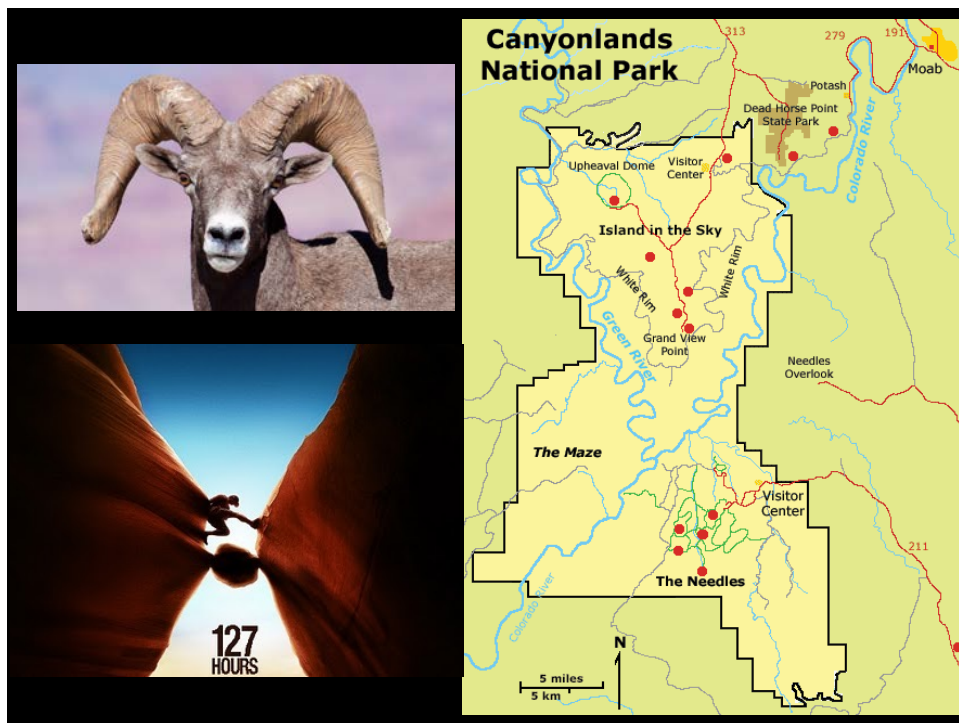


Canyonlands National Park - from Dead Horse Point
- redrock plateau cut by deep canyons

2



3



4

Late Paleozoic & Mesozoic sedimentary rock



erosional landscape - Canyonlands NP

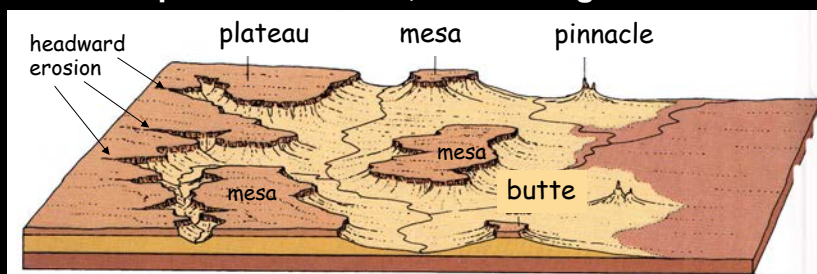
5



Canyonlands NP
- intersecting joint sets in Paleozoic-Mesozoic redrock

6

Plateaus, mesas, buttes and pinnacles - products of time, weathering and erosion



7



Drainage systems of gullies & streams cut canyons into the edges of plateaus by **headward erosion**. Shallow gullies draining the plateaus focus erosion along weathered joints near the tip of the canyon, causing the canyon to grow in a headward direction through time, dissecting the plateaus.

8

How do rivers erode down into solid rock to carve deep canyons with **incised meanders**?

confluence of the
Green & Colorado Rivers



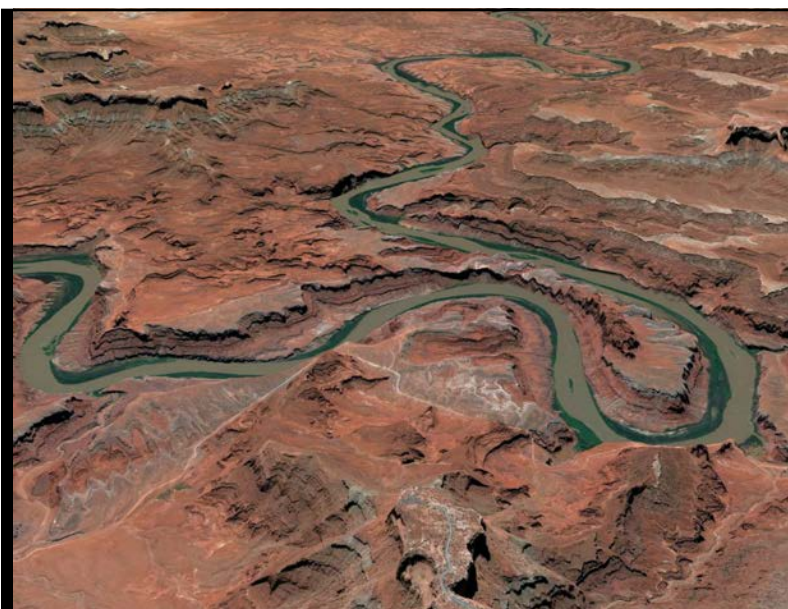
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"incised meanders" in
Colorado &
Green rivers in
Canyonlands

incised meanders are
deep, tightly
curving canyons
cut by rivers
(with no actual
floodplain)

10



**Google Earth perspective of incised meander ('gooseneck')
in Colorado River, Canyonlands NP**

11

How do rivers incise down into solid rock?



**Incised meander ('gooseneck') of Colorado River
- Canyonlands NP**

12



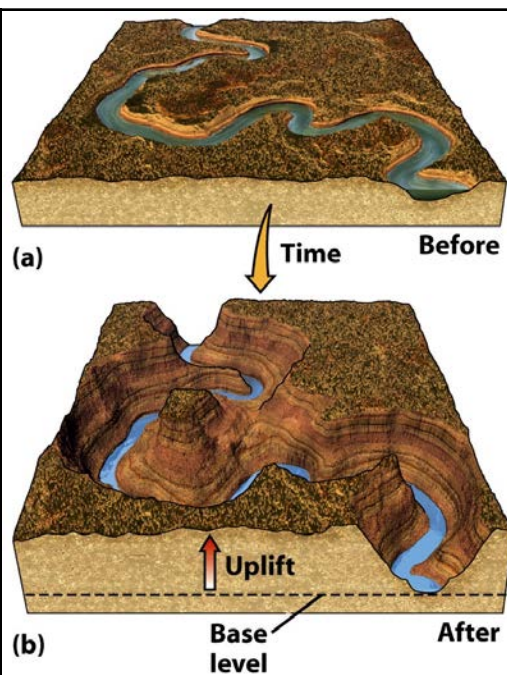
Meandering river across low-gradient flatlands

13

The meandering pattern of the river existed before the region was uplifted.

With late Cenozoic uplift (~5-6 m.y.a.), the gradients of streams increased and flowed faster, increasing their capacity to erode.

The rivers maintained their original channel pattern by downcutting (‘incising’) through the rock as it was uplifted (along faults) to become highlands, forming incised meanders.



14



San Juan River incised meanders, Utah
 - incision during flood stage by
 sediment transported within the water

15



San Juan River
Goosenecks State Park, Utah



Dolores River

16



**Incised meanders in Colorado River
within Grand Canyon NP**

17

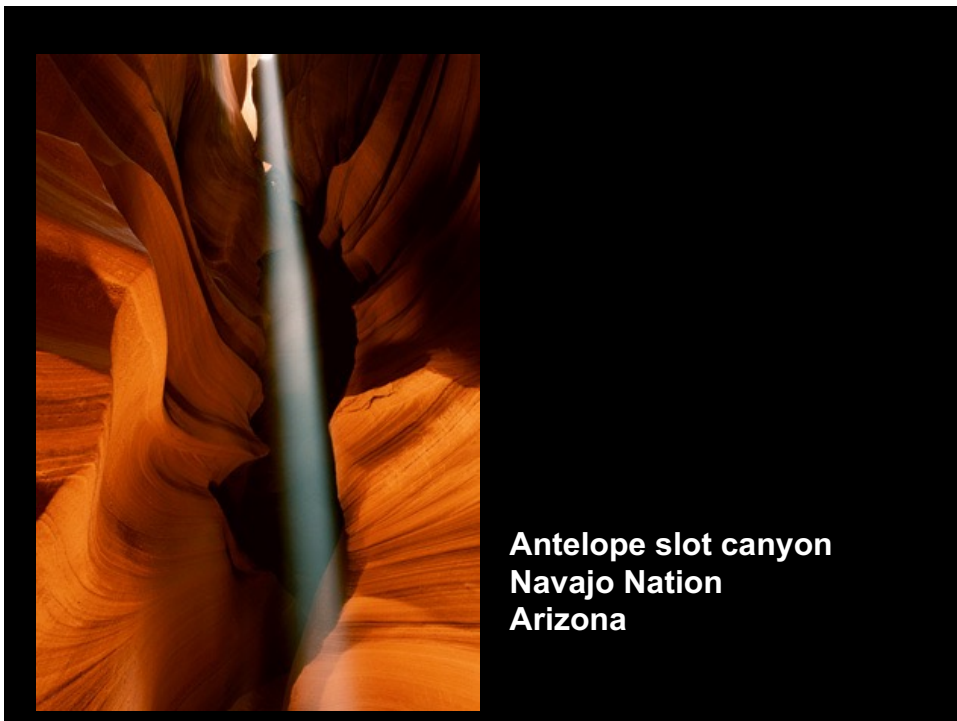
**slot canyon cut
into rock plateau,
Utah (50' deep)**



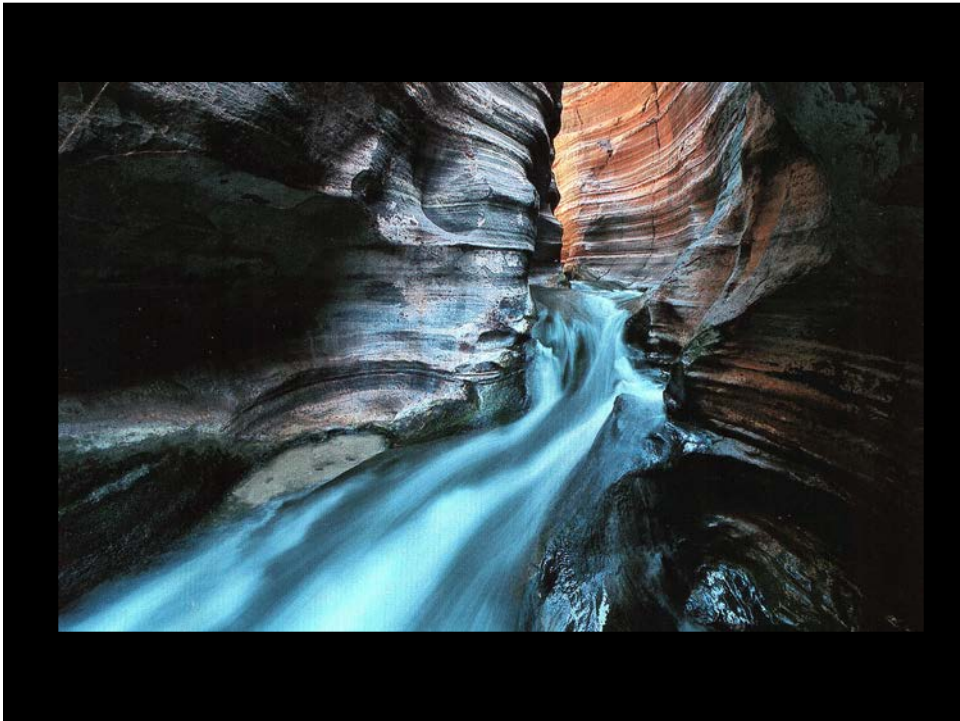
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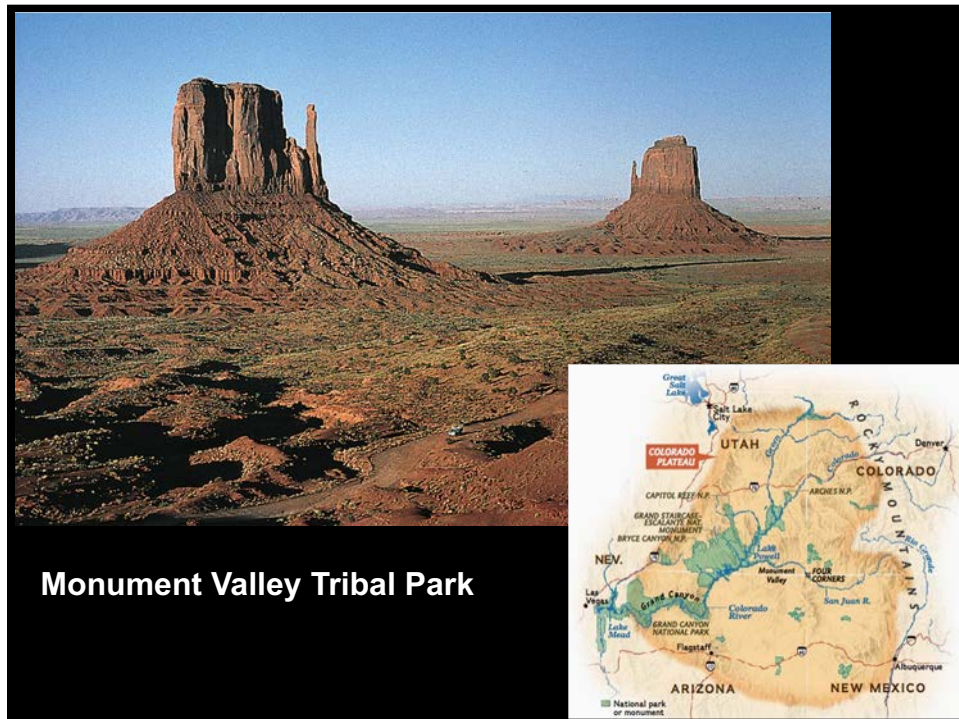
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