GEOLOGY OF THE LIVERMORE AND RED FEATHER LAKES AREAS

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Elementary Teacher

References

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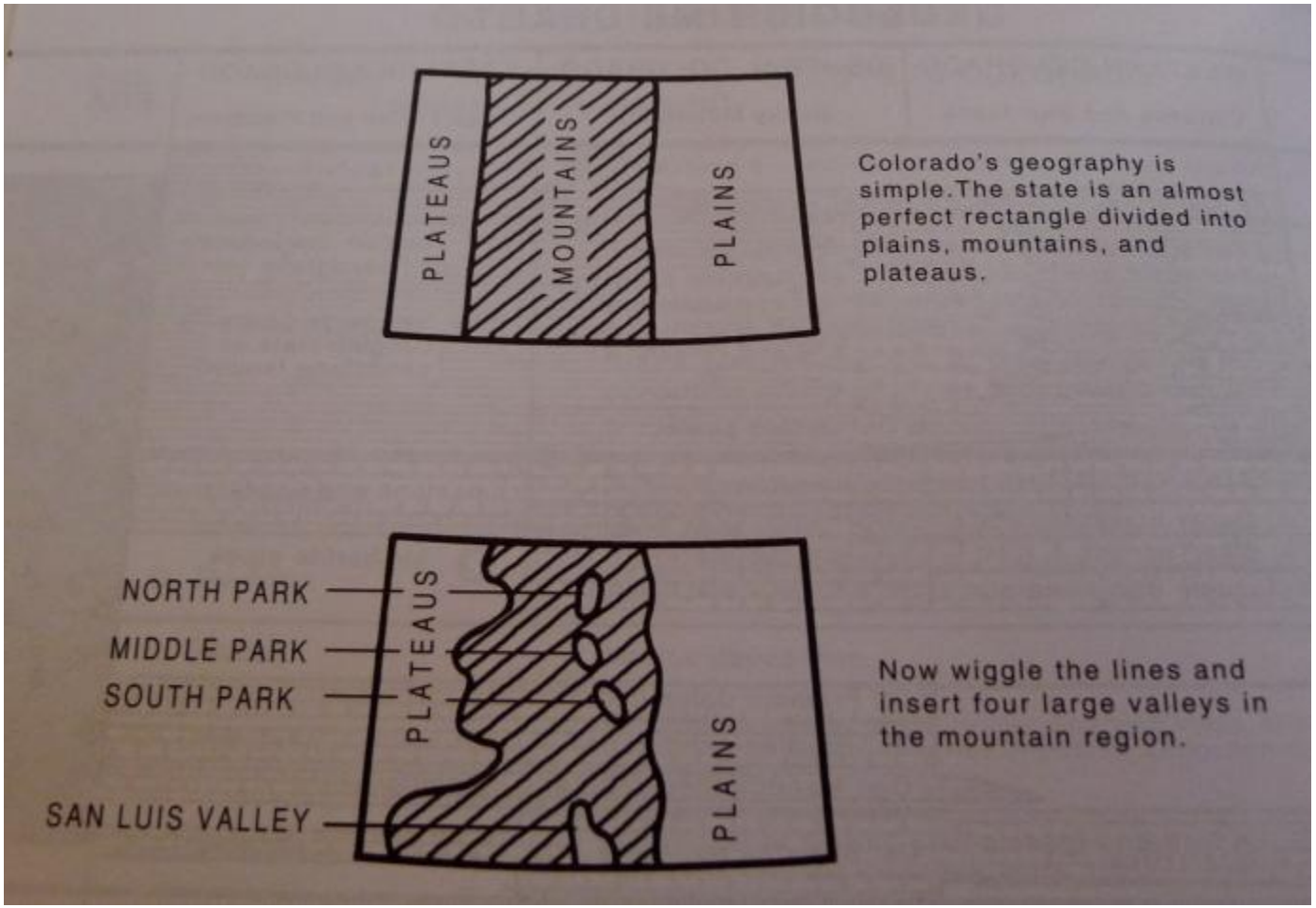
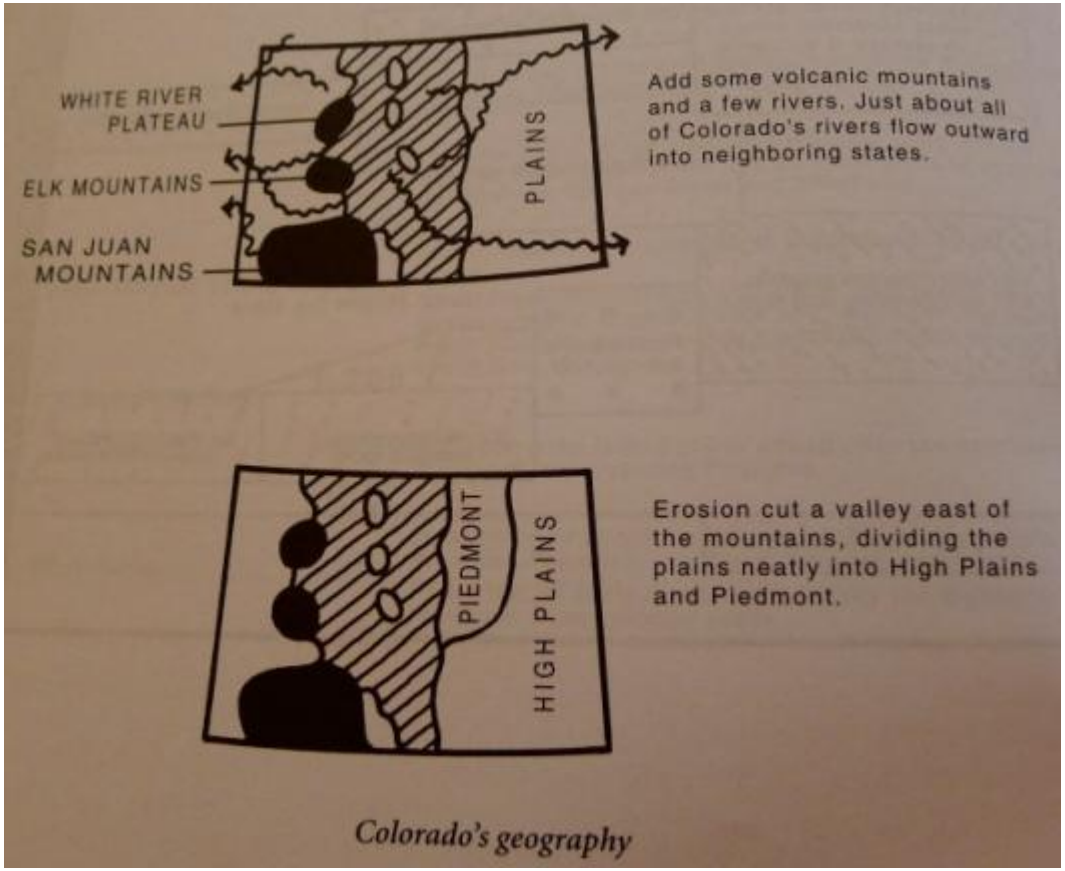
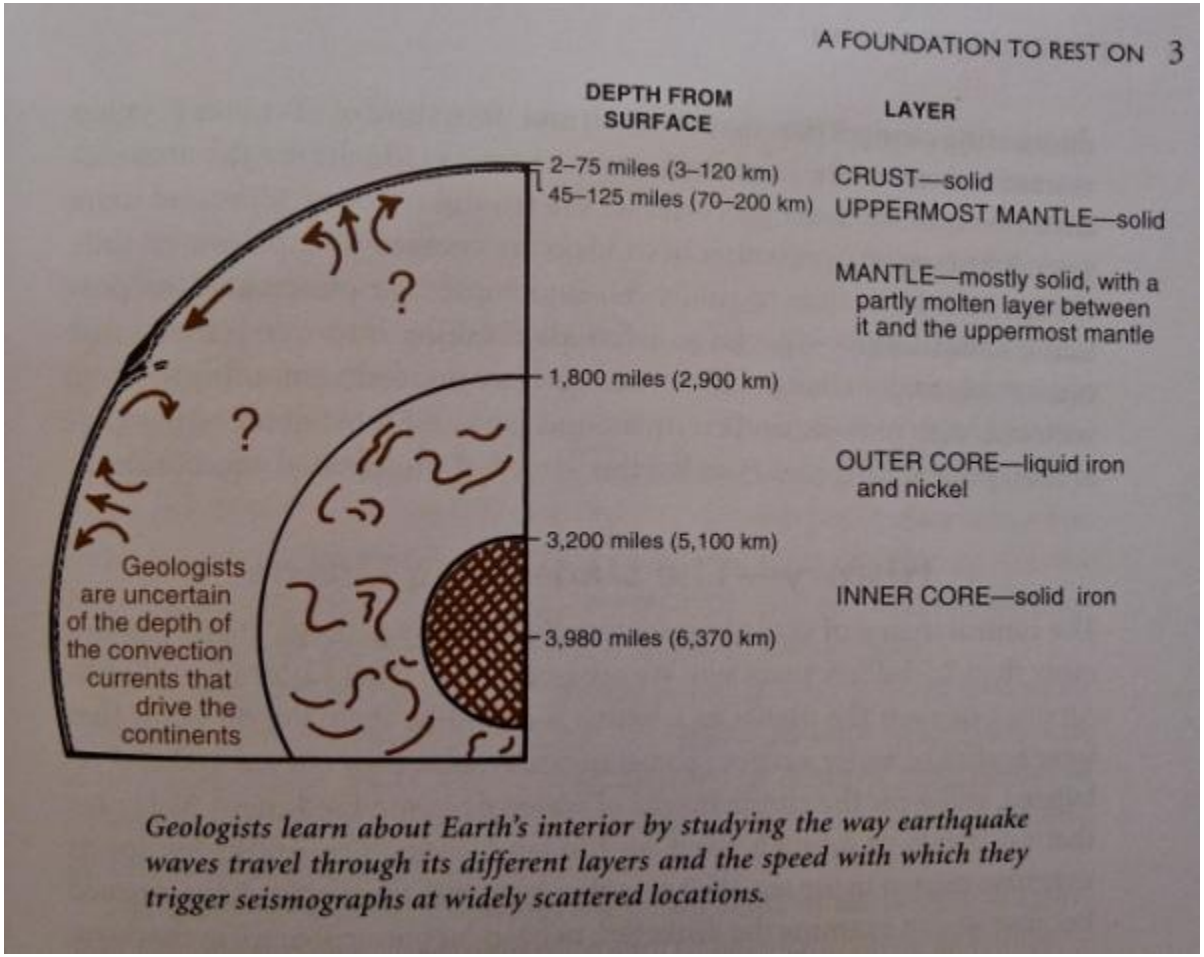
Colorado's Geography





But how did Colorado get like this?

The Earth's 3 Layers: Think of an Apple



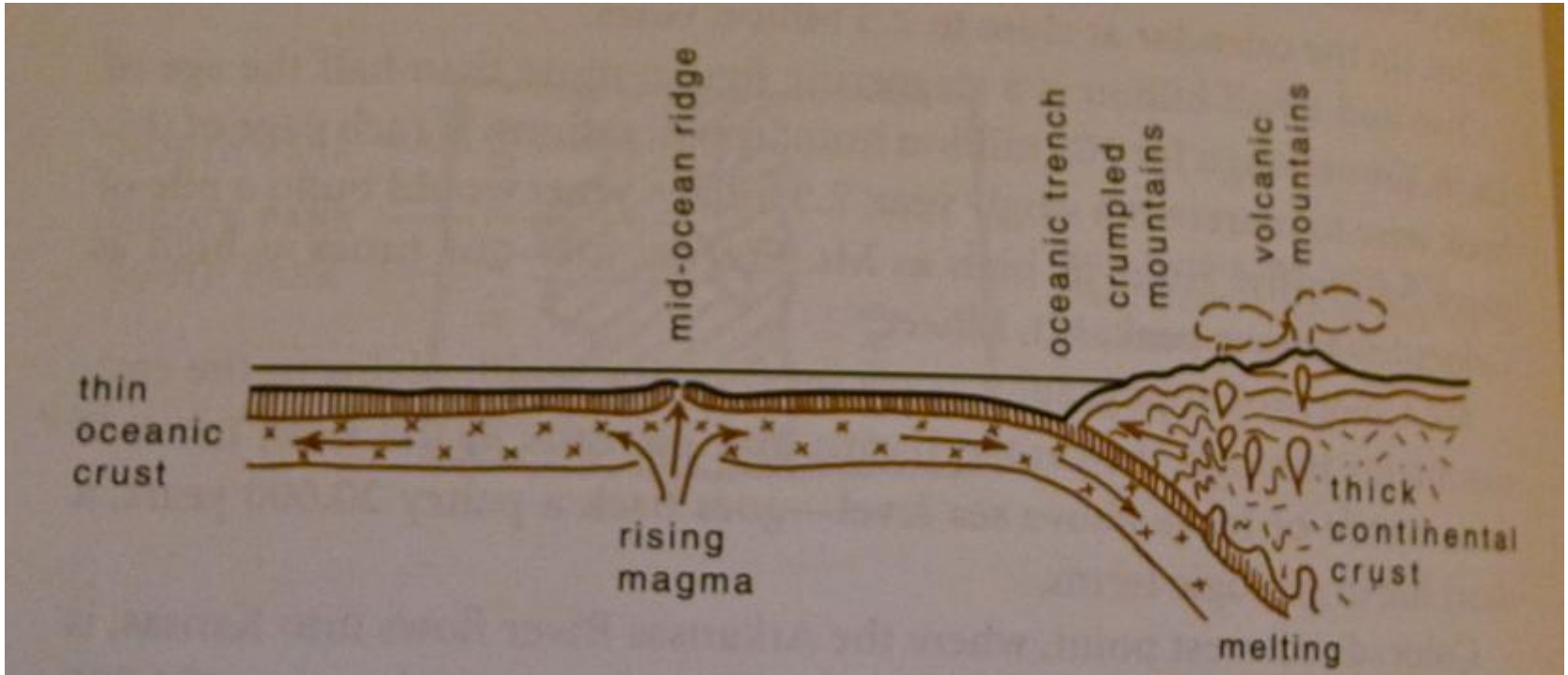
Loose mass of material pulled together by its own gravity. Molten, so molecules can move. Heavier molecules go to the center. Lightest molecules are the atmosphere. As cooled, crust formed. Cracks form.

16 Tectonic Plates

Ocean or continental crust sections tied to a rigid mantle slab ride on a hot, plastic mantle layer .

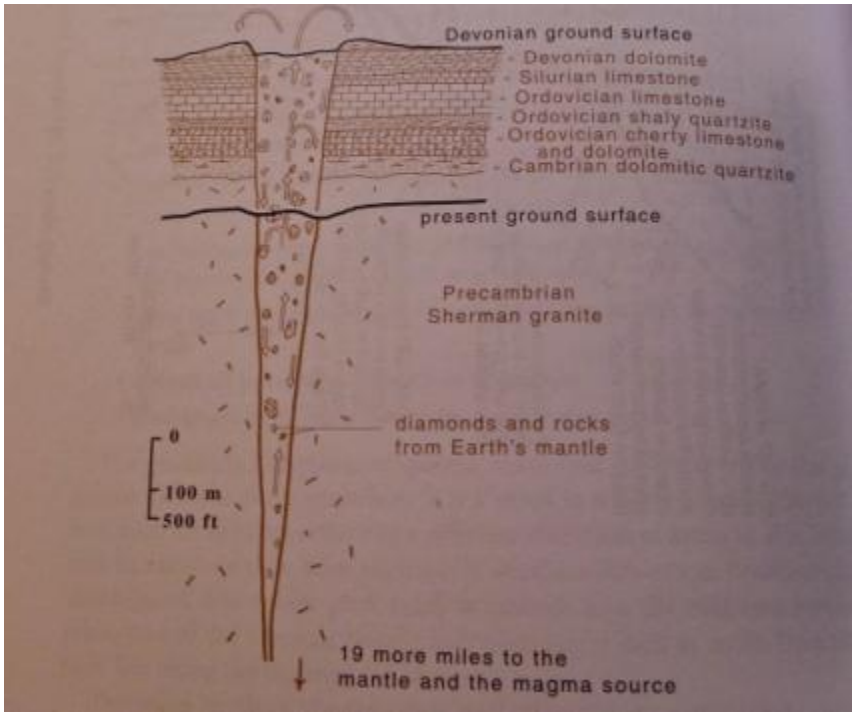
Ocean plates are 3 miles thick. Continental crust are 20 – 40 (Mt.) miles thick. Heavier ocean crust dives under lighter continental crust.

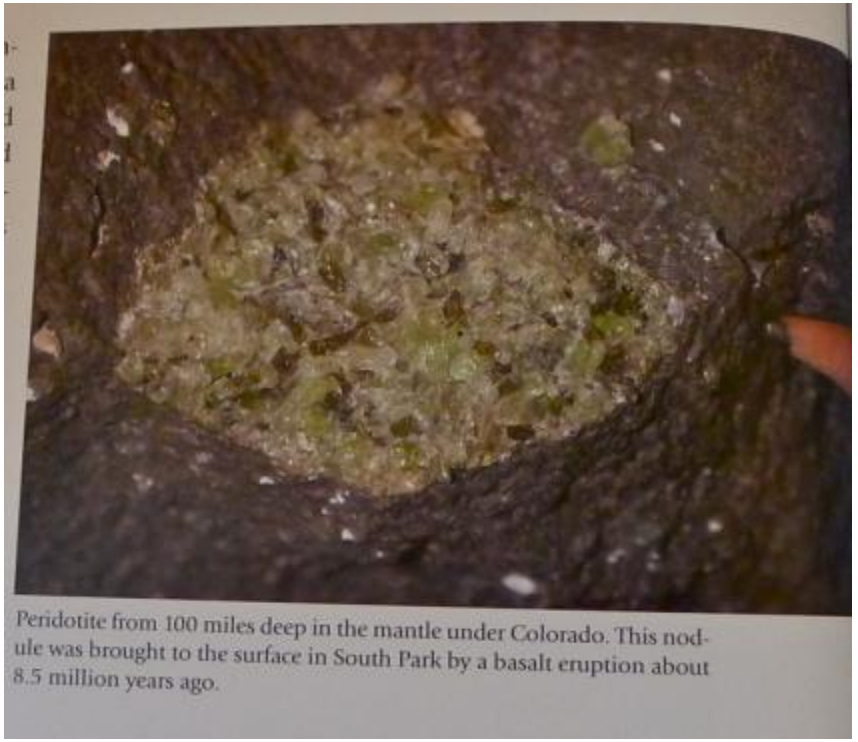
Plates Collide



Deep within Earth's mantle, powerful, slow-moving convection currents cause upwelling at mid-ocean ridges, where submarine volcanoes generate new crust. Where plates meet, heavier oceanic crust is pulled downward and remelted.

The most ancient rocks (4.5 – 2.5 billion years ago) on Colorado's surface came as garnet-bearing peridotite from the mantle through nearby (Chicken Park?) kimberlite pipes.

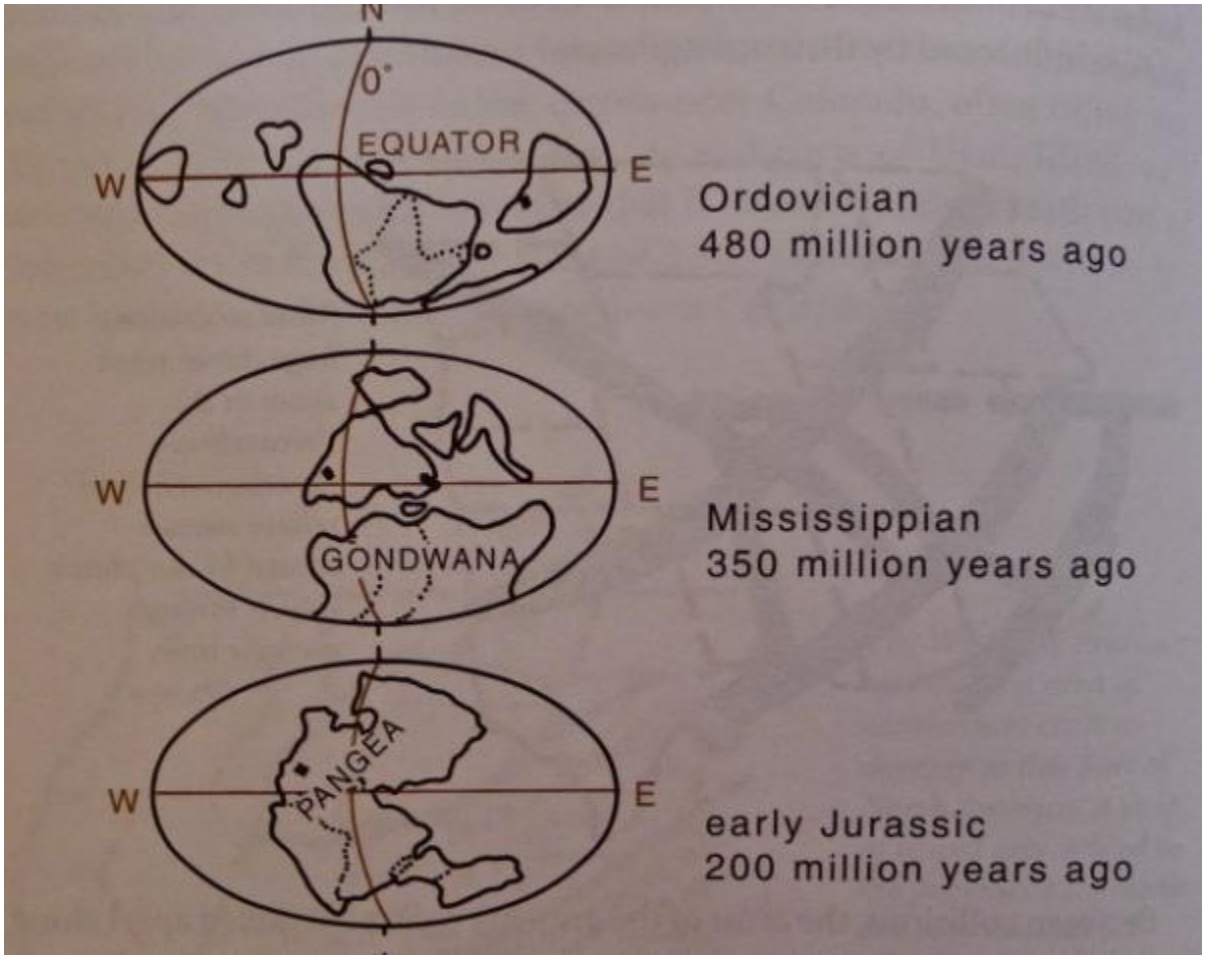


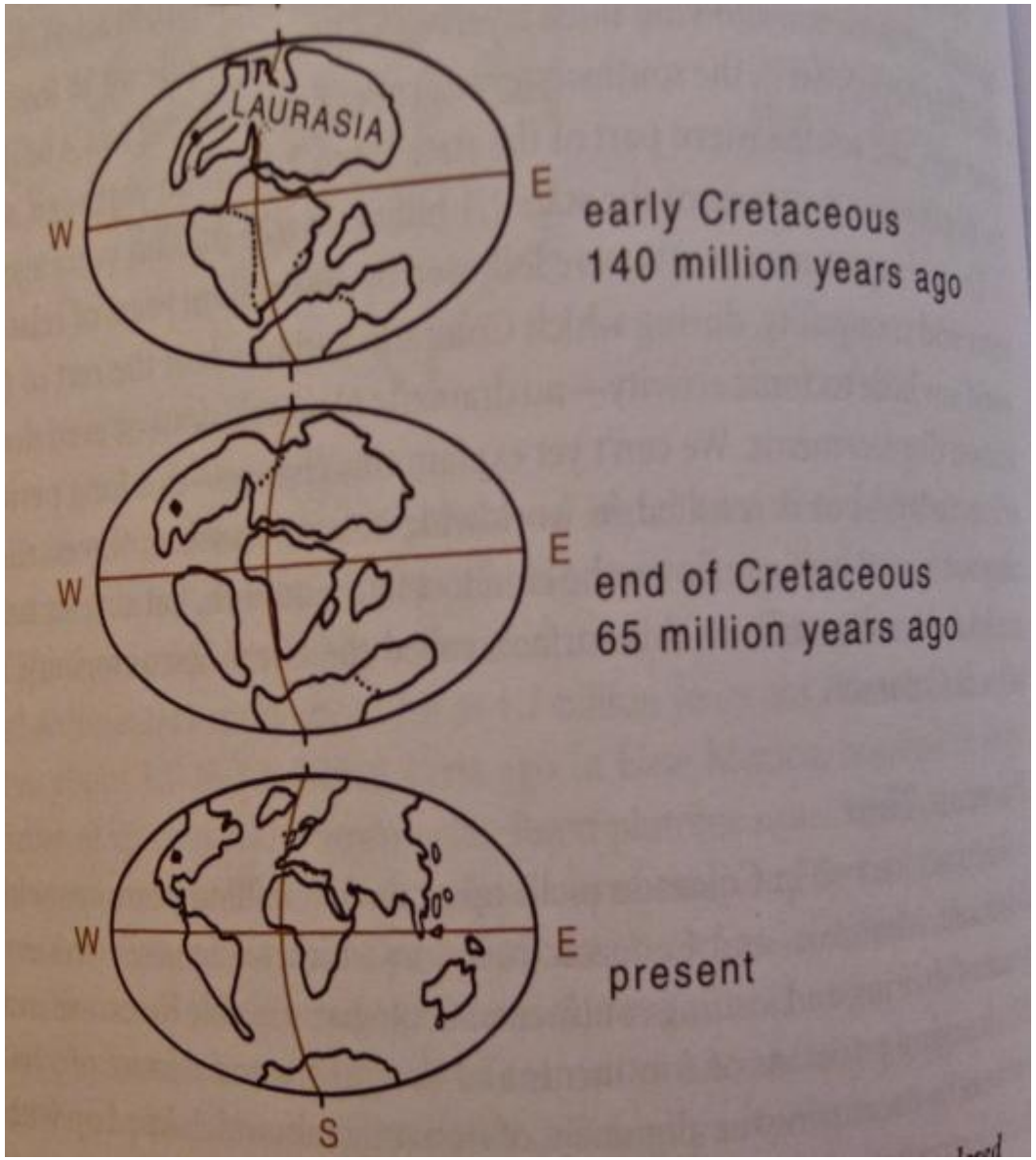


Peridotite from 100 miles deep in the mantle under Colorado. This nodule was brought to the surface in South Park by a basalt eruption about 8.5 million years ago.

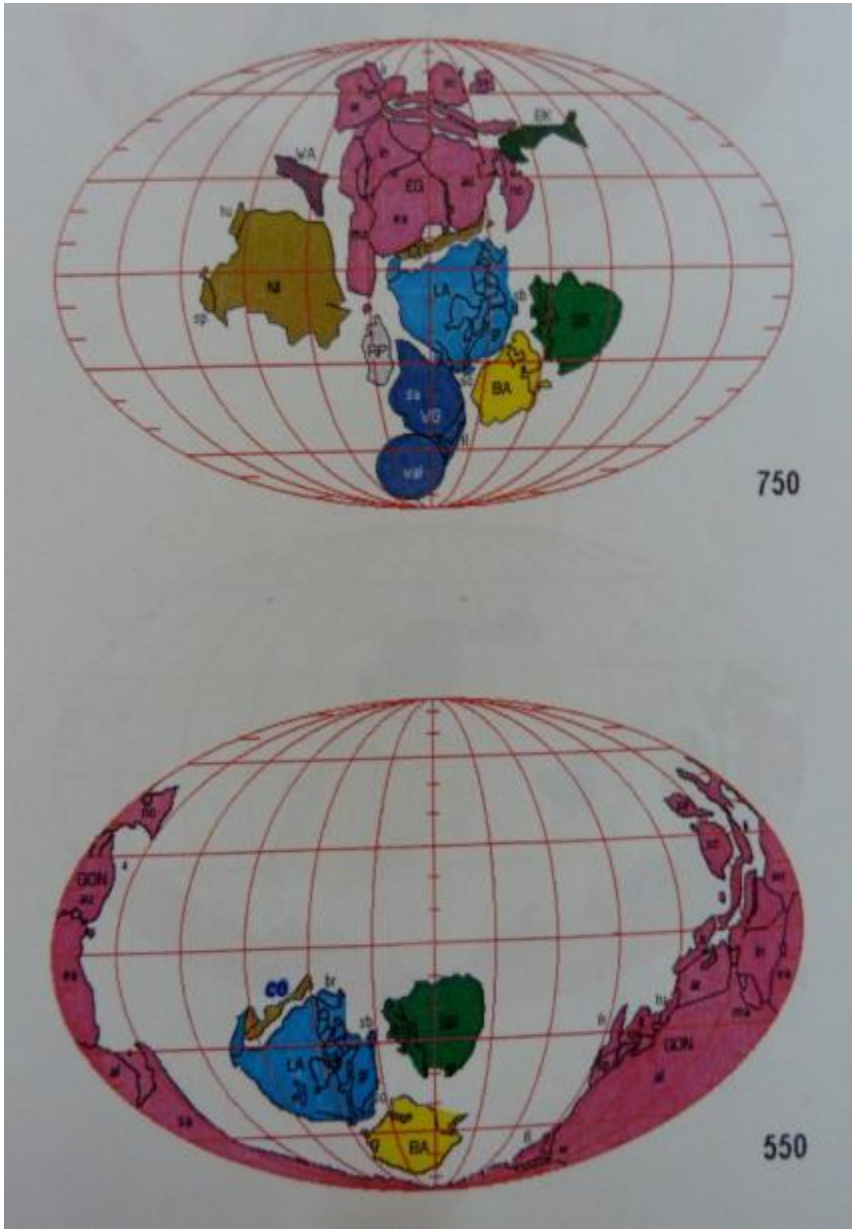
Colorado's Movement on Plates

Watch the small rectangle that is Colorado.





Laramide Orogeny



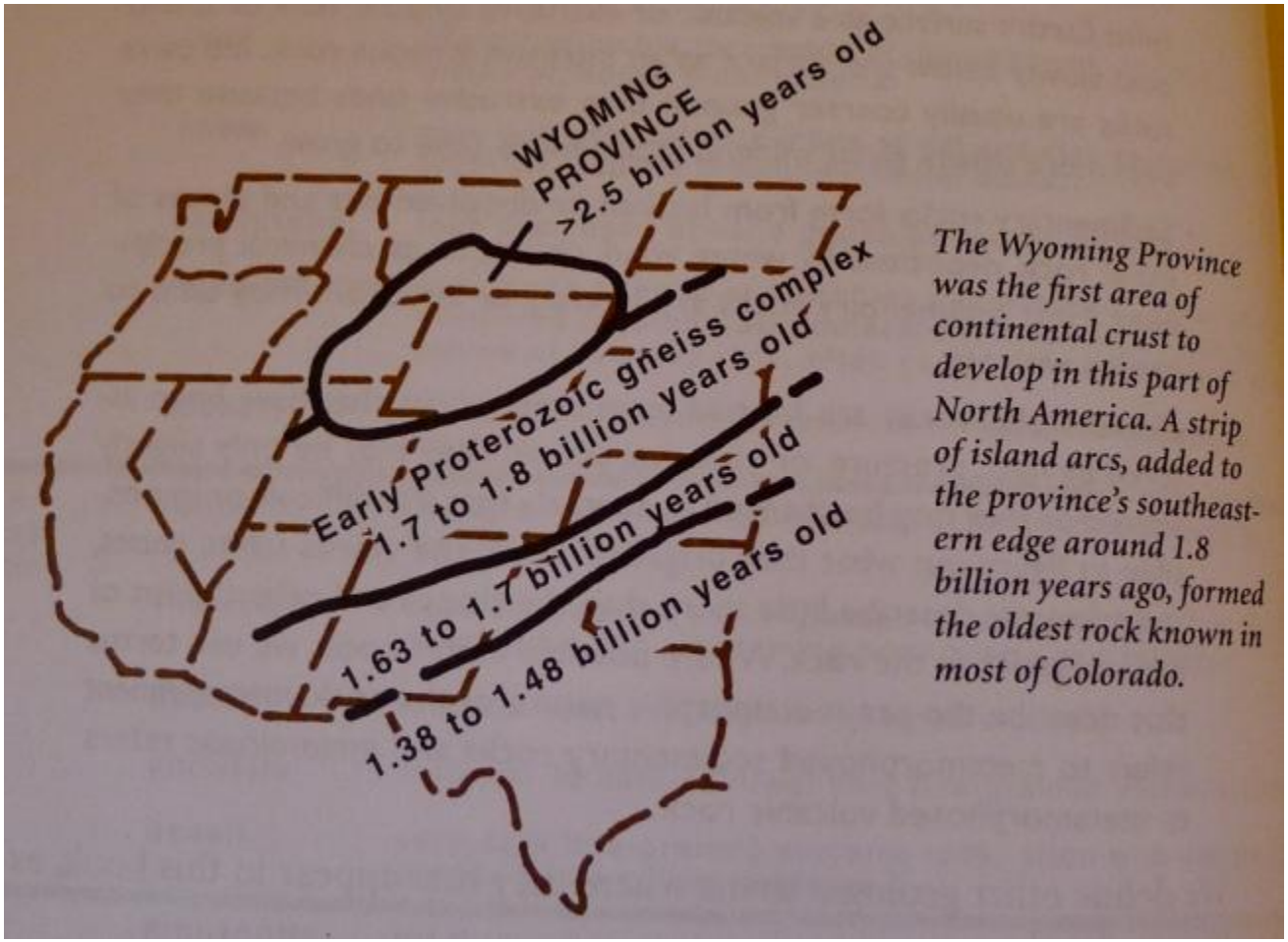
Pre-Cambrian Era:
Continents take shape.

Paleozoic Era: Age of Invertebrates, Fish, and Amphibians

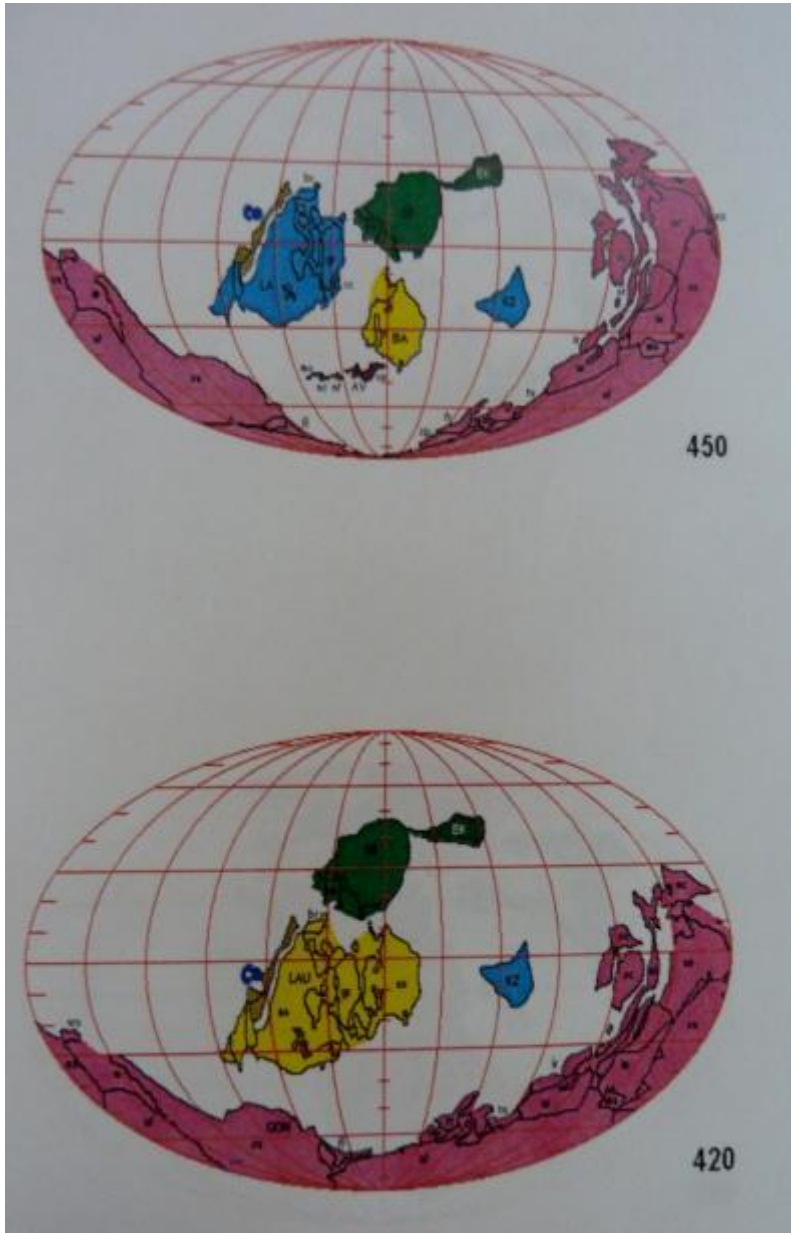
Colorado is almost all sea and sedimentary rocks are formed.

2.3 to .5 billion Years Ago:

Continent under Colorado rips apart leaving Colorado's NW corner and Wyoming. 3 sets of island arcs collided and added on.

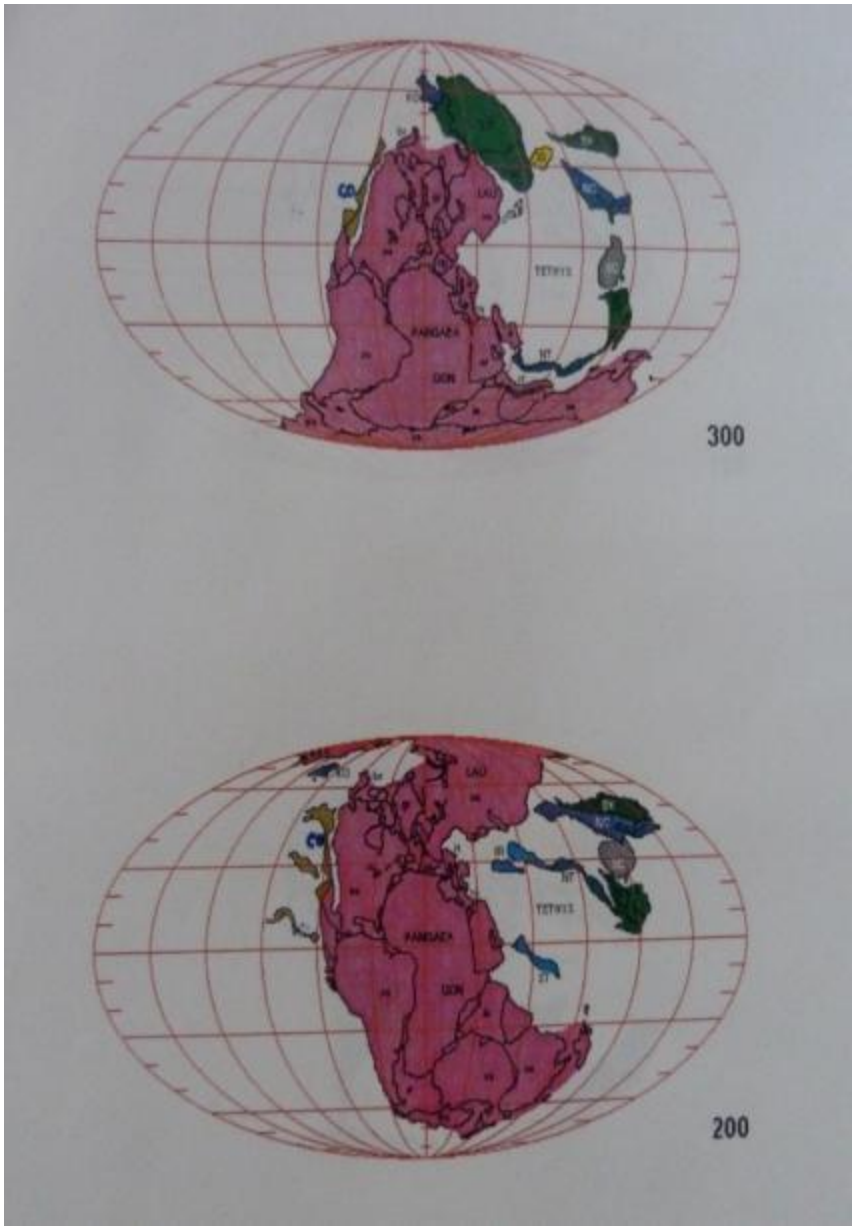


The Wyoming Province was the first area of continental crust to develop in this part of North America. A strip of island arcs, added to the province's southeastern edge around 1.8 billion years ago, formed the oldest rock known in most of Colorado.



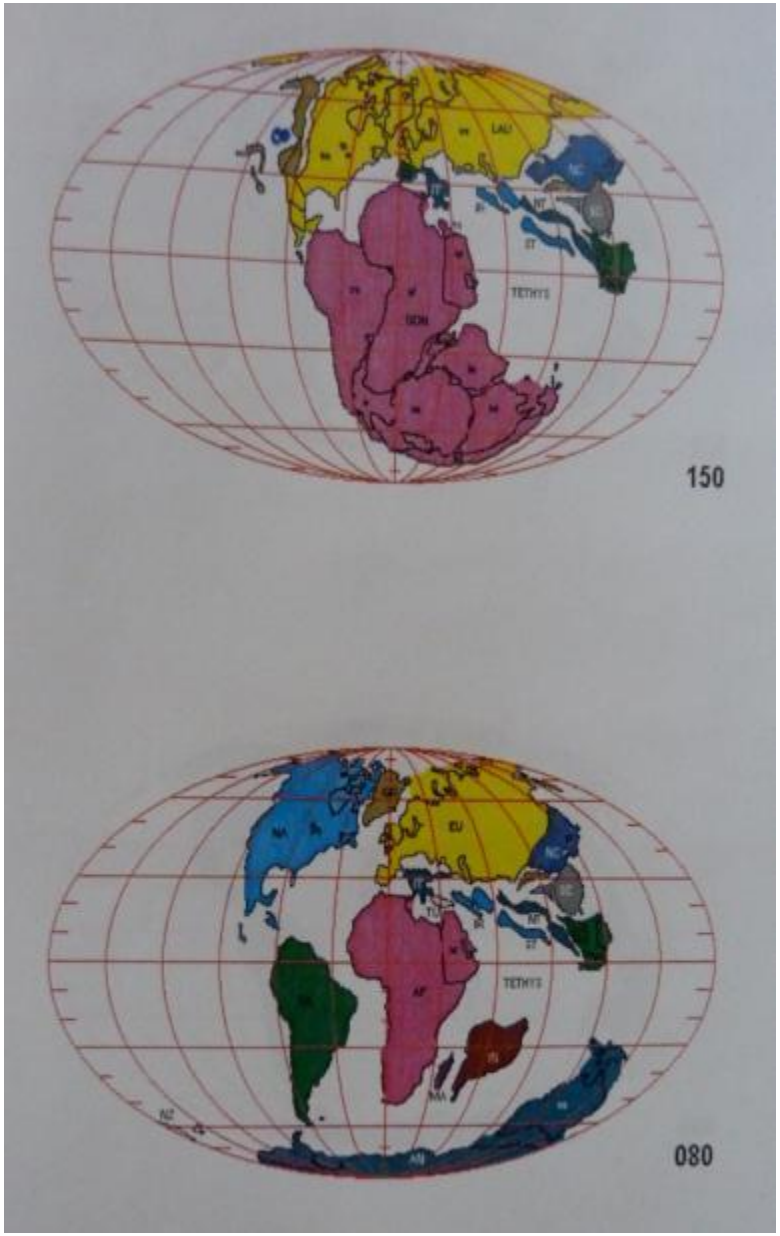
In Colorado shorelines come in and out.
Dolomite and limestone are deposited.
Fossils are diverse.

Seas in Colorado are at their highest.
Fossilized limestone will later be found in N. Colorado kimberlite pipes.



Pennsylvania Period: Seas deposit fine sand and mud. Ancestral Rockies uplift and erode red sediment to create the Fountain Formation's red sandstone and shale.

Permian /Triassic Periods: Colorado becomes arid and flat and is on the edge of a sea. Lots of animals die. Red, maroon, and pink hues are in sandstone and shale.



Jurassic Period: Dune sands are deposited with lots of crossbedding. N. America and Africa separate. Colorado is a swampland. The Morrison Formation yields richest collections of dinosaur bones and tracks.

Cretaceous Period:
Sea levels rose from N. and S. to almost cover and make CO subtropical. Pierre Shale and Dakota sandstone are deposited.

The Great Wipe-Out: K / T Boundary (66 Million Years Ago)

Hypothesis: a meteorite about the size of Denver hit the Earth near Mexico's Yucatan Peninsula causing extinction of dinosaurs, and other animals and plants.

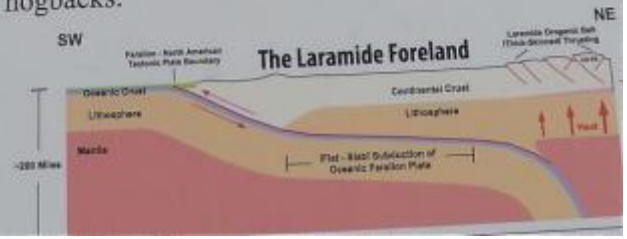
In Colorado observe the K/T boundary at Trinidad Lake State Park on the Long Canyon Trail.

Laramide Orogeny:
70 – 65 Million years ago
A Time of Tectonics and Uplift

The movement of tectonic plates, weathering, and erosion constantly reshape the Earth's surface. The Devil's Backbone and the Rocky Mountains were formed in an event known as the Laramide Orogeny.

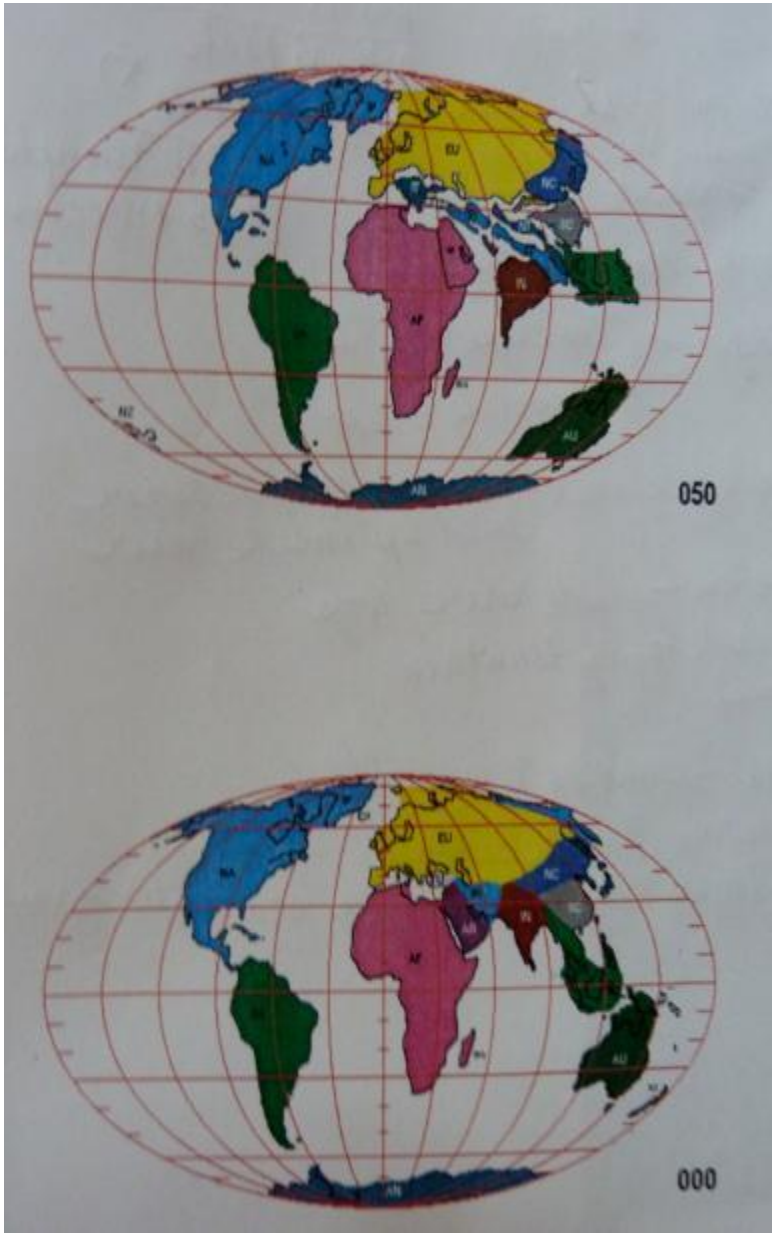
LARAMIDE OROGENY

The Laramide Orogeny began when the North American Plate and the thick oceanic Farallon Plate in Southern California collided. As the submerging oceanic plate melted, it compressed and thickened the North American Plate. The rocks above the compression began to bend, buckle, and break, causing the folding and faulting of sedimentary layers that created the Rockies and the Front Range hogbacks.



The Colorado Front Range

- Largest Laramide Uplift in the S. Rockies.
- 180 x 40 miles
- West boundary is North, Middle, and South Parks
- East boundary is the Denver Basin

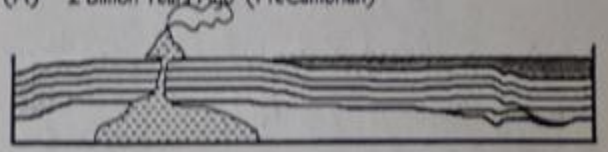


Tertiary Period:
66 to 1.8 mya
- **2 mountain building events**
- **Long's Peak 21,000' of uplift / downwarp**
- **3 igneous events**
- **Deposition of sediments.**

Quaternary Period:
1.8 mya to now
Why did big mammals go extinct 10,000 years ago? It was a time of massive glaciers. Deposits of 3 ice ages are in CO.

GEOLOGIC EVOLUTION of the Front Range

(A) 2 Billion Years Ago (PreCambrian)

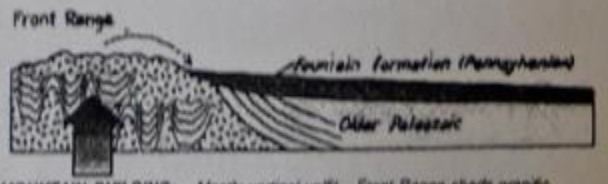


Deposition, Volcanism, ???

(B) 1.75 Billion Years Ago (PreCambrian)

MOUNTAIN BUILDING: *Metamorphism of older sedimentary rocks , volcanic activity and granitic intrusions*

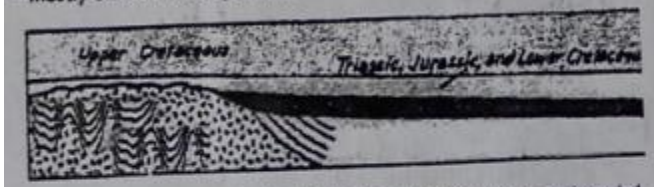
(C) 300 Million Years Ago... Ancestral Rockies Uplift



MOUNTAIN BUILDING: *-- Mostly vertical uplift ...Front Range sheds granitic sediment into alluvial fans and shallow seas. Arkose, sandstone and limestone*

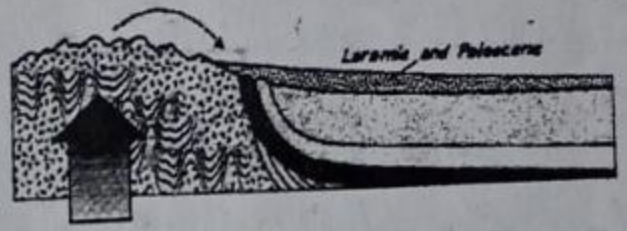
D) 250 to 65 Million Years Ago....Paleozoic & Mesozoic

--mostly erosion and deposition--



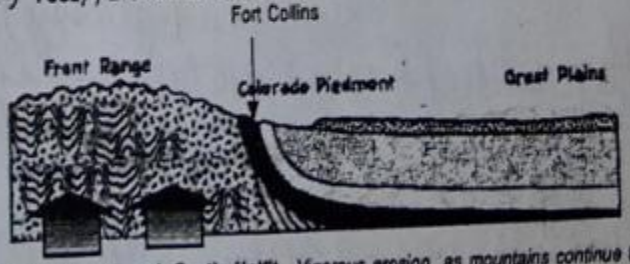
Deposition in shallow seas .Erosion of highlands to sea level. Final seas leave beh last beach toward end of Cretaceous.

E) 65 Million Years Ago (end of Mesozoic beginning of Cenozoic)



MOUNTAIN BUILDING: (LARAMIDE OROGENY) *Reactivation of uplift from late Paleozoic times. Sedimentary rocks arched upwards. Faulting creates zones o mineralization. Crest of mountain ranges begin to erode. Vertical uplift exceeds 20,000 feet !*

F) Today , Erosion and Broad Uplift



Erosion and Broad, Gentle Uplift. *Vigorous erosion as mountains continue to rise slowly. Hogbacks are remnants of tilted beds.*

Repeated Periods of Volcanic Mountain Building, Intrusive and Extrusive

Repeated Periods When Seas Cover the Lands

Repeated Periods of Folding and Faulting

Repeated Periods of Faulting

Glaciers Advance and Retreat, Carving Mountains

Water, Wind, Ice, and Chemicals Repeatedly Erode the Mountain Tops

A Tour from Ft. Collins to Livermore to Red Feather Lakes

Following the layers back in time:

Top to Bottom and

East to West

Principles for Defining Geologic Age

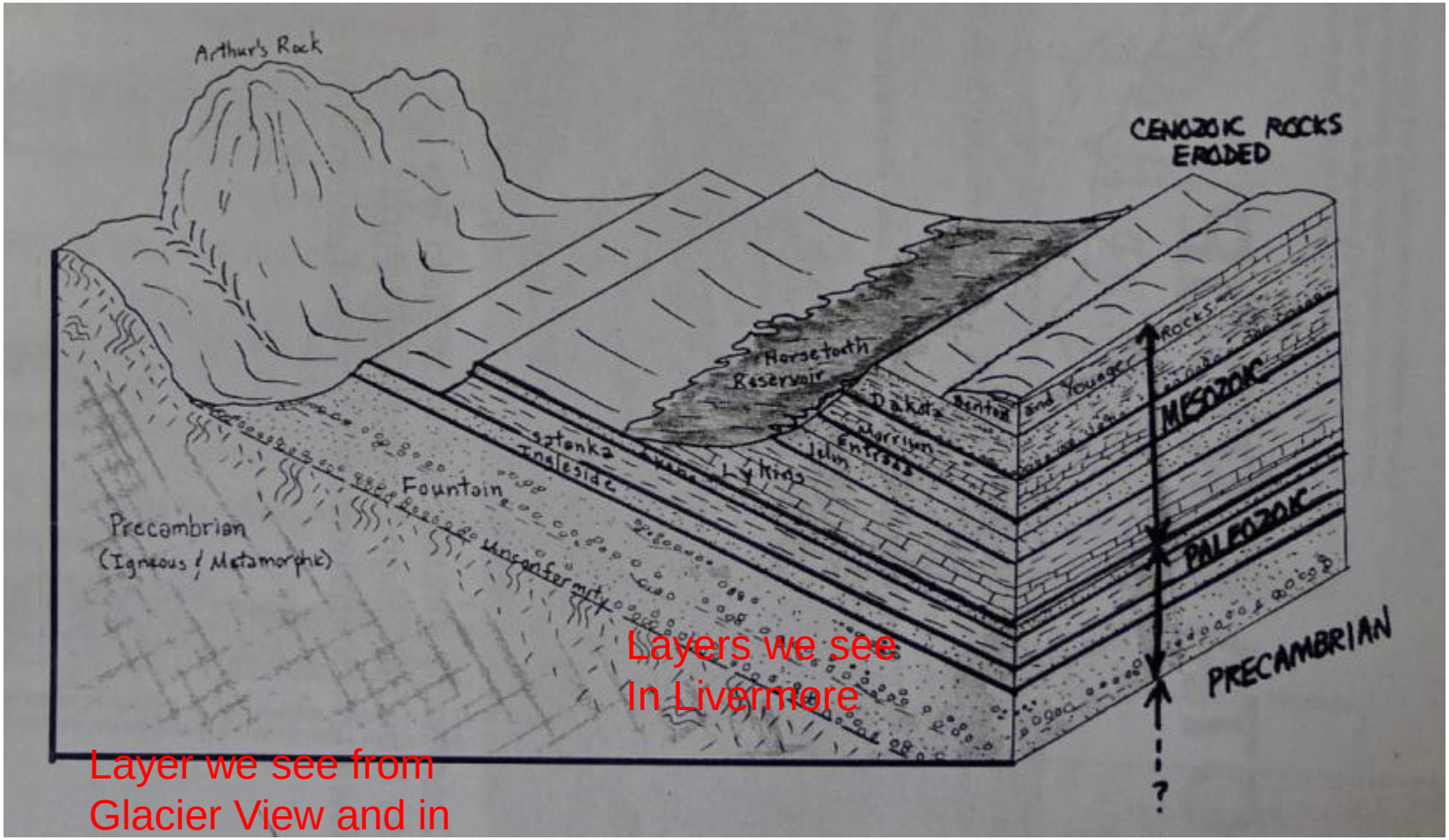
1. Uniformitarianism (Physical properties we see today operated in the past and at roughly the same rates.)

2. Superpostition (Sedimentary rock layers get older as we go down, like setting a layer cake.)

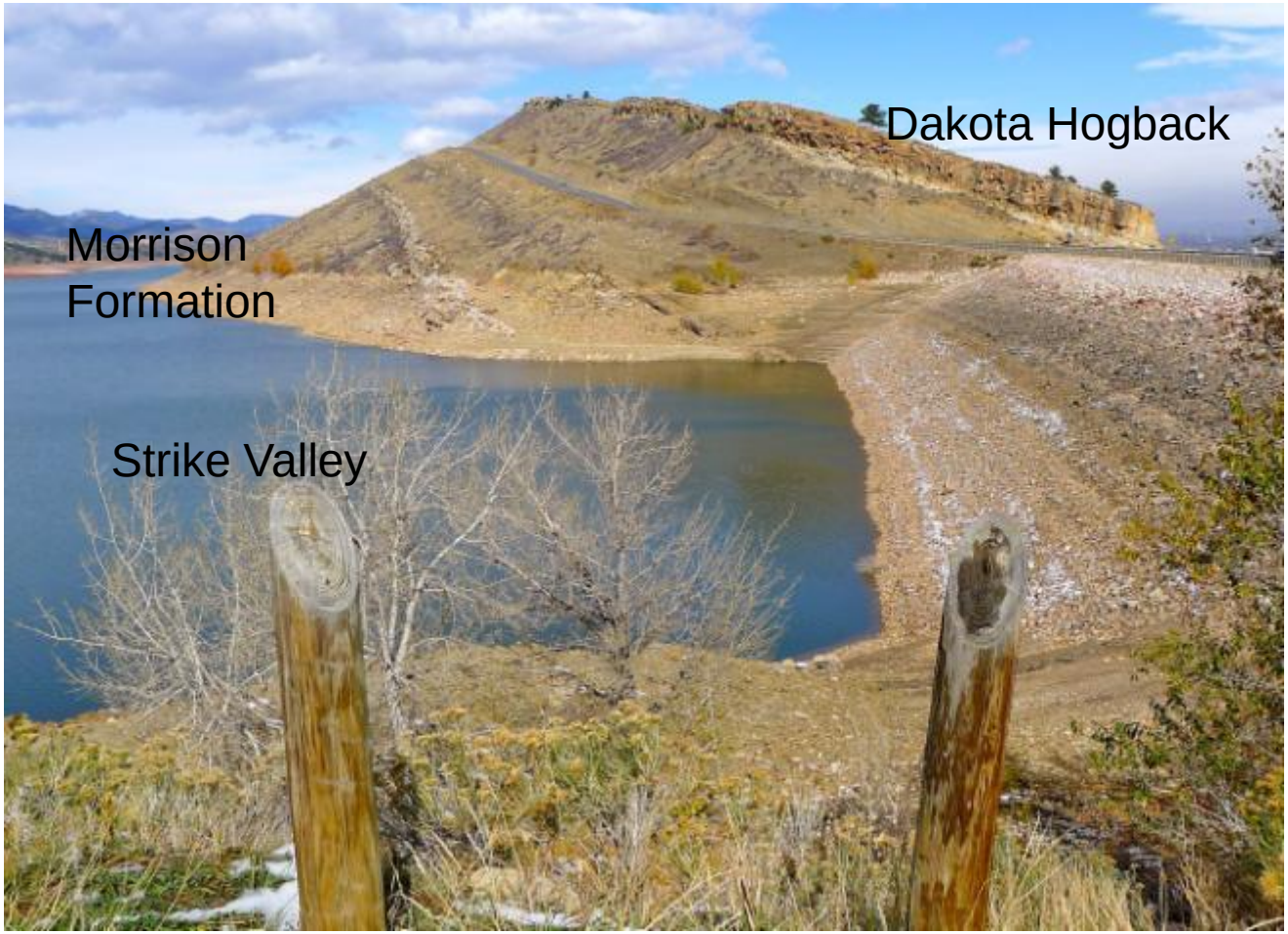
3. Original horizontality (Sediments deposit originally fairly horizontally due to gravity.)

4. Cross-cutting relations (If one geologic feature cuts across another, the cut feature is older. Ex: fault is younger than layers.)

Horsetooth Reservoir Cross-section



Horsetooth Reservoir



Horsetooth Reservoir Westside

Fountain Formation and then Granite

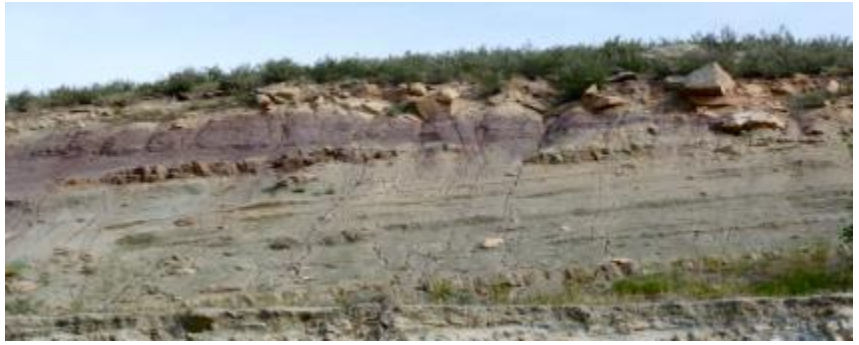
Bellvue Fold Anticline and Dakota Hogback at Watson Lake:

Resistant 100-million-year-old Dakota Sandstone formed along shorelines as seas repeatedly covered Colorado.

Curve north of Ted's Place:

150 million-year-old Morrison Formation of purple and gray-green shale was accumulated in flat lands with palms roamed by dinosaurs .

Resistant and younger Dakota Sandstone protects the soft shale.



Sandstone Blocks are Quarried

Ingelside Formation on top of dark Fountain Formation on Owl Canyon's East Side

Fountain Formation: 300 million years old

Thin maroon layer of fine-grained sand

Dunes

Ingelside Formation Continues on Owl Canyon's West Side

Owl Canyon's Rocks and Minerals

Limestone (from sea shells)

Calcite, a calcium carbonite mineral found as crystals in limestone cavities. A penny scratches it.

Gypsum is a mineral formed in evaporative deposits.

- Bodies of water dried up and left behind soft, chalky gypsum.
- Satin spar has slender parallel fibers
- Indian Money is the mineral aragonite, sometimes replaced by calcite.

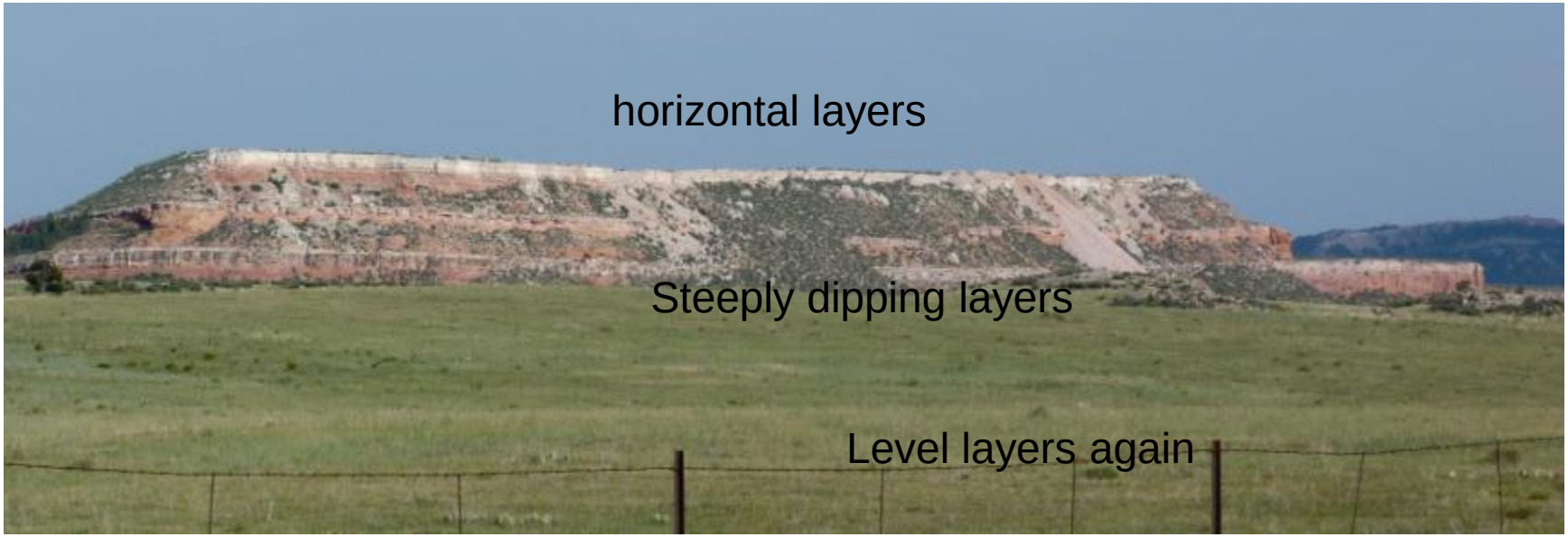
Sandstone

Quartz grain sediments are cemented together and often colored from iron. Ripples form from wave action.

Colorado Lein mines the Ingleside Formation which contains gypsum, limestone, dolomite, and sandstone.

Along US 287 / 80C: Deadman Butte(Owl Canyon Formation: red siltstone and sandstone)

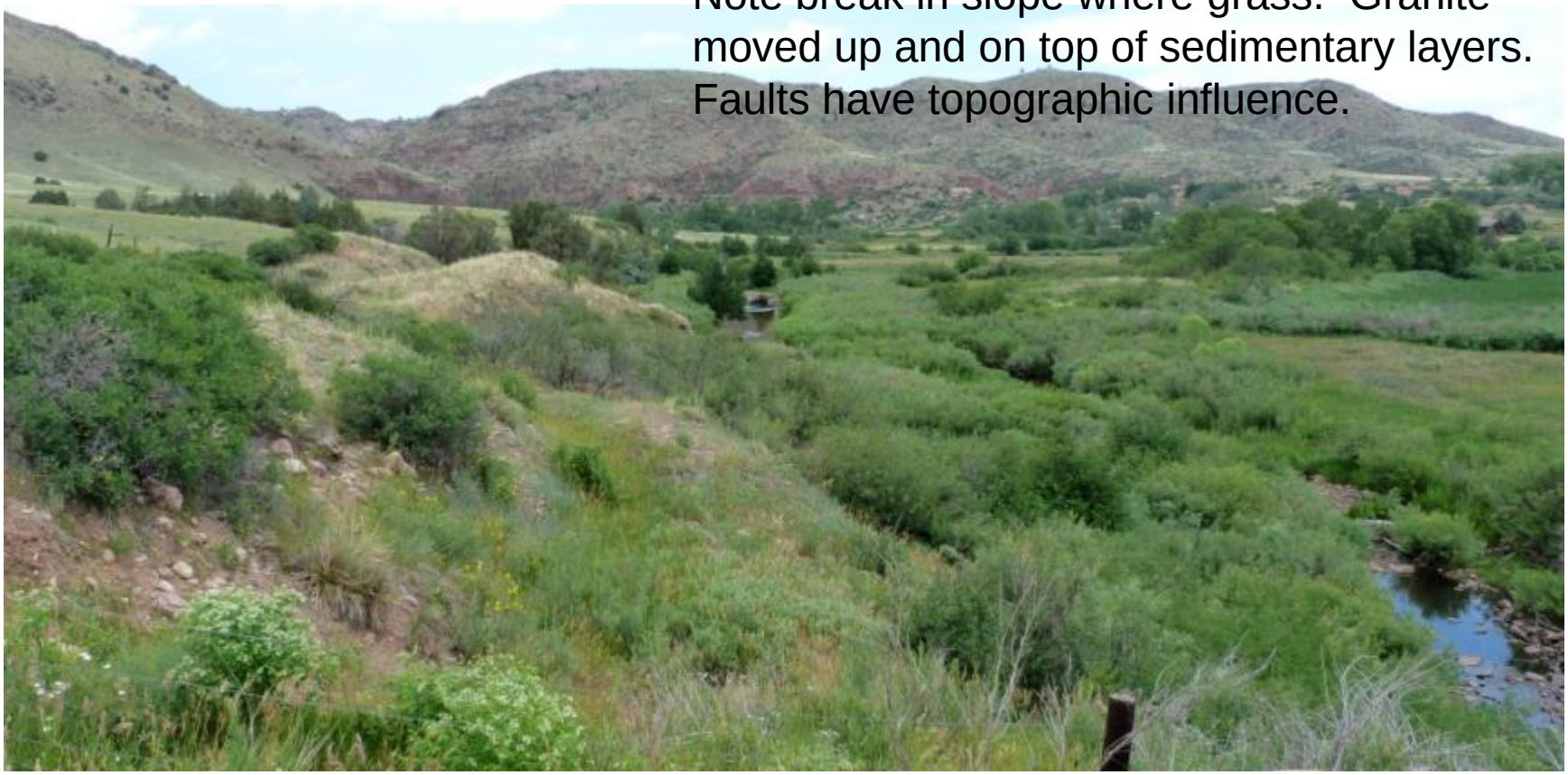
Grayback Ridge Monocline at US 287 and 80C



N. Fork of Poudre and 80C
Fountain Formation
(Layers of thin shale, blocks of limestone, purple sandstone not cemented)

Igneous Rocks Meet Sedimentary Rocks

80 C at the N. Fork of the Poudre River

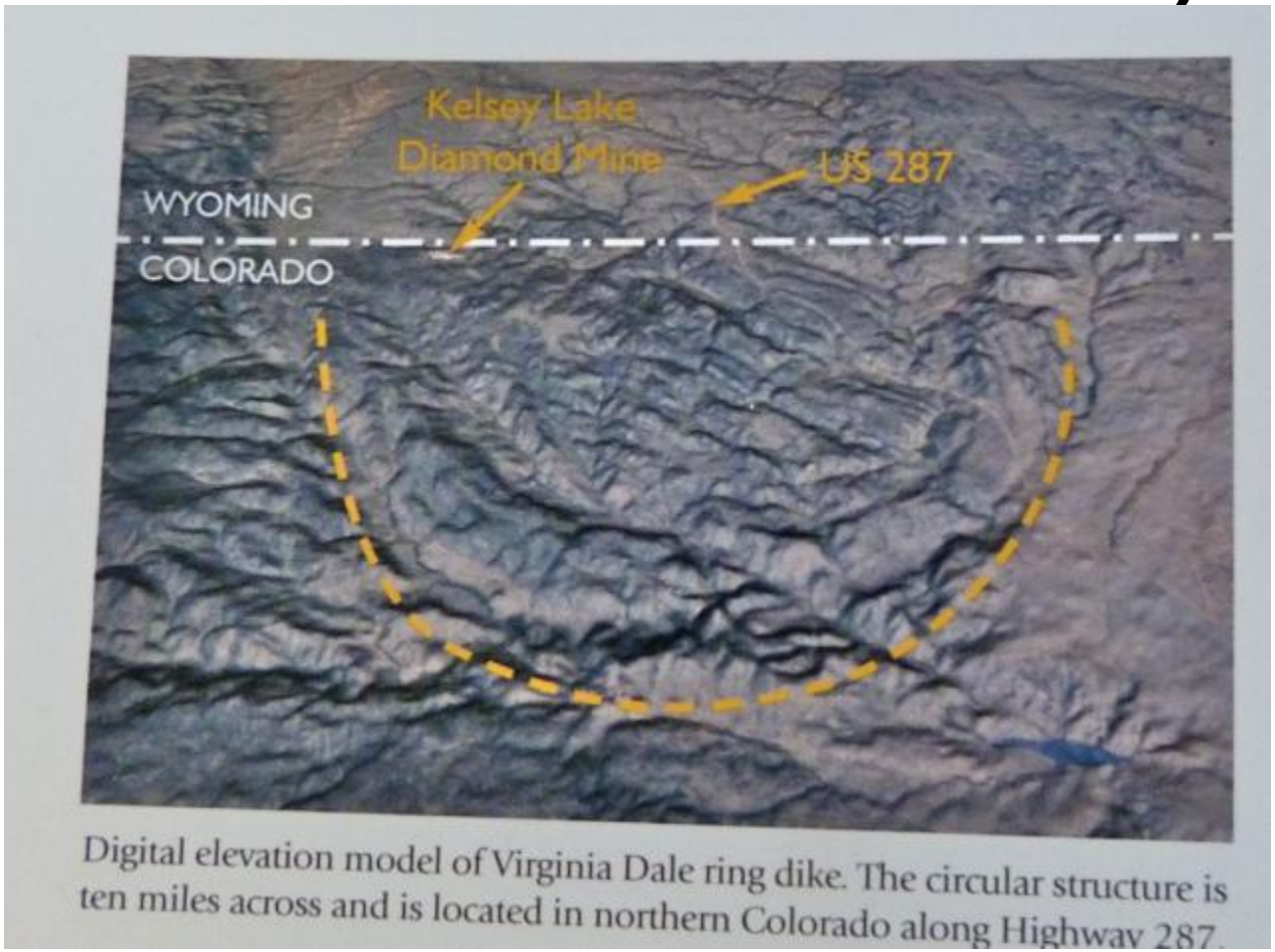


Note break in slope where grass. Granite moved up and on top of sedimentary layers. Faults have topographic influence.

Turkey Roost (Off 80C at Middle)

A Tor (rocky outcrop)

Turkey Roost is possibly part of the Virginia Dale ring dike (a long, narrow igneous intrusion that cuts across rocks).



Digital elevation model of Virginia Dale ring dike. The circular structure is ten miles across and is located in northern Colorado along Highway 287.

Granite is the main rock of the outcrops in Cherokee Park and RFL.

Fine-grained rock cooled quickly. Larger grained rock cooled slowly, so crystals had time to form.

One mineral in granite is feldspar, usually pink or white.

The igneous rock granite with a vein of the mineral quartz.

Prairie Divide is the hard erosional surface that was left when the layers above were weathered and carried away.

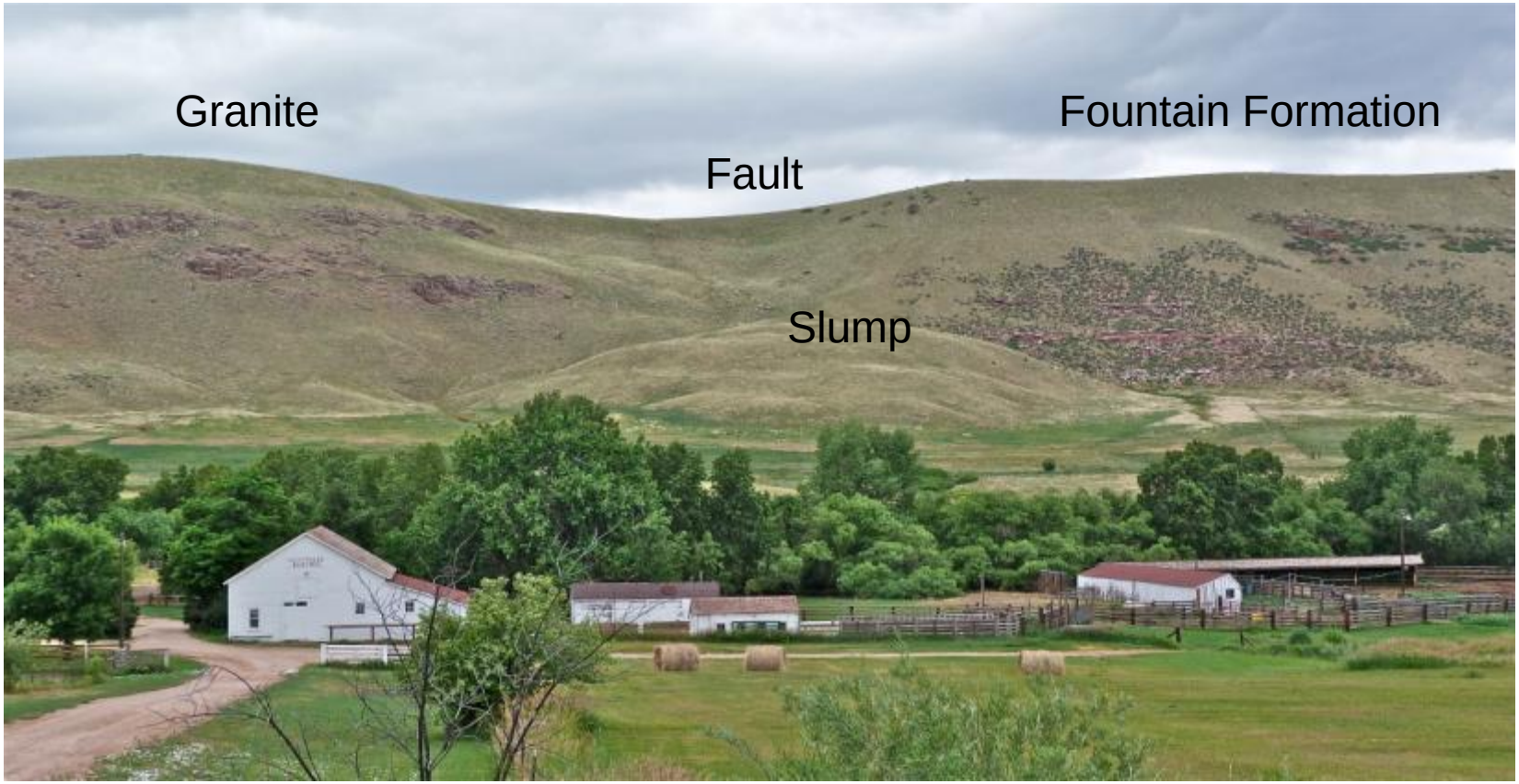
From Prairie Divide looking east. The valleys you see are all along faults.

The Livermore Valley is the only place where the sedimentary formations also go east to west. Igneous intrusions caused this.

The sand dunes of the Fountain Formation go 6 miles along 74E.

The Fountain Formation sand dunes can be formed by wind or water.

Igneous meets Sedimentary on a system of NW to SE faults on 74E at the Scottdale Ranch.



Petrified Tree at mile 6.

Petrified wood is chert / jaspar that's made when silica rich sediment buries a forest. The silica dissolves in water that passes into the wood. The dissolved silica gradually replaces the wood's cellulose. takes the shape of the wood.

Greyrock Mountain is a part of the granitic Log Cabin Batholith. It intruded surrounding older rock 1.4 billion years ago.

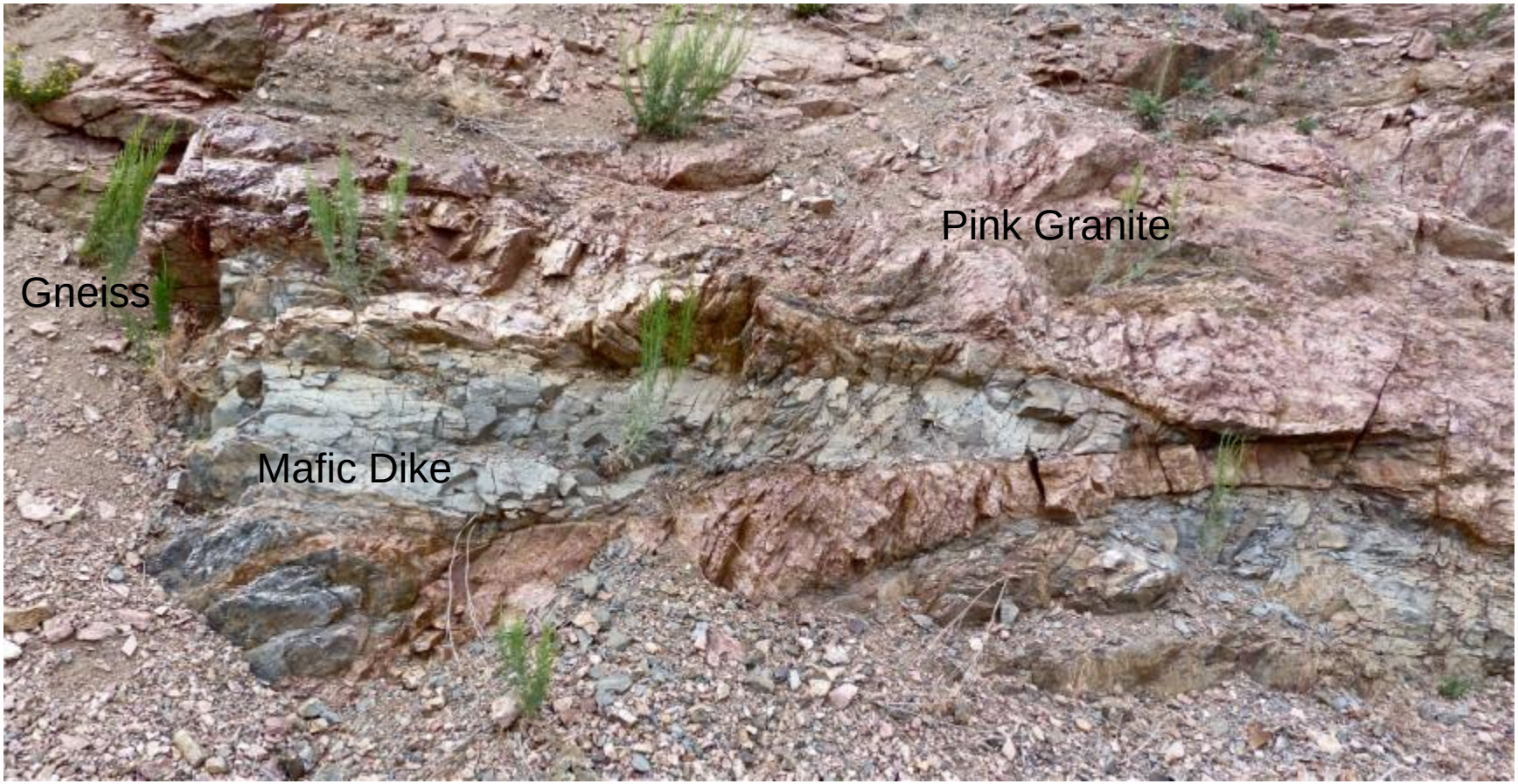
The McNey Hill Rock Cut Showcases Igneous (volcanic) and Metamorphic (changed) Rocks.

Metamorphic Rocks (changed by heat and pressure)

Gneiss gets so hot the molecules elongate into large crystaled bands.

Schist has tight layers of compact rocks, often mica.

1. There was Gneiss.
2. Mafic (old, dark basalt) intruded the gneiss.
3. Granite intruded all layers.

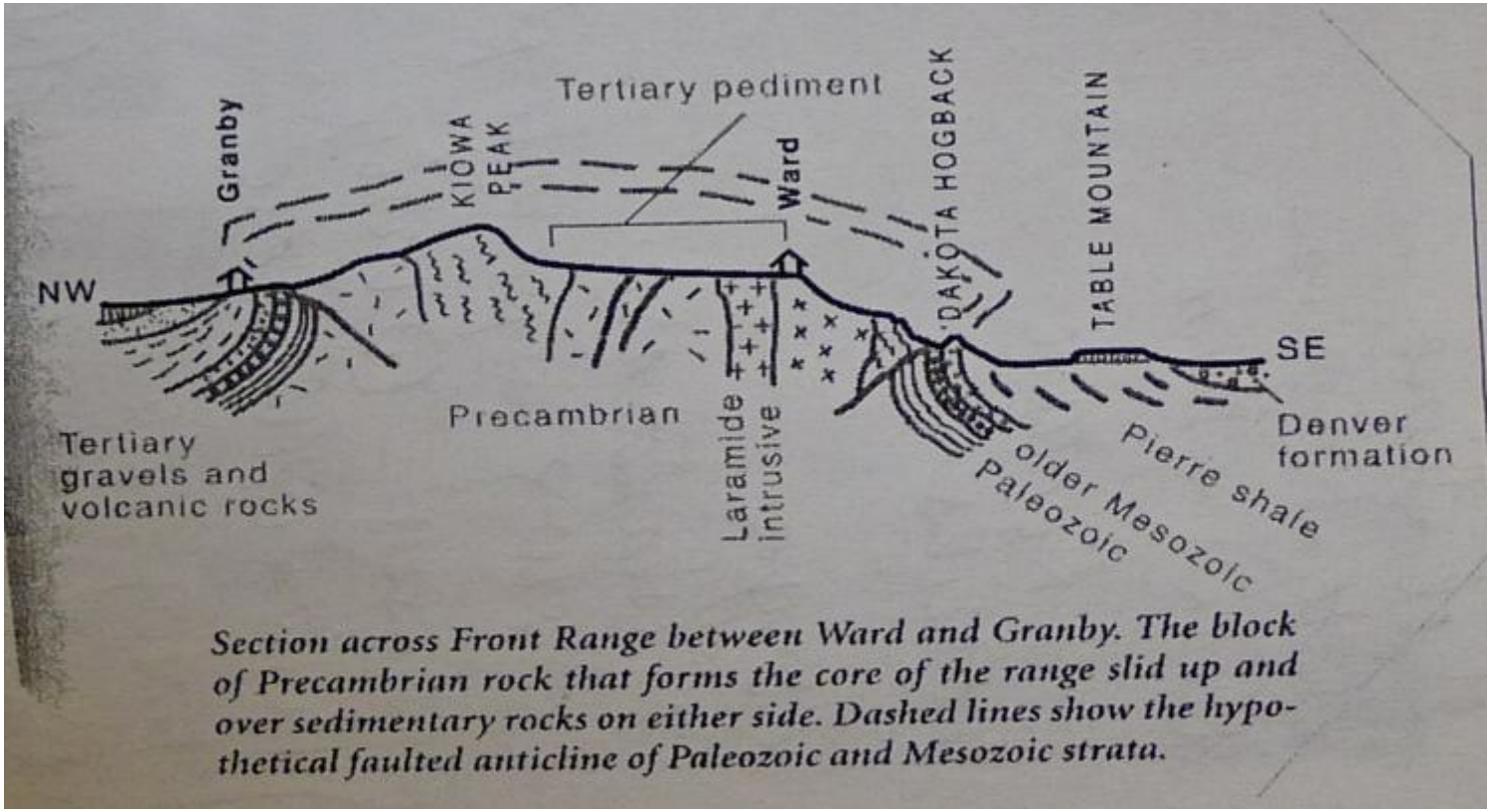


Why are Red Feather rocks rounded?

The granite intrudes into other layers. As the layers erode, the load lightens and the granite cracks. Weathering is done by chemicals, water, wind and ice which enter the cracks. Weathering happens fastest at edges. Slabs of rock peal off like an onion skin in a process called exfoliation.

Long's Peak is 14,255', part of a 1.42 million year old batholith. The flat top is remnants of an erosional surface. The rest of the erosional surface dropped 7,000'; a 21,000' difference.

We have traveled from the Front Range where the erosional surface settled to the mountain tops.



Section across Front Range between Ward and Granby. The block of Precambrian rock that forms the core of the range slid up and over sedimentary rocks on either side. Dashed lines show the hypothetical faulted anticline of Paleozoic and Mesozoic strata.

Go Forth and Enjoy Colorado's Geology