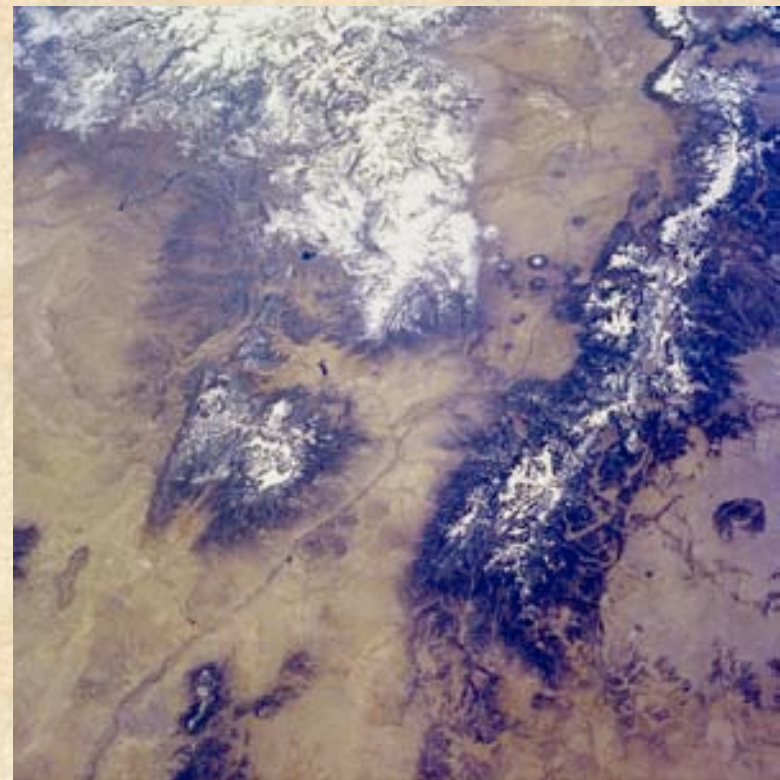


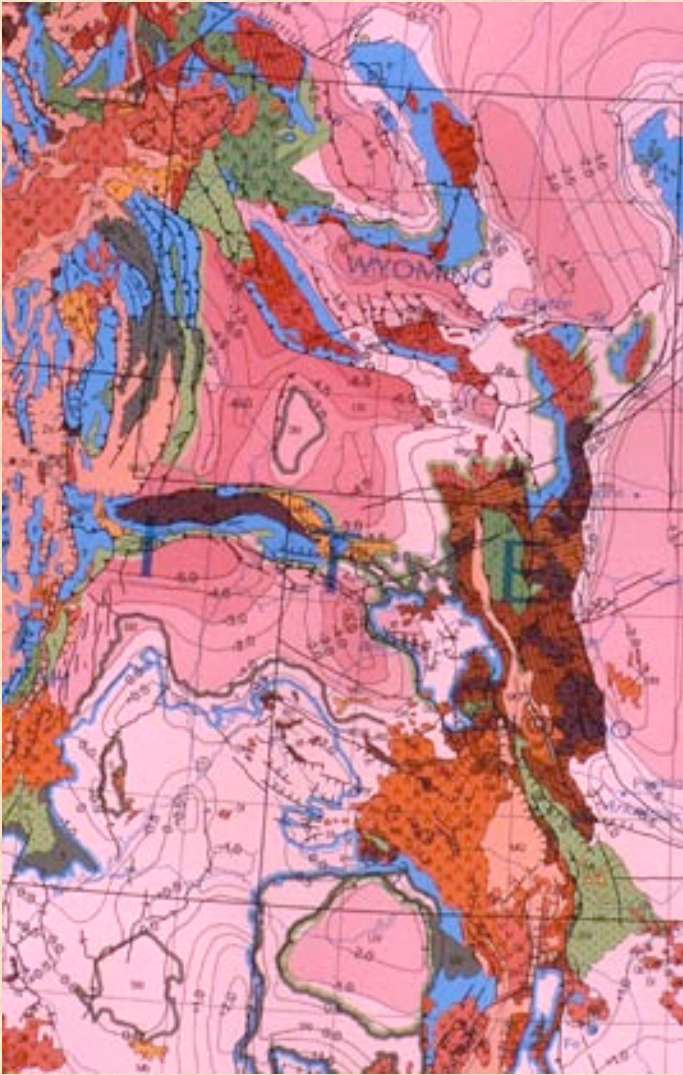
Parks from Space: Alternative Views of Colorado Plateau and Rio Grande Rift Parklands Using Remote Sensing Imagery and Astronaut Photographs

Joseph F. Reese, Geosciences Department, Edinboro University of PA

- In this presentation, I will show several parklands of the Colorado Plateau and Rio Grande Rift from a distinctly alternative perspective -- Space. Remote sensing imagery and astronaut photographs give a unique view of some of our continent's most recognizable landscapes.*



Rocky Mountains



Tectonic Map of North America,
Central Rocky Mountains



(from the Space Shuttle)

PHOTOGRAPHS and IMAGES OBTAINED FROM:

EARTH SCIENCES AND IMAGE ANALYSIS LAB:

"The Gateway to Astronaut Photography of Earth"

- <http://eol.jsc.nasa.gov> (several captions are from this source)
- Space Shuttle and International Space Station photographs taken by astronauts

EARTH OBSERVATORY / VISIBLE EARTH:

- <http://earthobservatory.nasa.gov> (some captions are from this source)
- <http://visibleearth.nasa.gov> (some captions are from this source)
- satellite imagery from Landsat 7, MODIS, MISR, SeaWIFS

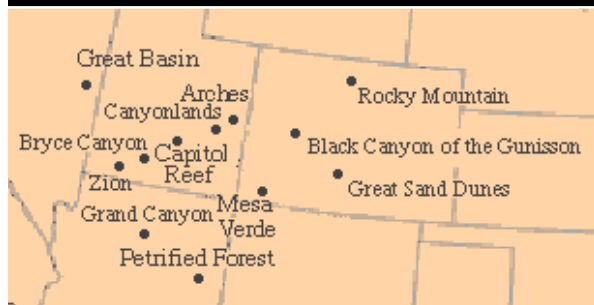
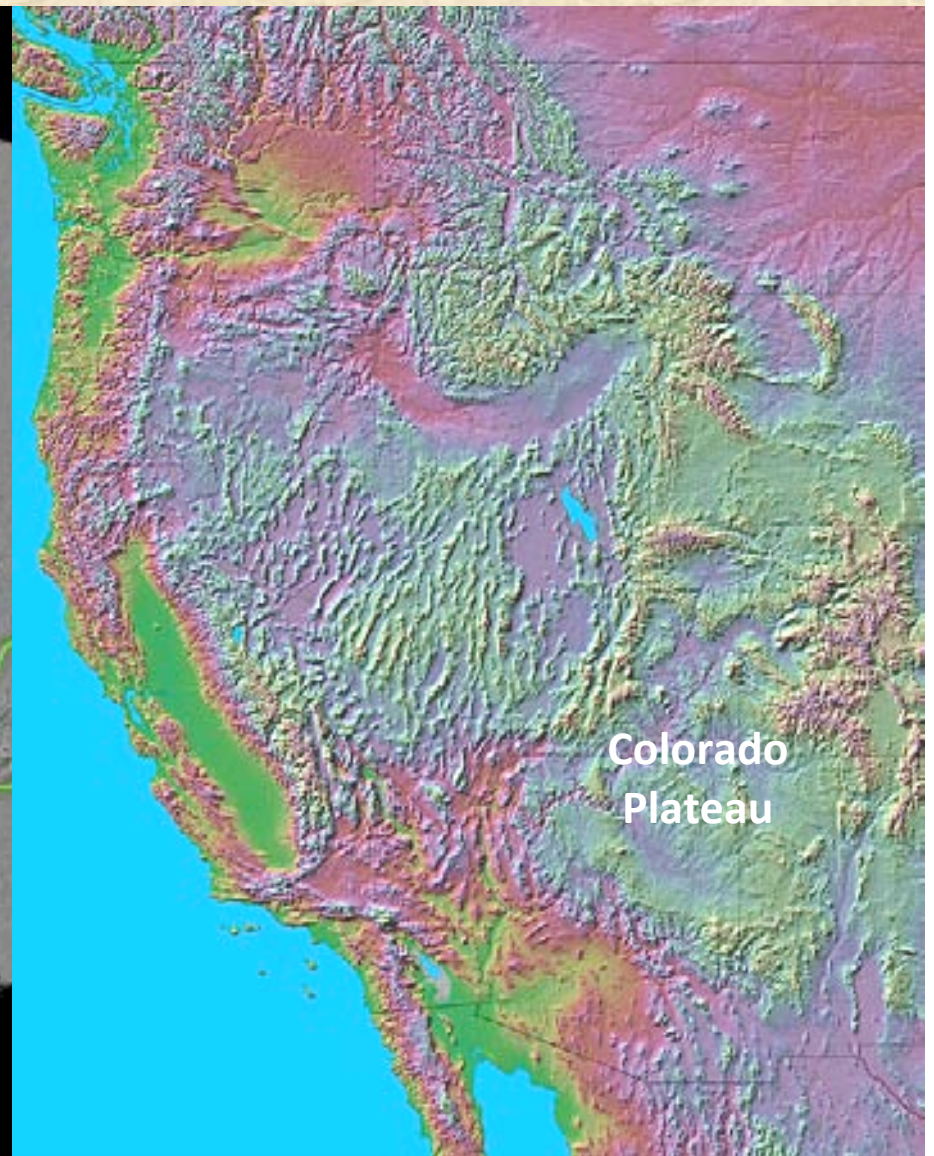
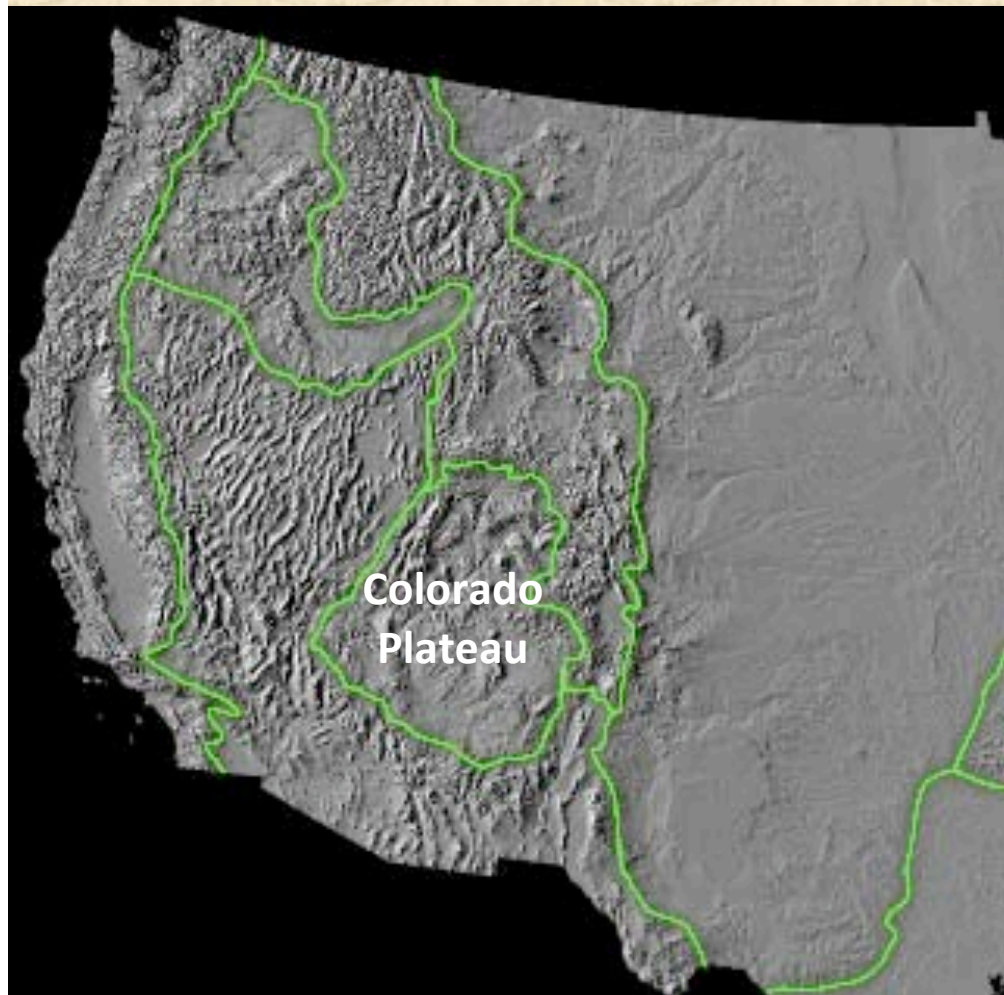
Jet Propulsion Lab – ASTER:

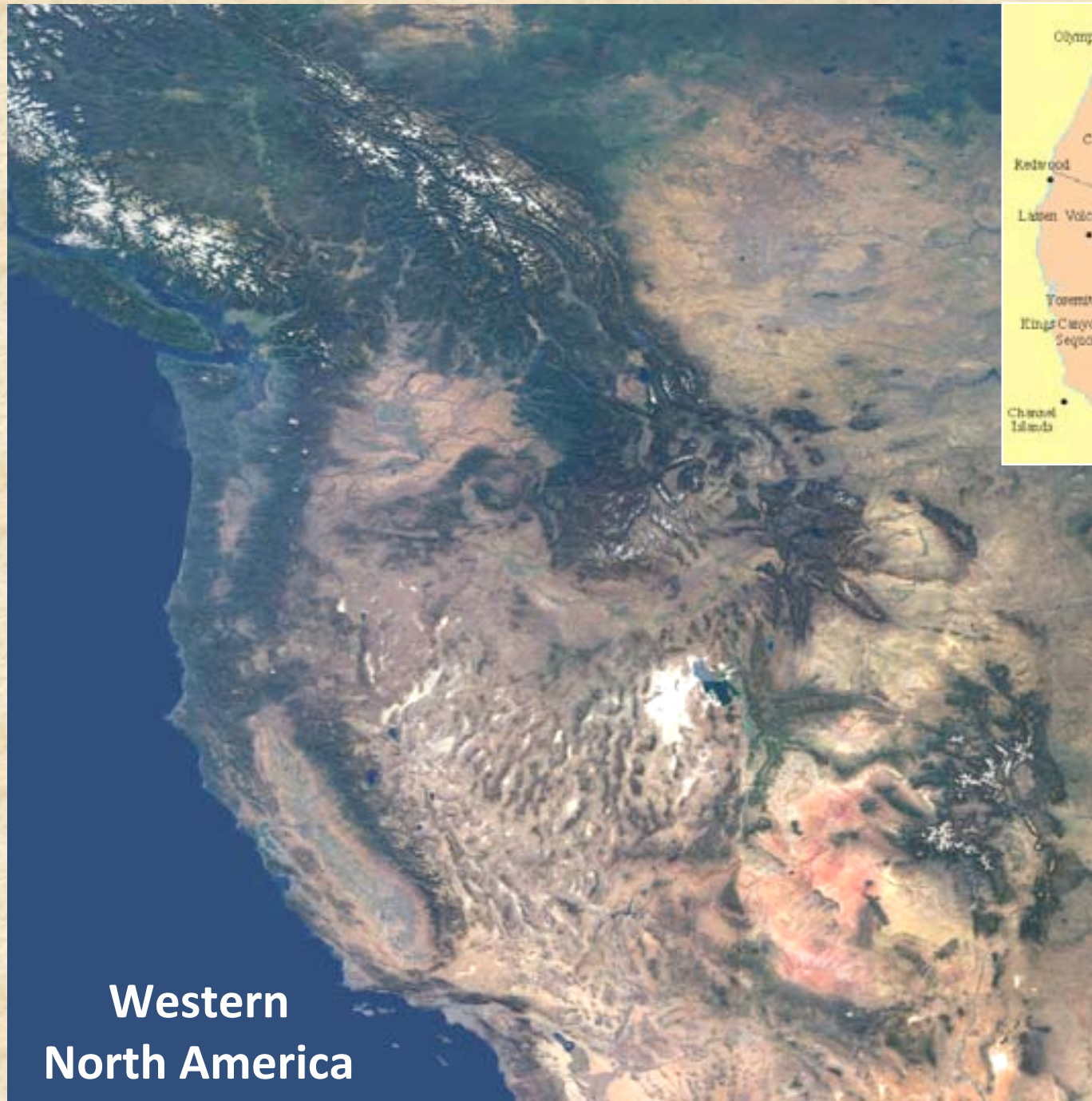
- <http://asterweb.jpl.nasa.gov/gallery/>

FIELD and AERIAL PHOTOS and FIGURES from:

Yann Arthus-Bertrand, Russ Finley, Lou Maher, John Shelton, Chernicoff (text), Plummer and McGeary (text), Tarbuck and Lutgens (text), United States Geological Survey, and various other texts and websites!

Physiographic Map of the Lower 48 States, USA



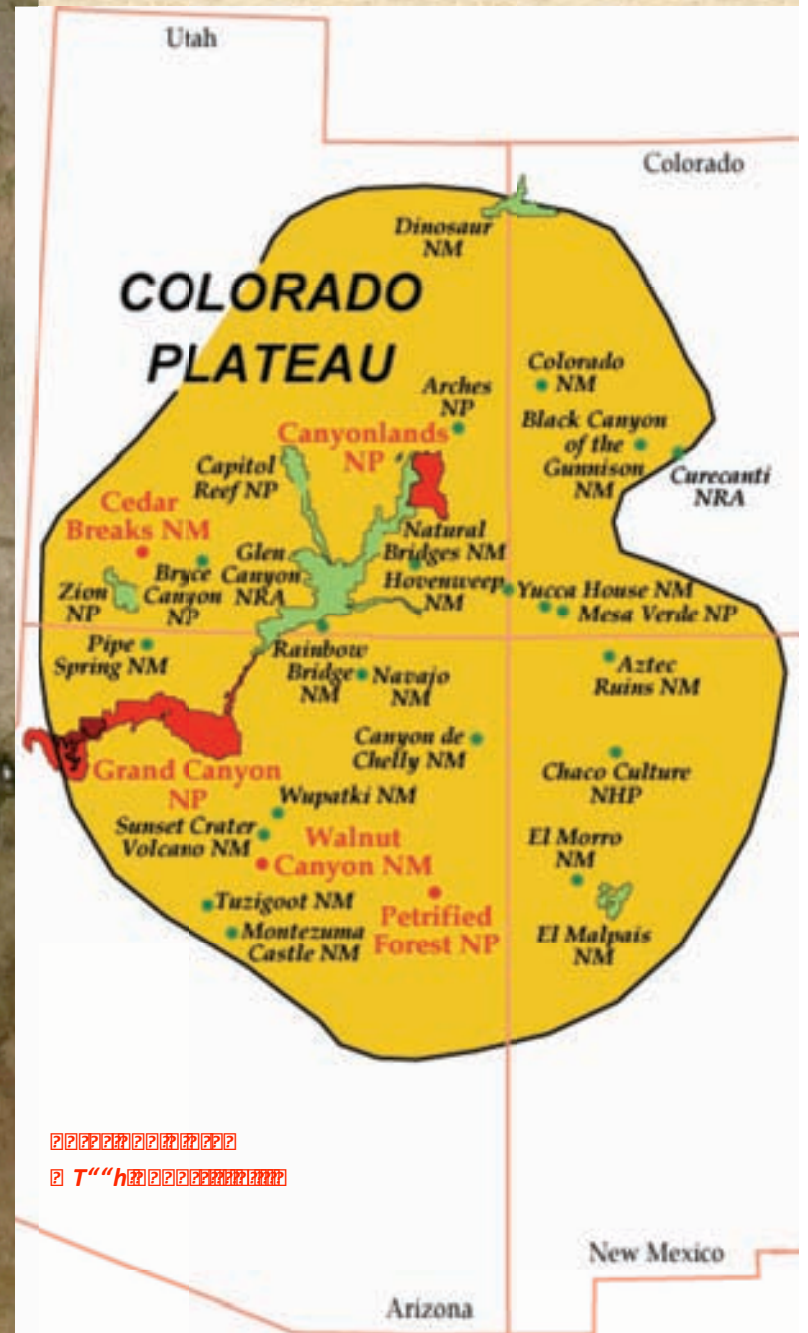


Western North America



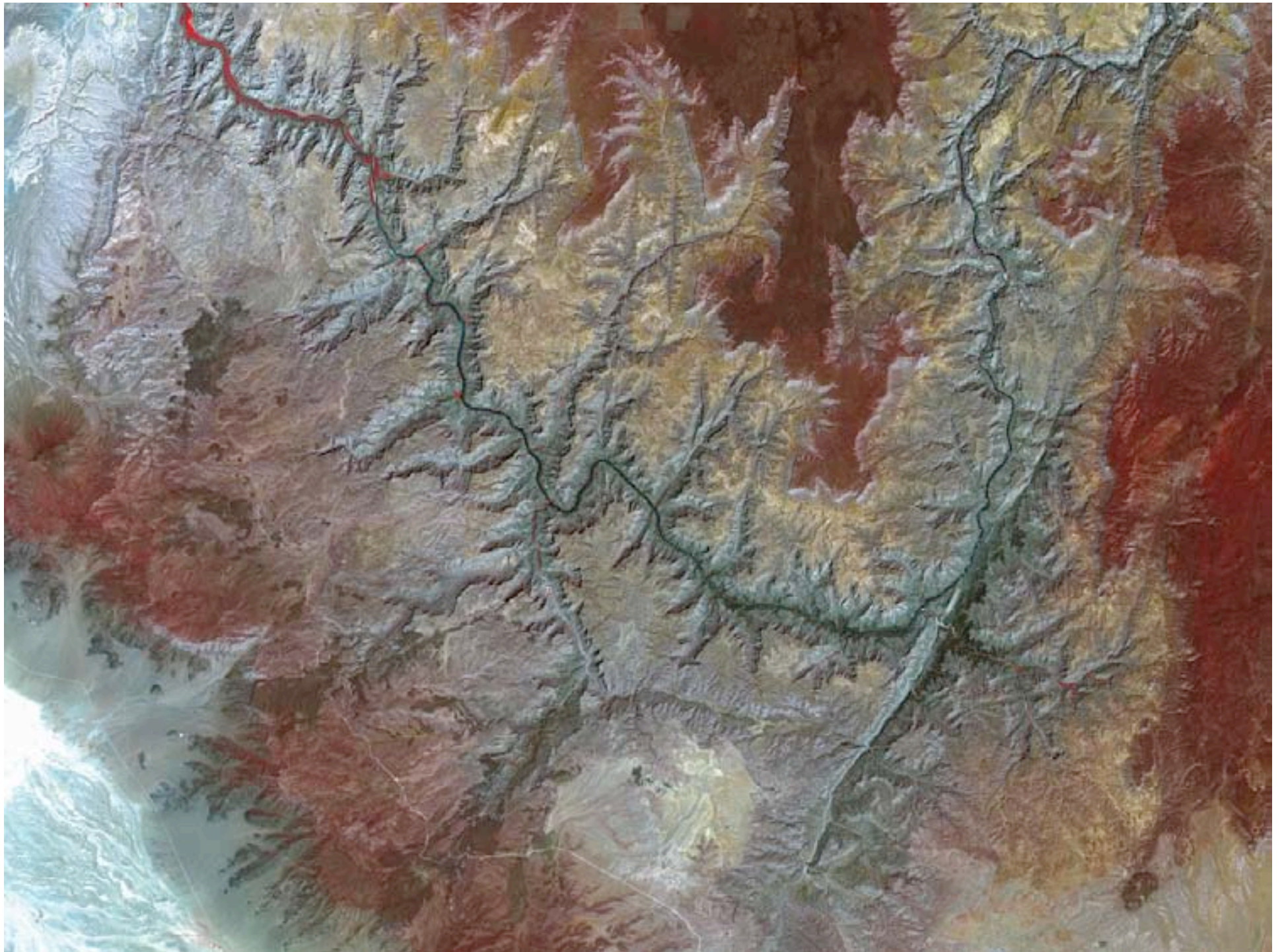
Location map of
National Parks in
Western U.S.

This natural-color image combines data from over 500 Multi-angle Imaging Spectro-Radiometer (MISR) orbits with shaded relief Digital Terrain Elevation models from the Shuttle Radar Topography Mission (SRTM) and other sources.



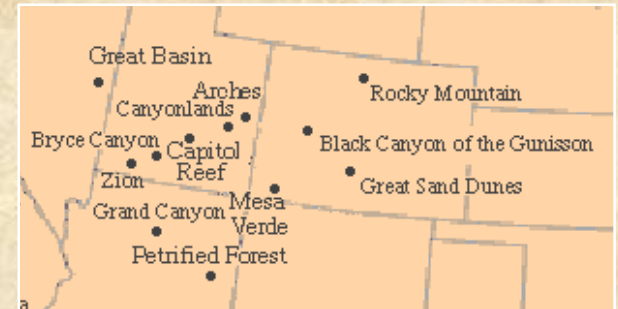
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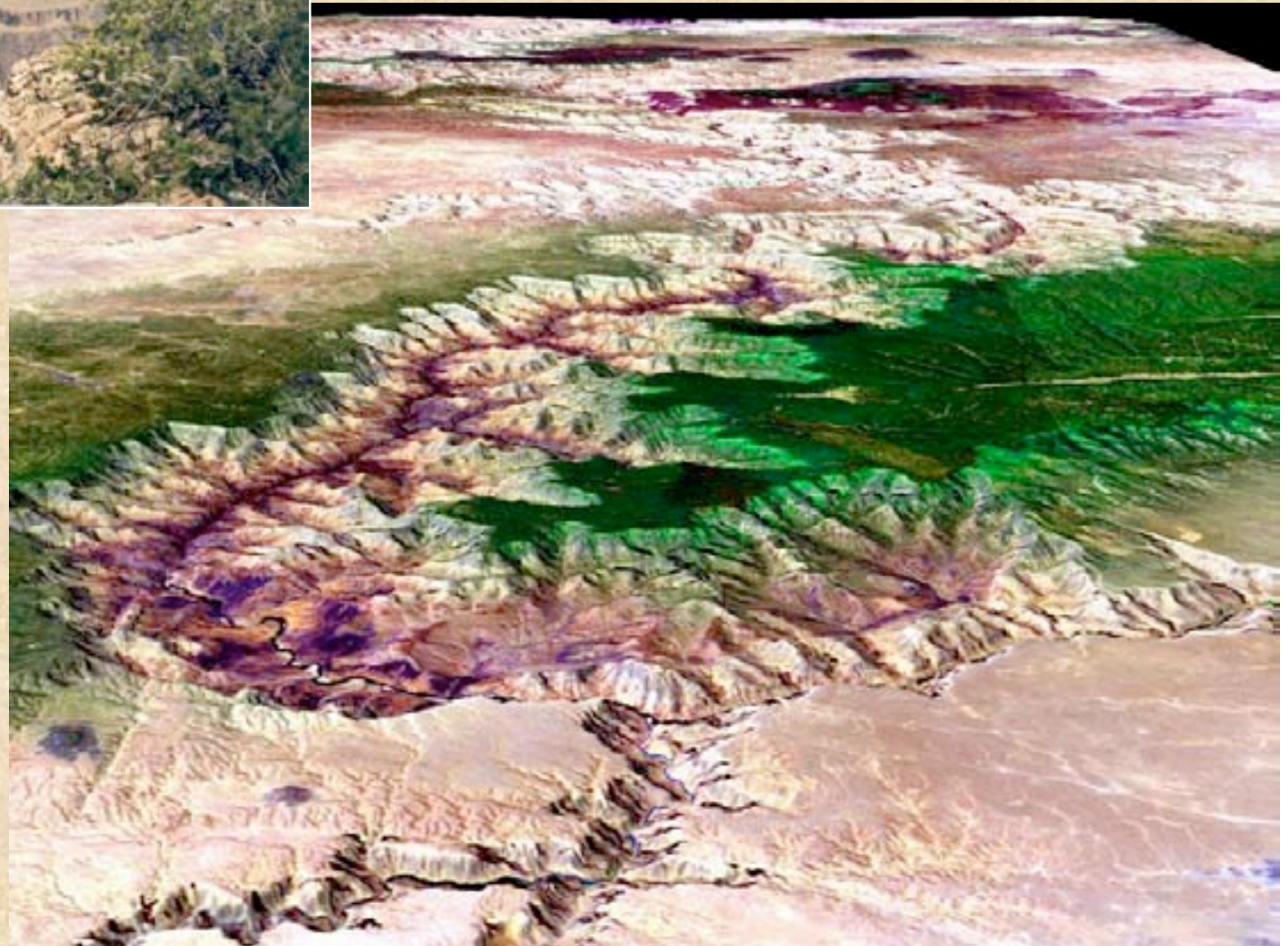


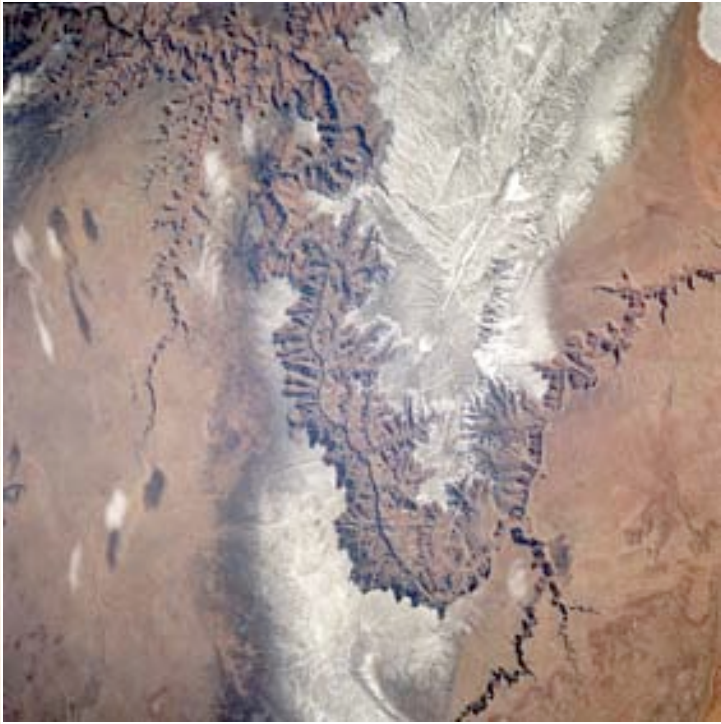
Grand Canyon, AZ



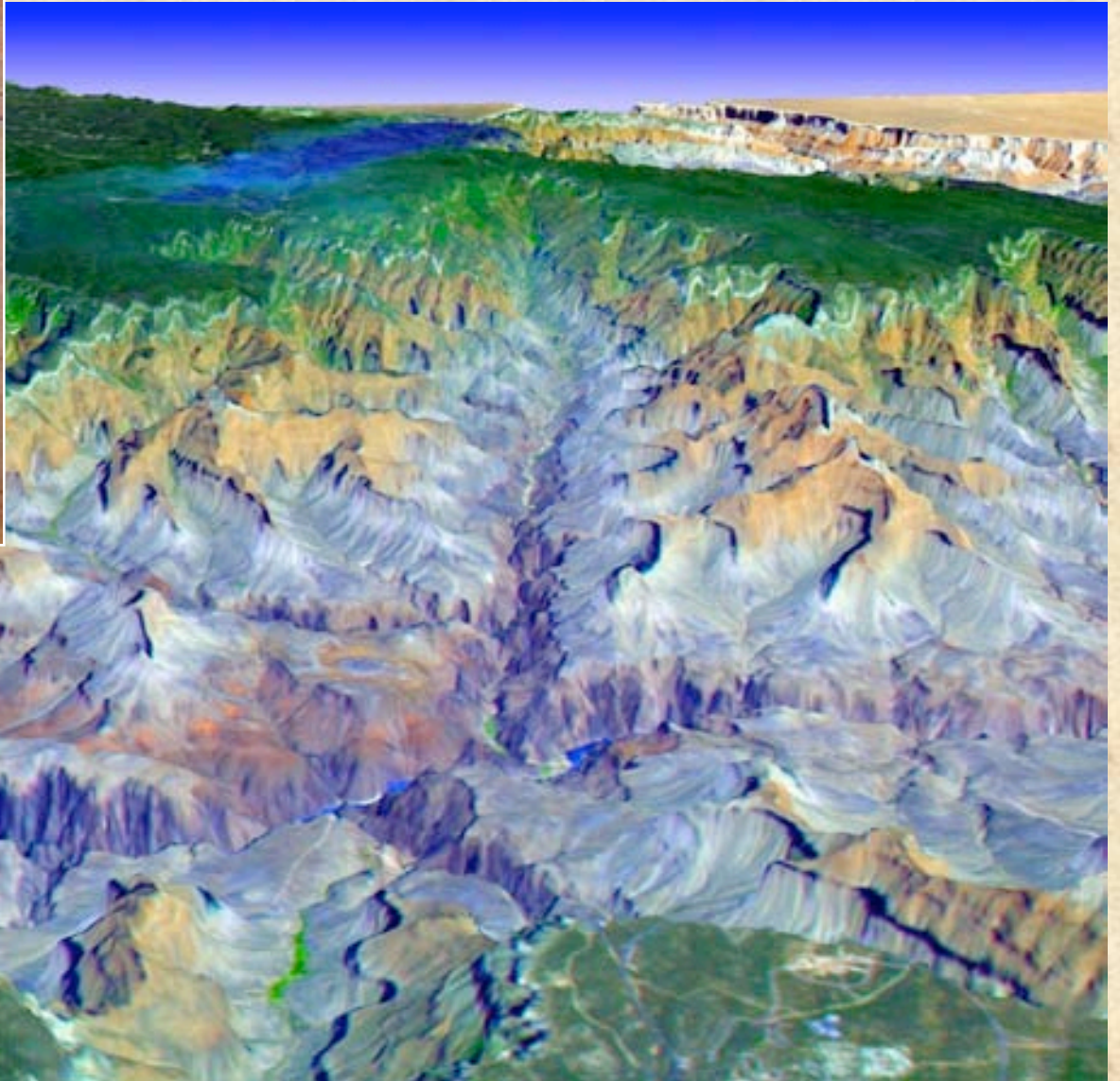
Joe pondering his
existence while along
the South Rim...

This visualization combines
simulated natural color
imagery from the Landsat 7
Enhanced Thematic Mapper
Plus (ETM+) instrument with
elevation data derived from
the Shuttle Radar Topography
Mission (SRTM) and the
United States Geological
Survey's Digital Terrain
Elevation Data (DTED).





Space Shuttle photograph of the Grand Canyon
(with snow on Kaibab and Coconino plateaus)

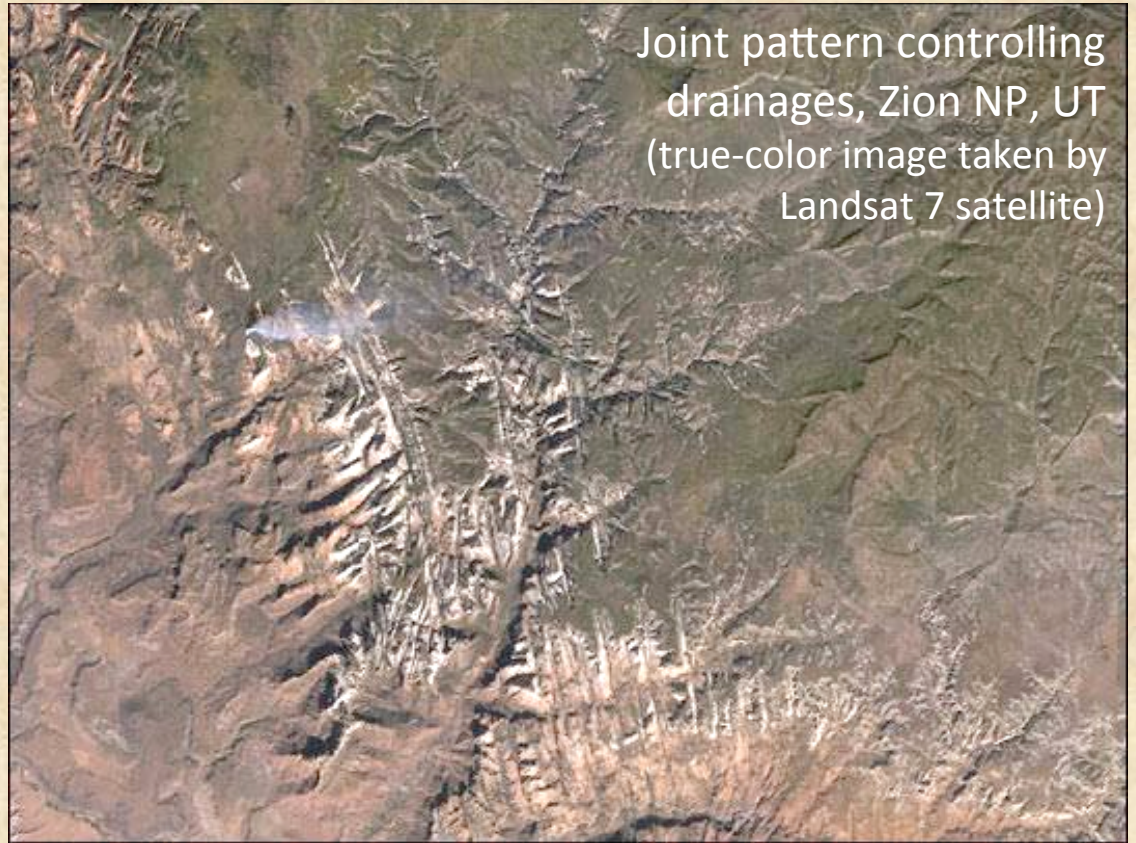


ASTER image of the Grand Canyon
(view northeastward up Bright Angel Canyon)

Waterpocket Fold,
Capitol Reef NP, UT
(Space Shuttle photo)



Joint pattern controlling
drainages, Zion NP, UT
(true-color image taken by
Landsat 7 satellite)



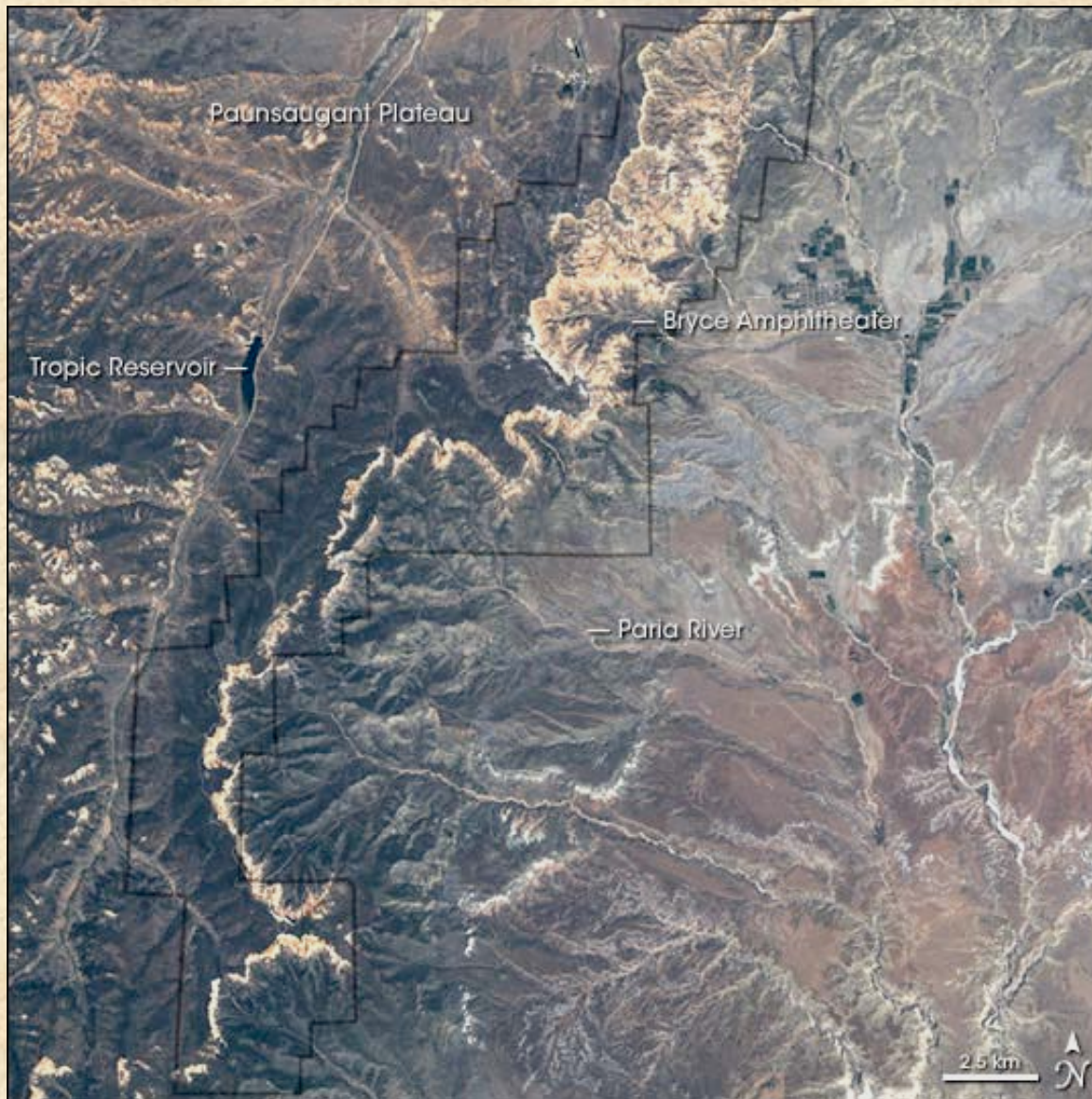
Some structures:
from
Colorado Plateau
parks



Close-up space views of Zion
Canyon (right) and Waterpocket
Fold (below)



Bryce Canyon NP, UT



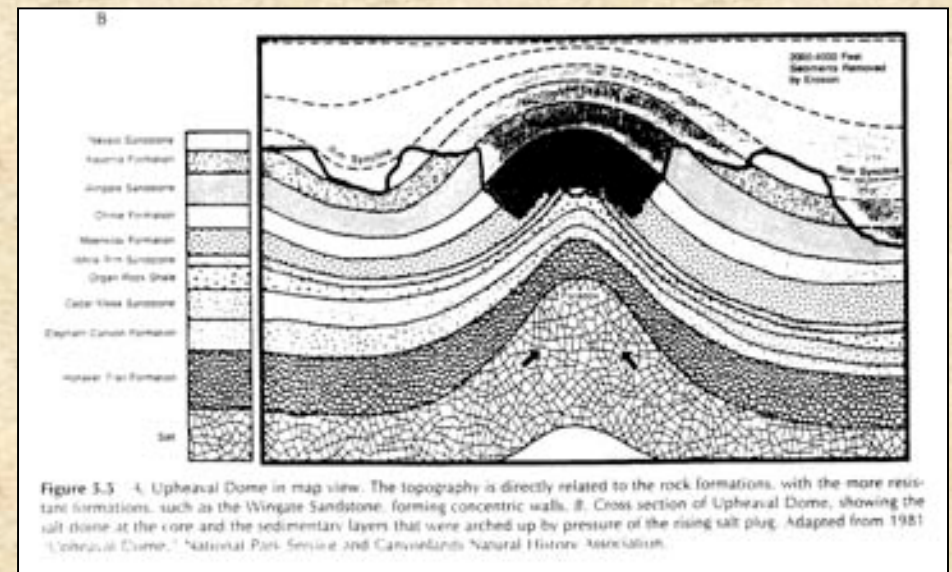
Bryce Canyon from air

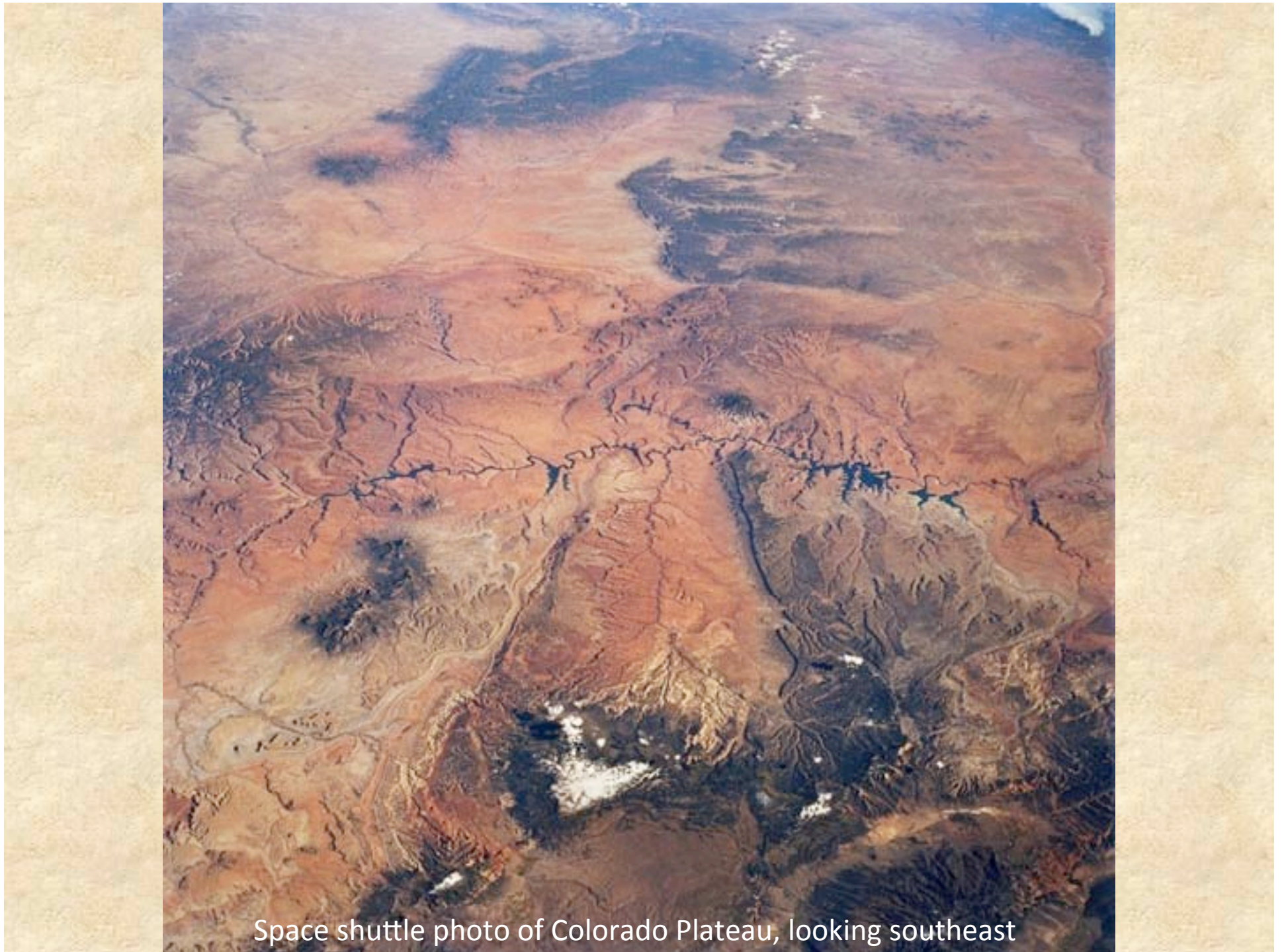




Focus on Upheaval Dome...

Two Space Shuttle views of the Canyonlands area, UT





Space shuttle photo of Colorado Plateau, looking southeast

Lake Powell and the Colorado River, Colorado Plateau, UT-AZ

“The building of Glen Canyon Dam ushered in the modern environmental movement...” -- David Brower, Sierra Club



“The canyonlands did have a heart, a living heart, and that heart was Glen Canyon and the wild Colorado.”

-- Edward Abbey





3/25/99

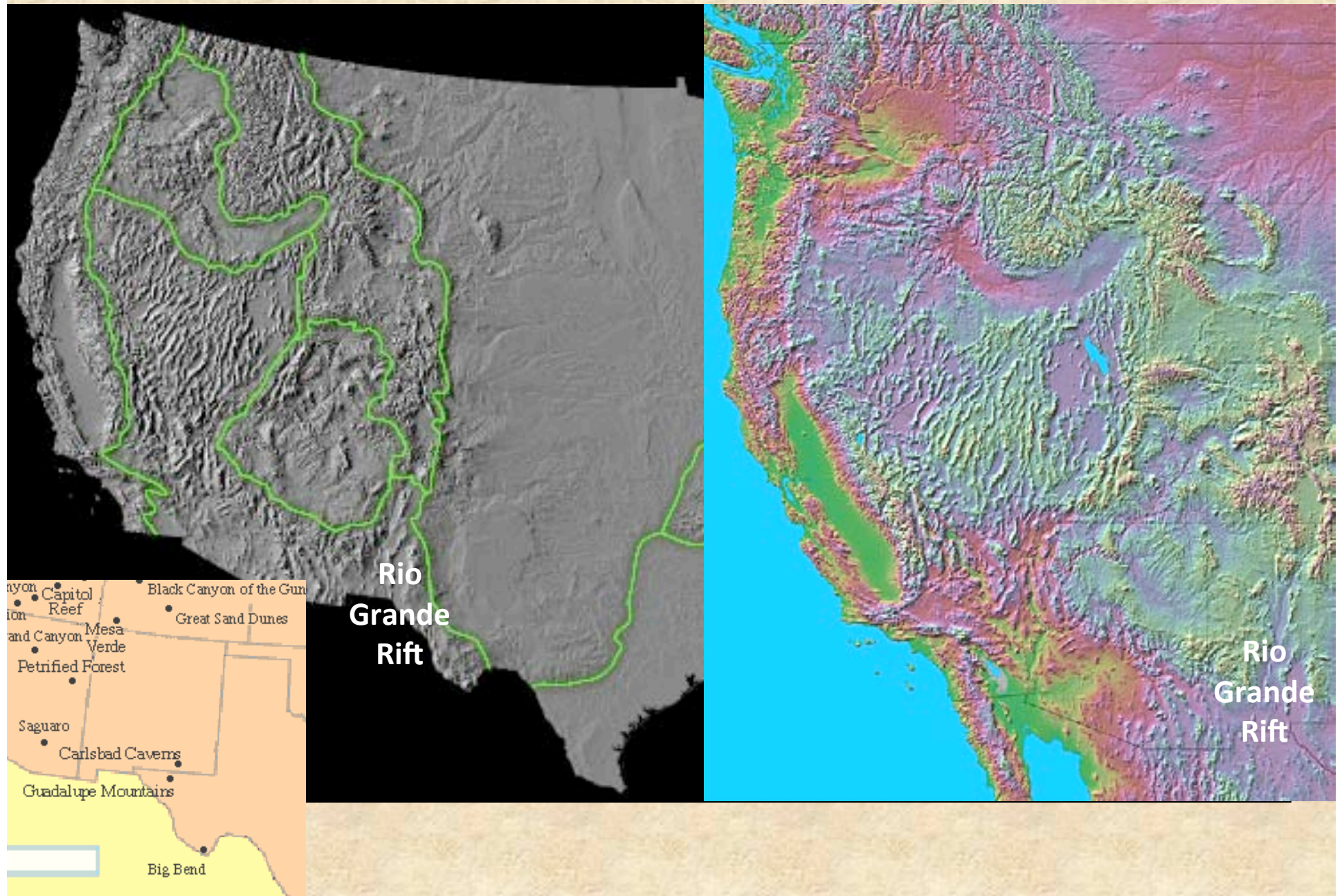
Lake Powell...

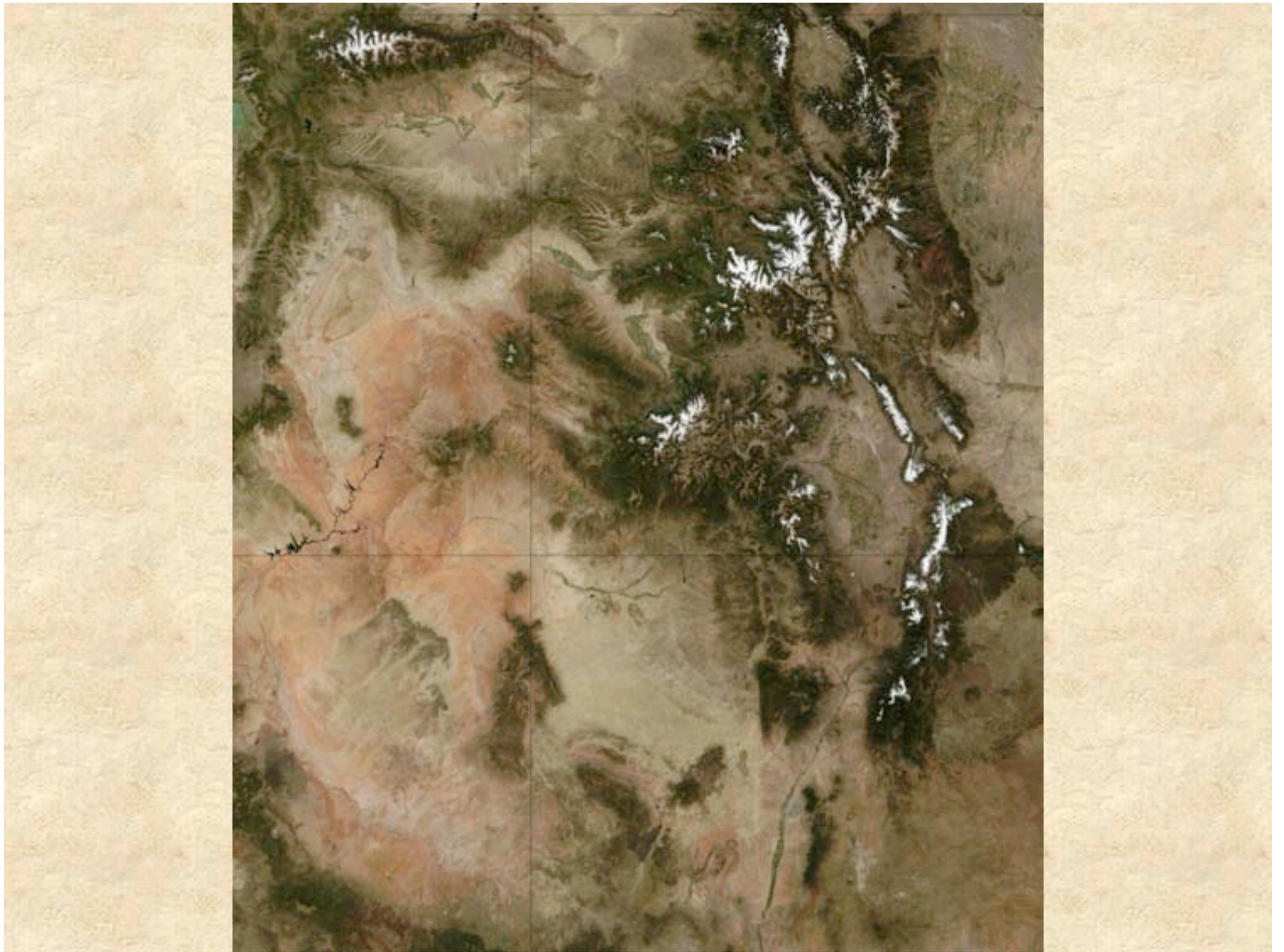
... changes in
reservoir level



4/2/05

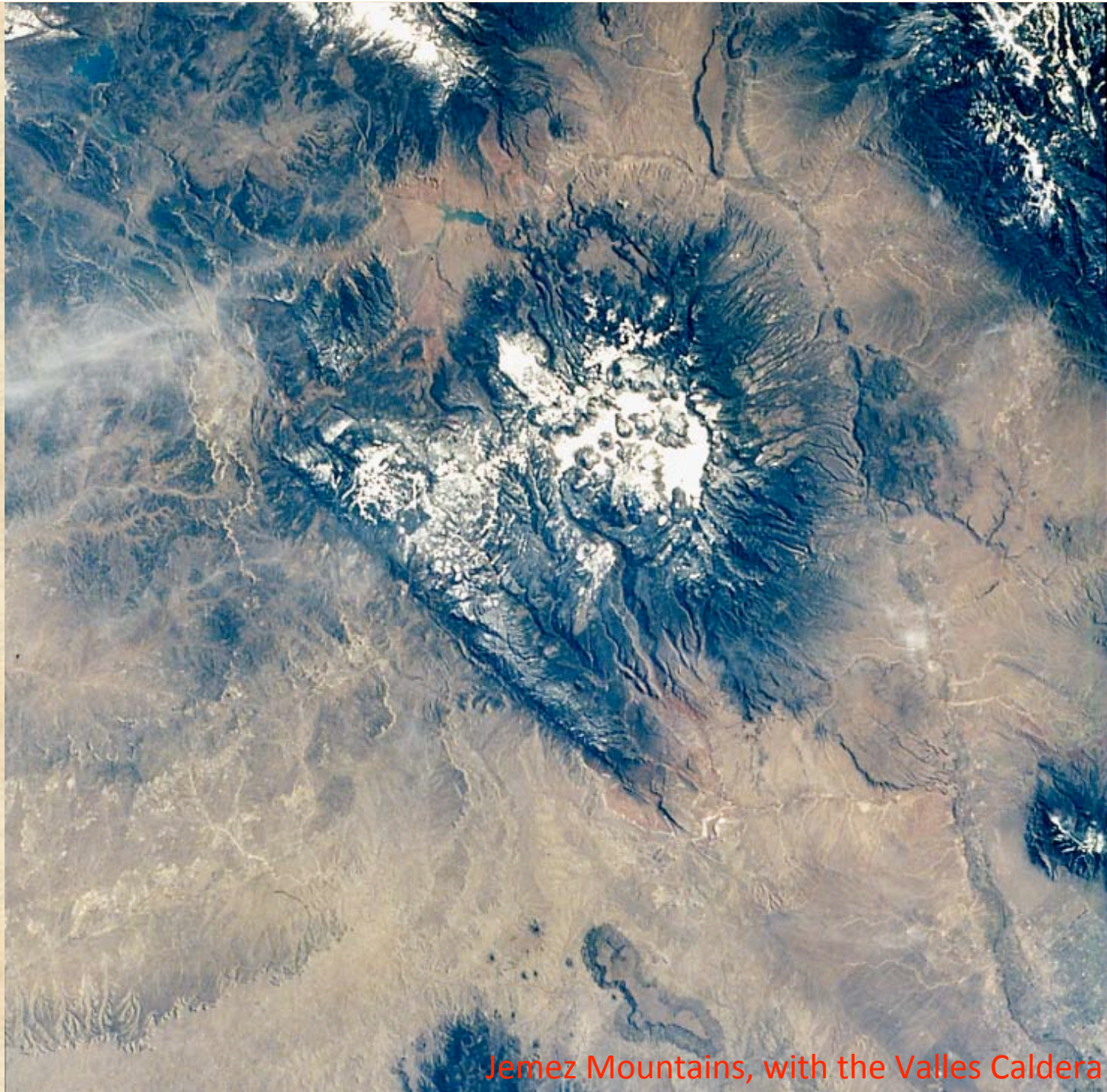
Physiographic Map of the Lower 48 States, USA





Rio Grande Rift, looking south





Jemez Mountains, with the Valles Caldera

Rio Grande Rift



Great Sand Dunes NP, CO

White Sands NM





Great Sand Dunes NP, CO





CONCLUSIONS

Remotely sensed imagery and astronaut photographs...

- give a distinctly alternative and spectacular perspective of some of our continent's most recognizable landscapes – those in America's parklands
- provide a clear link between local geologic setting and regional landscape formation
 - can readily distinguish North American physiographic / tectonic provinces
- present the parklands at scales typically not seen in National Park Geology courses
 - are used to introduce the regional geology of a particular park or set of parks



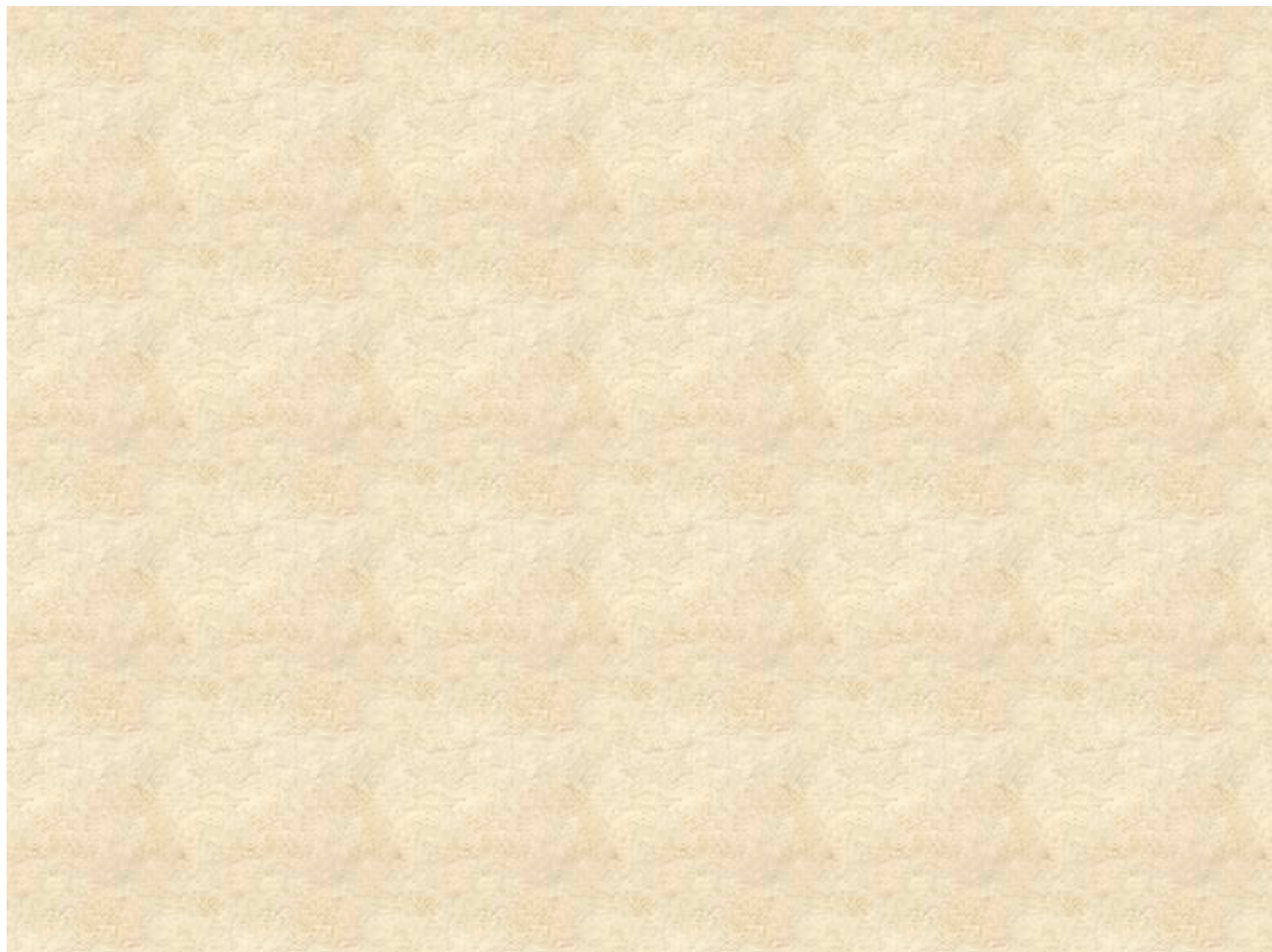


CONCLUSIONS

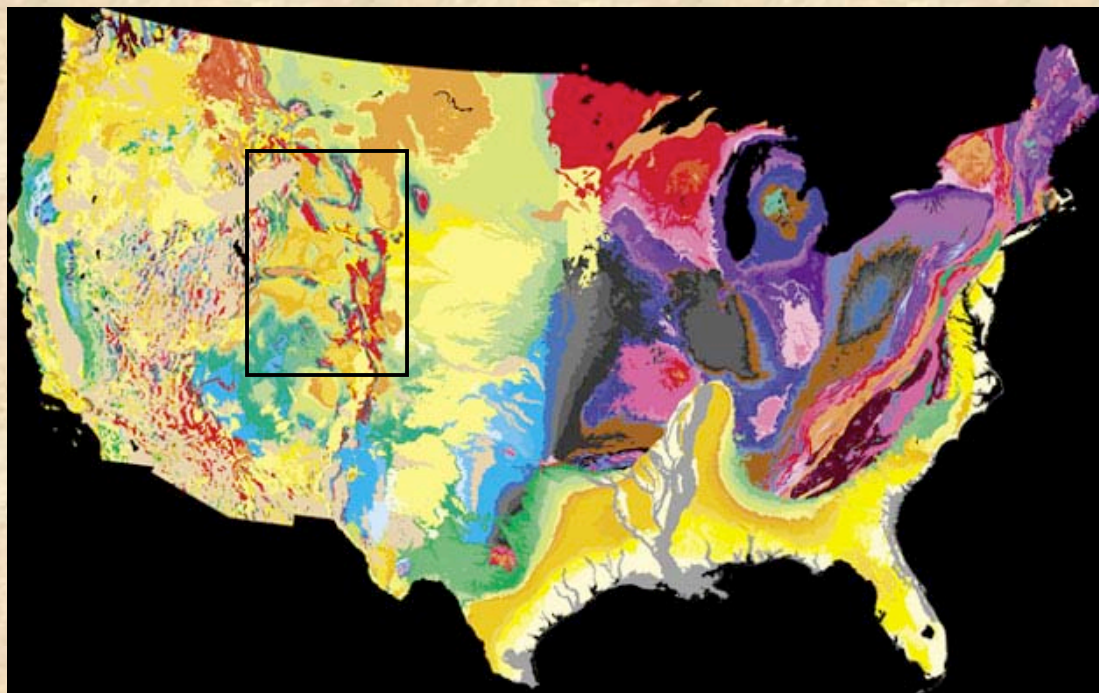
- Regional-scale landforms related to deformation and mountain-building, volcanism, deposition, and erosion are easily observed, interpreted, and contrasted.
- Associated geologic processes and their modern and ancient large-scale products are beautifully documented.
- Integrating these views with more typical air and ground photos provides a continuum of scales to observe and study Park geology.
- Many views are visually stunning as well as educational and, with their aesthetic appeal, serve to enhance student curiosity and interest in Park geology.



A seamless zoom from space to the ground, using data from Terra/MODIS, Landsat/ETM+, and QuickBird, and ending at the Grand Canyon. From NASA Goddard Space Flight Center, Scientific Visualization Studio.
(URL: <http://svs.gsfc.nasa.gov>)



Geologic map of the
contiguous United States



Space Shuttle photo of the Rockies

Physiographic map of the
contiguous United States



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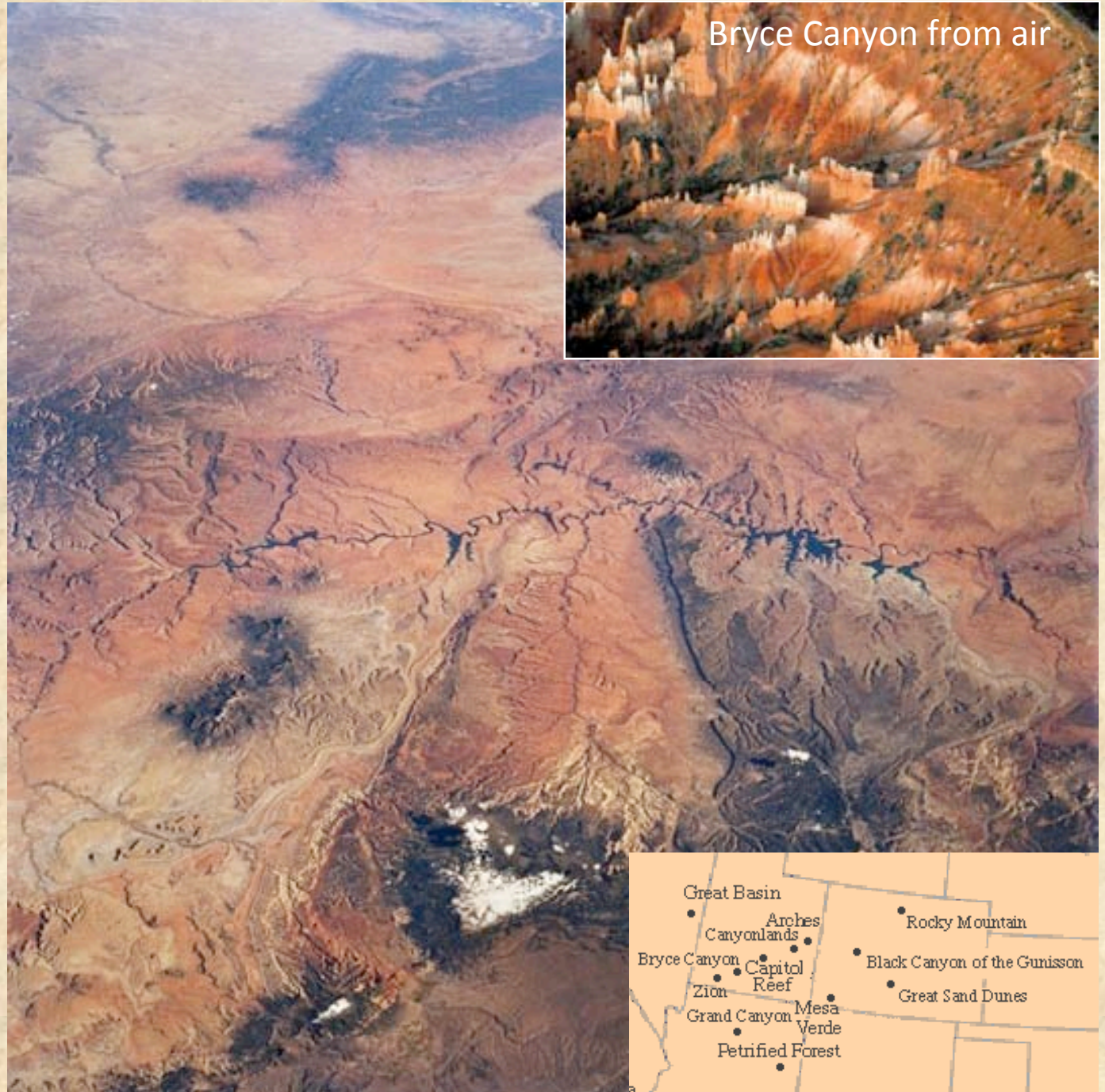
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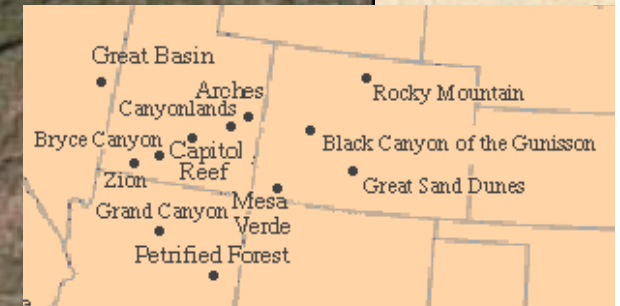


Space Station
photograph of the
Colorado Plateau,
mostly UT (looking SE)

Parklands include:

- Glen Canyon NRA
 - Canyonlands NP
 - Capitol Reef NP
- and numerous others!





Space Shuttle photograph of joint pattern controlling drainages, Zion NP, UT

Map of western U.S. Cordillera showing distribution of major tectonic elements and rock bodies of late Cretaceous to early Tertiary age.

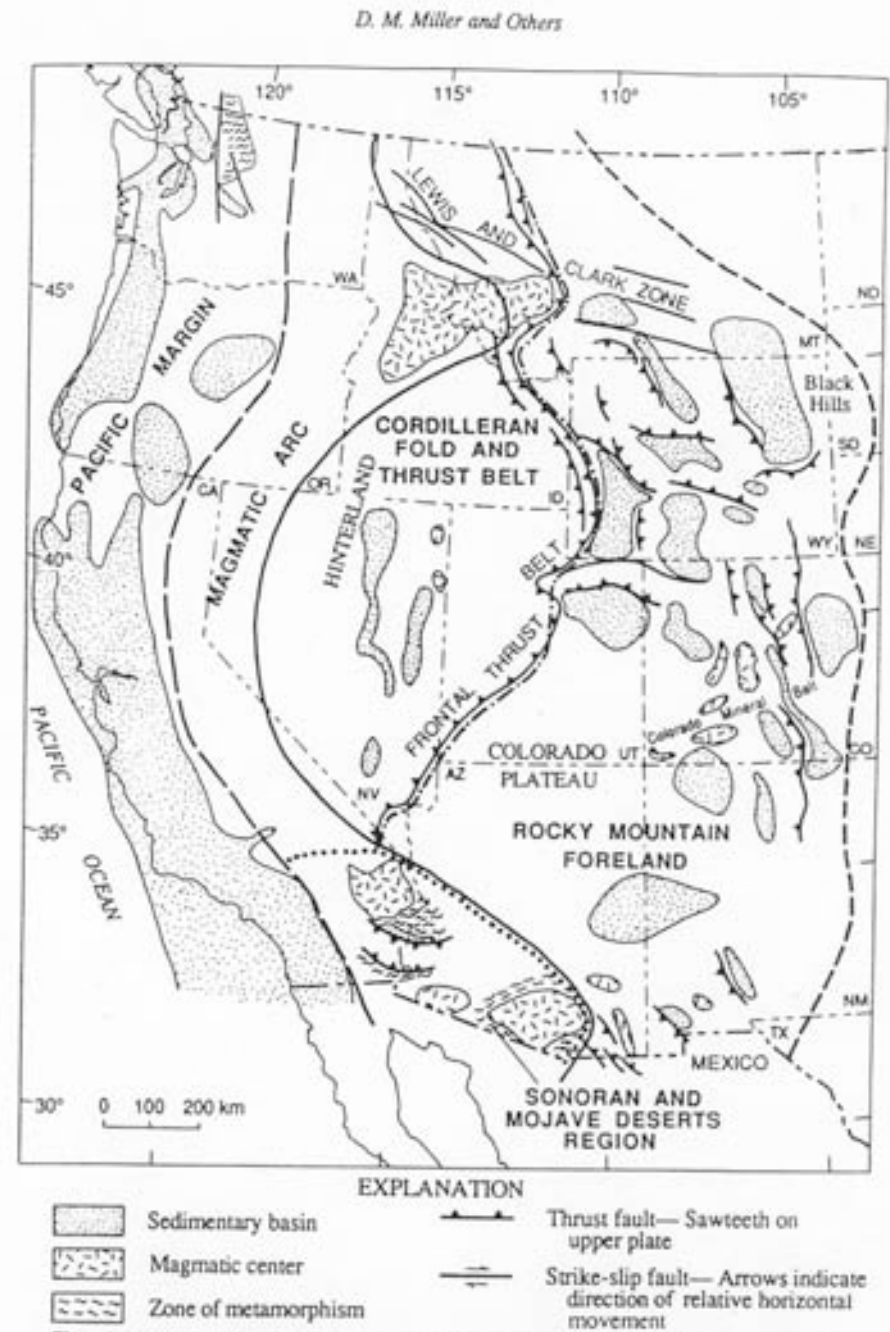
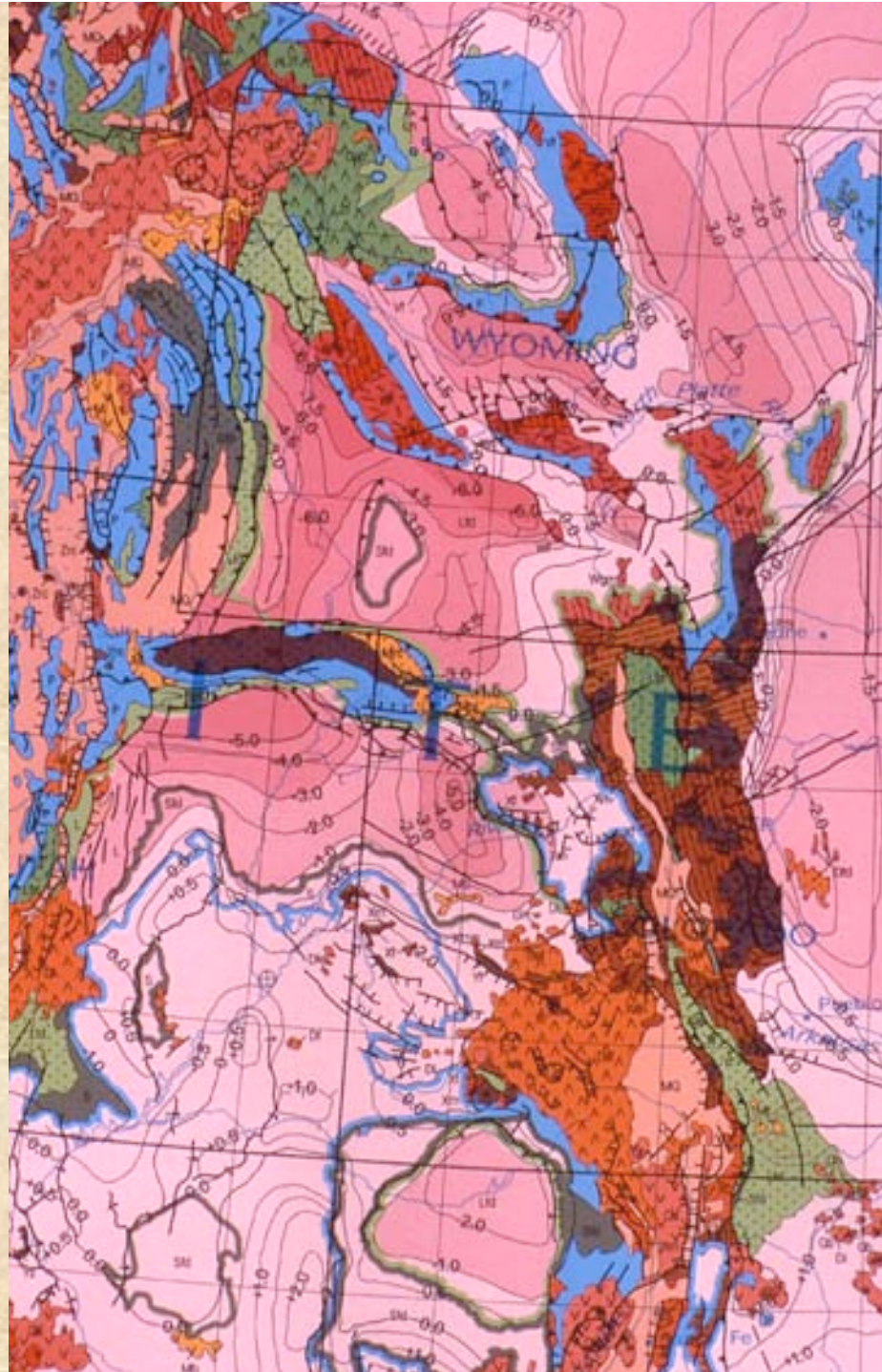
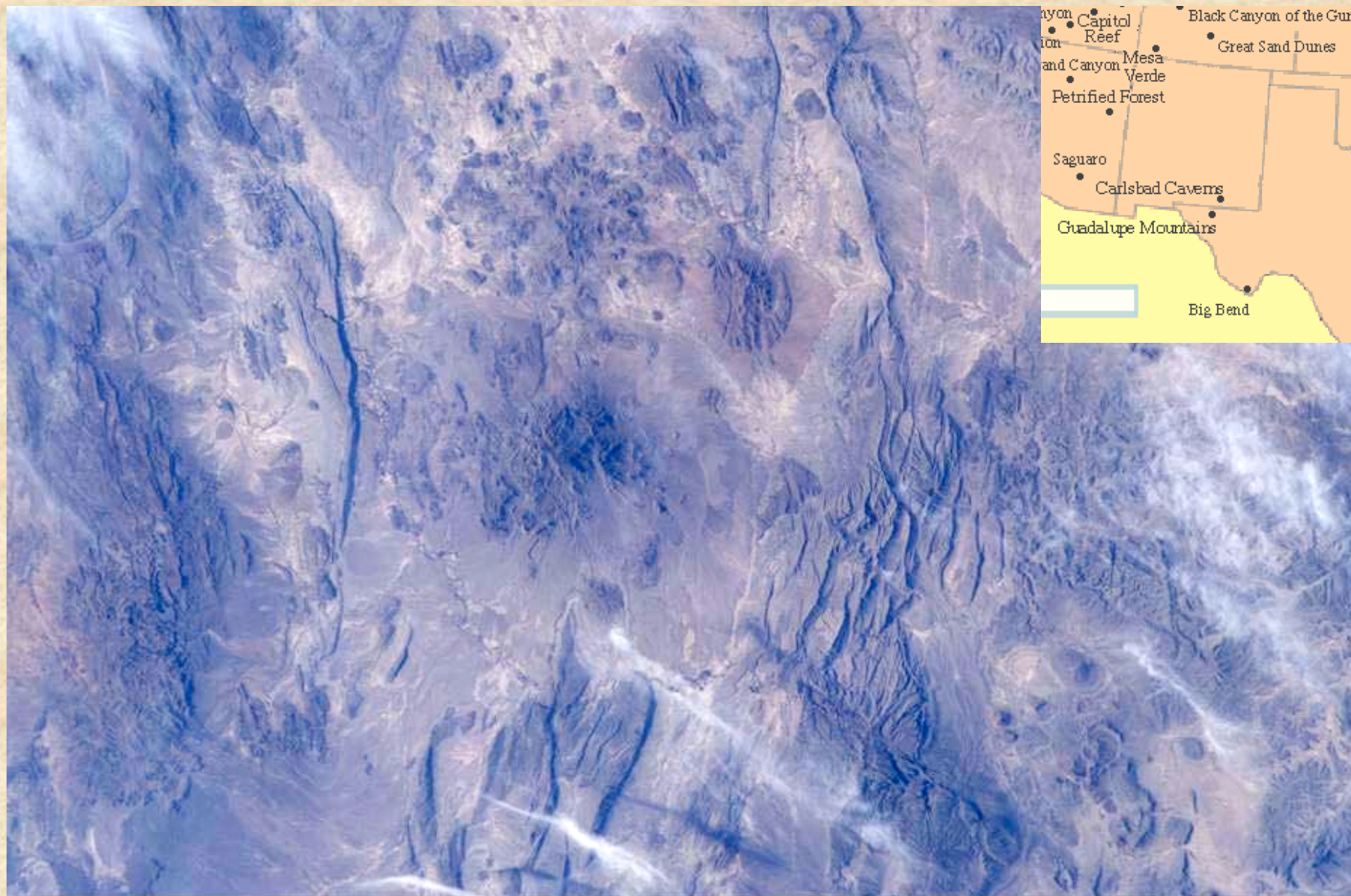


Figure 1. Map of the western U.S. Cordillera showing distribution of the major tectonic elements and locations of Late Cretaceous to early Eocene sedimentary, igneous, and metamorphic rocks. Those regions described in this chapter are outlined. Deposits east of the Rocky Mountain foreland region are described by Baars and others (1988).

**Rocky Mountains, from
the Tectonic Map of
North America,
by Muehlberger (1996)**





ISS006E31319

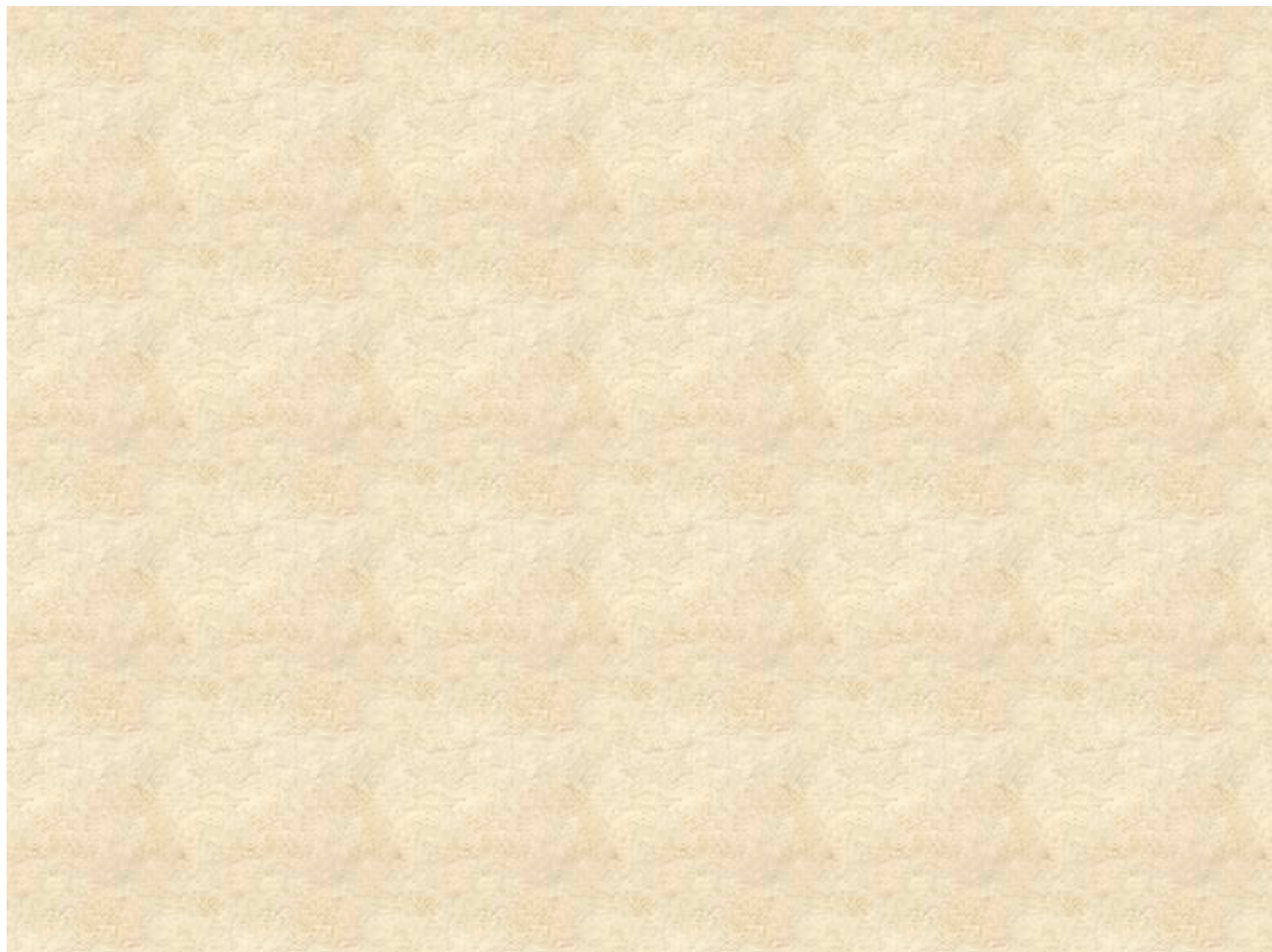
Big Bend NP, TX



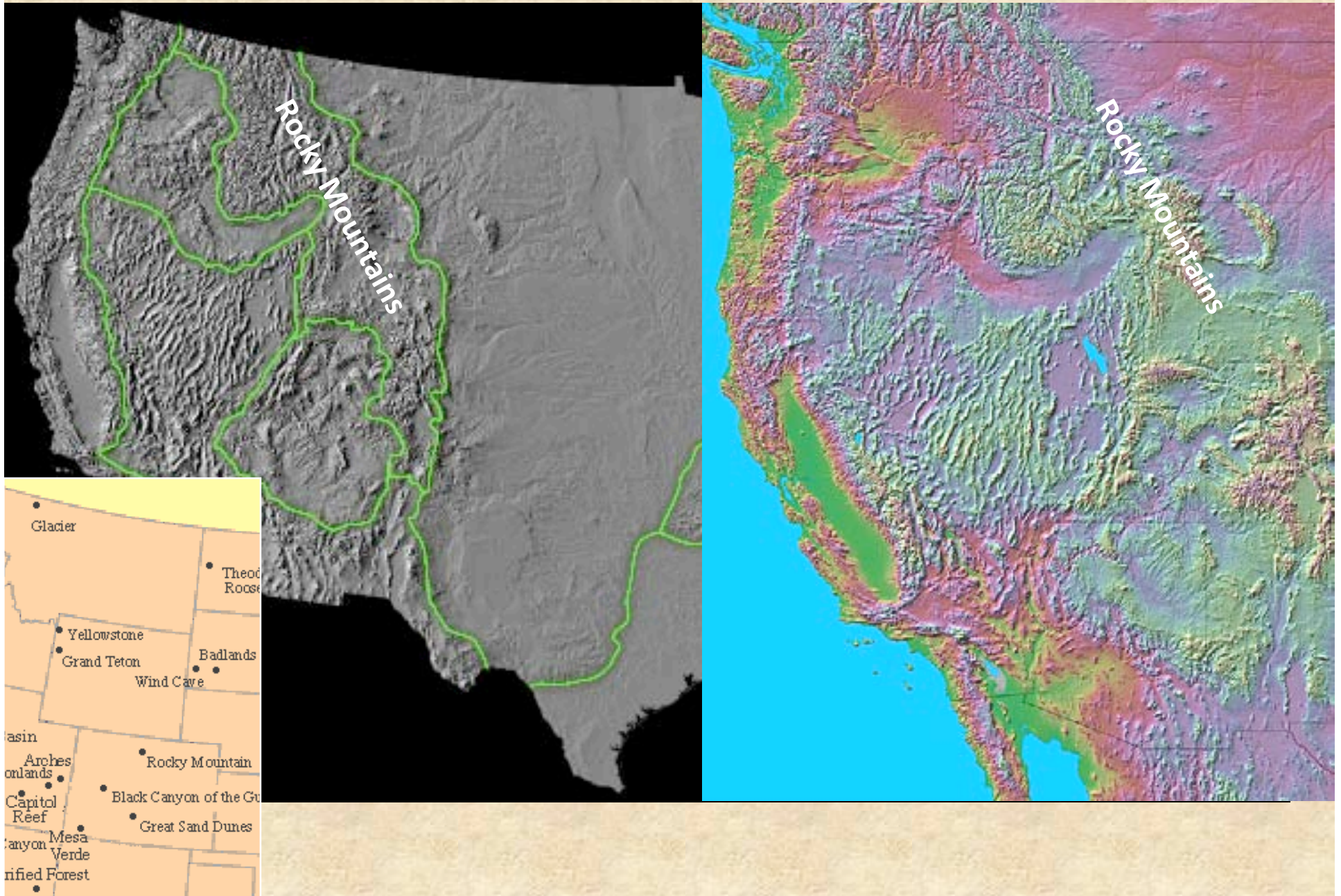


The otherworldly footprint of black basaltic lava creates a striking landscape at Black Point Lava Flow in northern Arizona, seen in this photograph taken from the International Space Station. The flow is part of Arizona's San Francisco Volcanic Field, a group of geologically young (approximately six million to less than one thousand years old) volcanoes, lava flows, and cinder cones located just north of Flagstaff, Arizona.

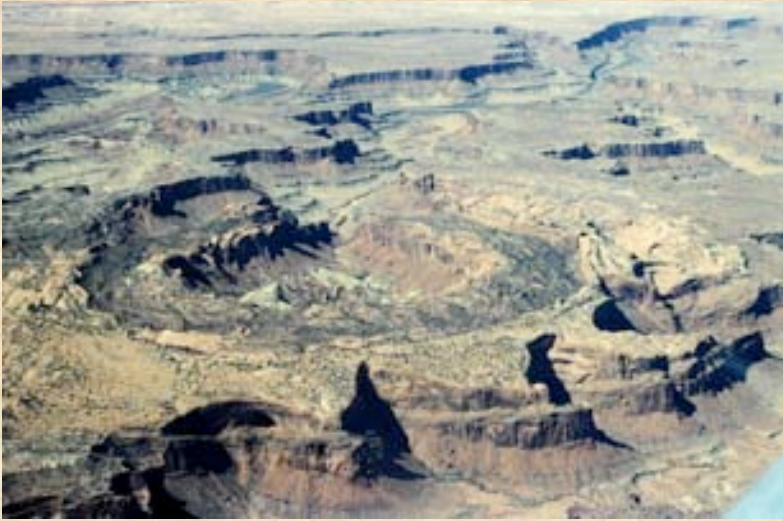
When it erupted onto the surface, the Black Point Lava flowed eastward over the older Permian and Triassic sedimentary rock sequences (spanning the period from roughly 300 to 240 million years ago) that are so well known around the vicinity of the Grand Canyon. The eastern edge of the flow slumps down to the surrounding plain, and it ends along the Little Colorado River (lower right).



Physiographic Map of the Lower 48 States, USA



Upheaval Dome, Canyonlands,
Salt Valley, Landscape Arch





Rocky Mountains

B

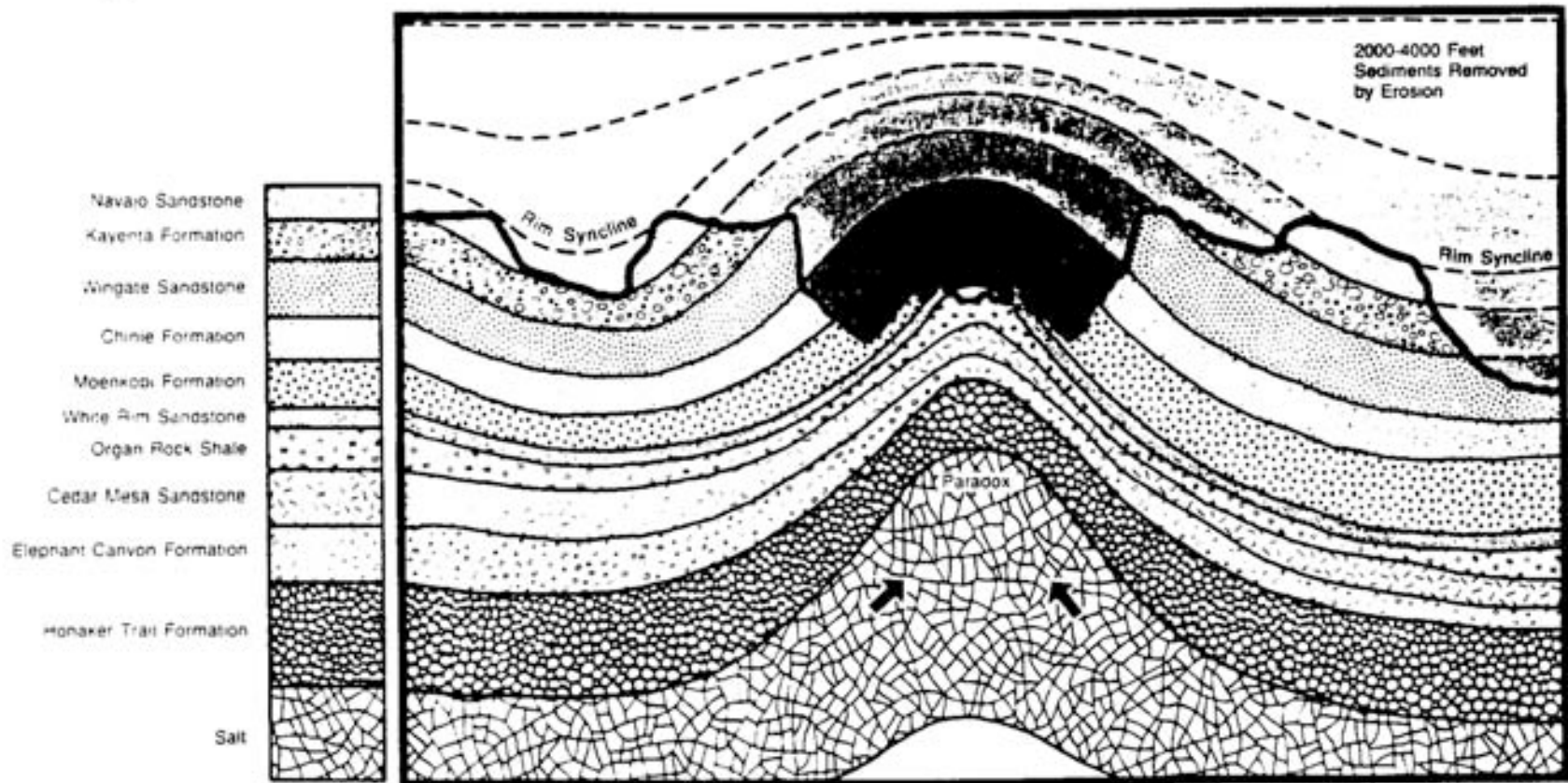
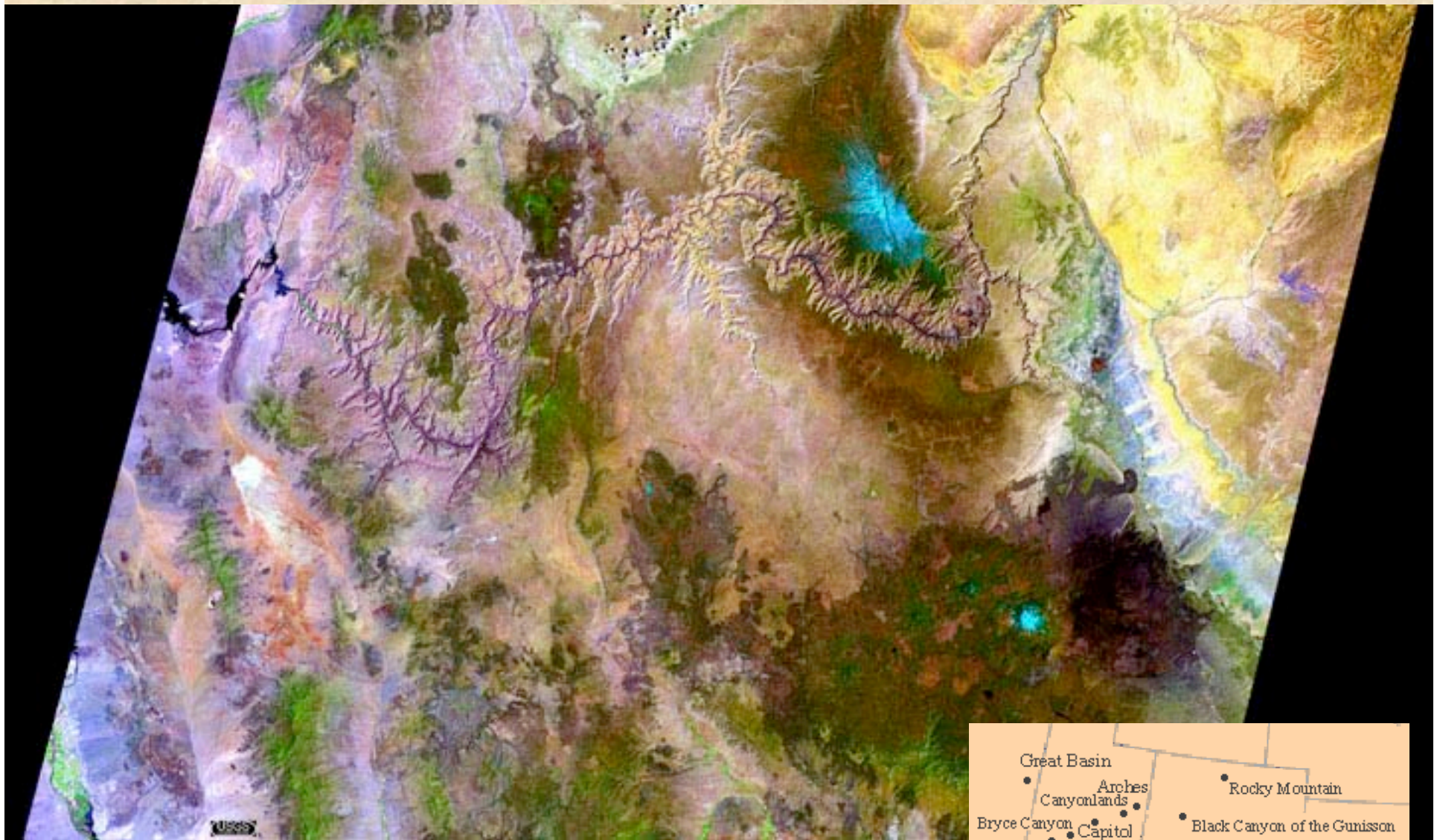


Figure 5.5 A. Upheaval Dome in map view. The topography is directly related to the rock formations, with the more resistant formations, such as the Wingate Sandstone, forming concentric walls. B. Cross section of Upheaval Dome, showing the salt dome at the core and the sedimentary layers that were arched up by pressure of the rising salt plug. Adapted from 1981 "Upheaval Dome," National Park Service and Canyonlands Natural History Association.



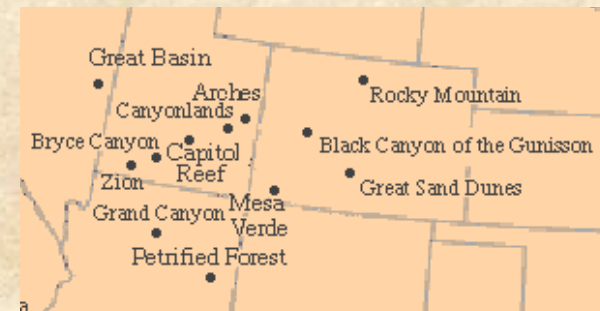
This detailed astronaut photograph (ISS020-E-9861) shows part of Big Thomson Mesa, near the southern end of Capitol Reef National Park. Capitol Reef National Park is located on the Colorado Plateau. Big Thomson Mesa is part of a large feature known as the Waterpocket Fold.

The Fold is a geologic structure called a monocline—layers of generally flat-lying sedimentary rock with a steep, one-sided bend, like a carpet runner draped over a stair step. Geologists think that monoclines on the Colorado Plateau result from faulting (cracking) of deeper and more brittle crystalline rocks under tectonic pressure; while the crystalline rocks were broken into raised or lowered blocks, the overlaying, less brittle sedimentary rocks were flexed without breaking.

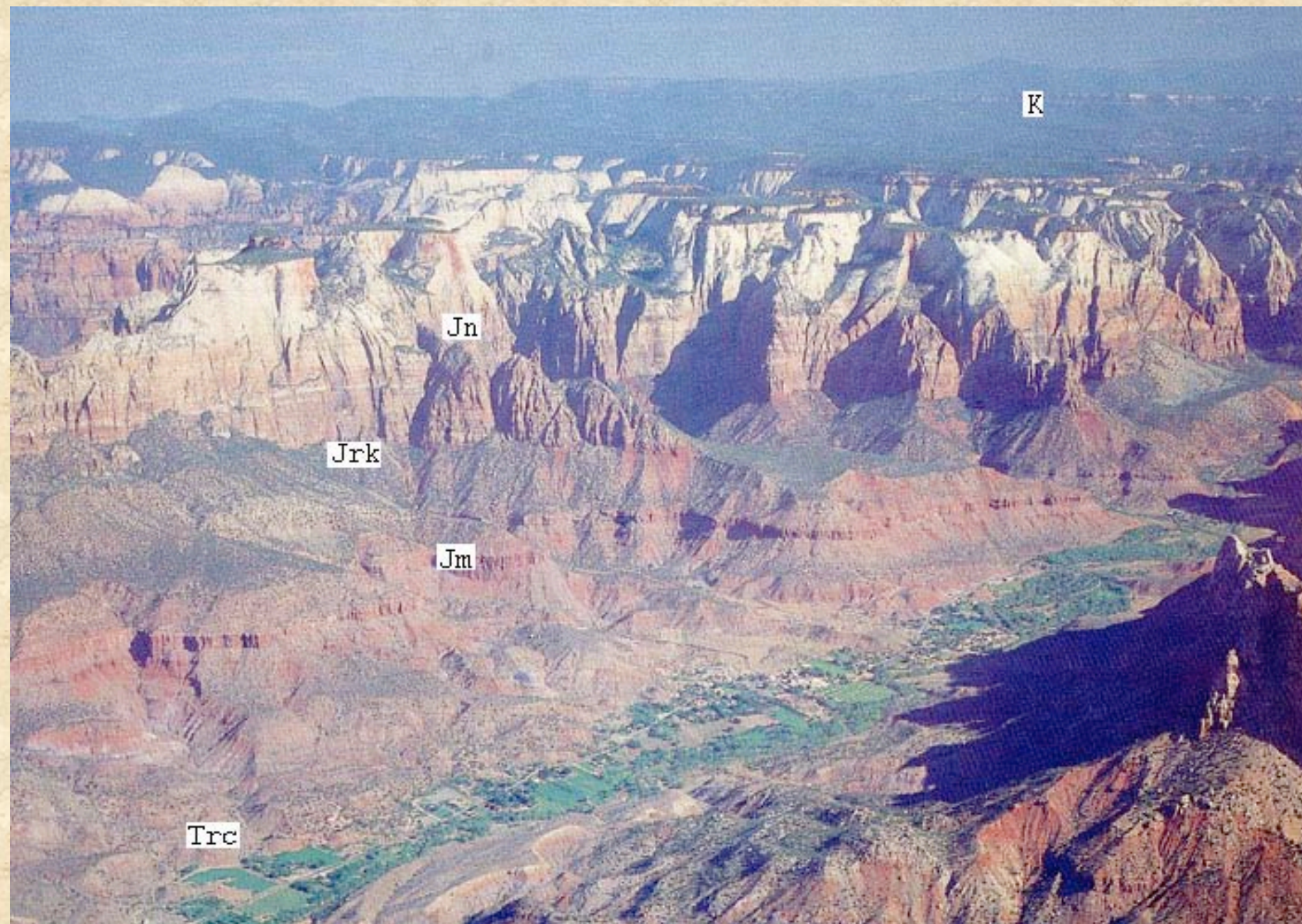


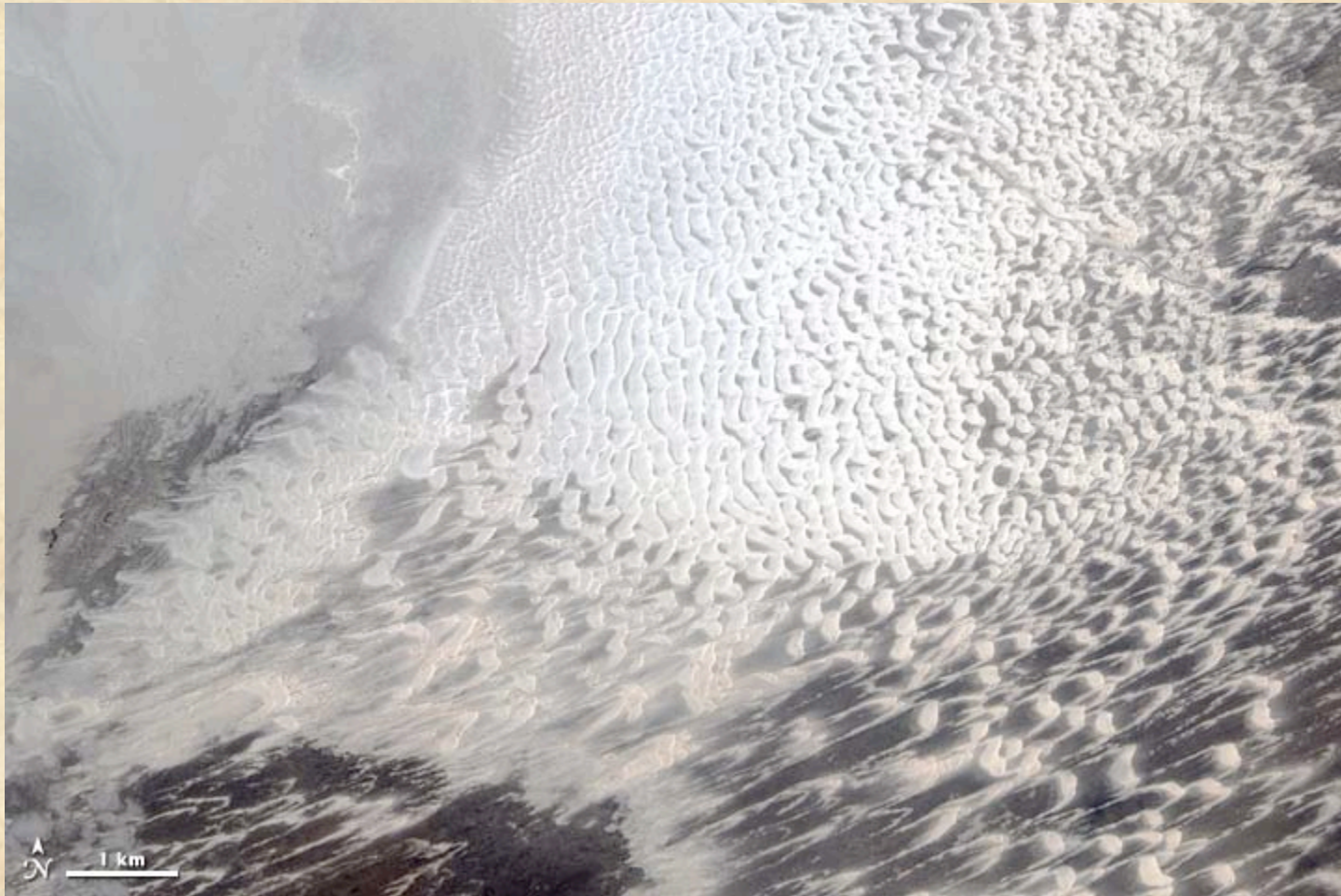
**Landsat satellite image
of the Grand Canyon, AZ**





Waterpocket Fold, a major Laramide monocline, Capitol Reef NP, UT





At the northern end of the Chihuahuan Desert, which stretches from the southwestern United States into northern Mexico, sits a field of gleaming white sands that form dunes. The sands sprawl over some 715 square kilometers (275 miles) of south-central New Mexico. About 40 percent of the area falls within the White Sands National Monument, managed by the U.S. National Park Service.

The Advanced Land Imager (ALI) onboard NASA's Earth Observing-1 (EO-1) satellite captured this photo-like image of part of the White Sands National Monument on June 27, 2009. This image shows part of the southeastern portion of the park. The dunes shown in this image are advancing toward the northeast, and the brilliant white sands contrast with darker soils.



In south-central New Mexico, some 25 kilometers (15 miles) north of the brilliant white gypsum deposit that includes [White Sands National Monument](#), a charcoal-brown scar undulates across the arid landscape. The scar is the Carrizozo Malpais, a massive lava flow left over from volcanic activity that occurred several thousand years ago. Stretching roughly 75 kilometers (47 miles), Carrizozo is one of Earth's longest known lava flows from the Holocene Epoch (the geologic time span since the end of the Pleistocene Ice Age). The enhanced Thematic Mapper on NASA's Landsat 7 satellite captured this photo-like image of Carrizozo Malpais.

