

Geological History of Summit  
County from the End of the  
Paleozoic through the Formation  
of the Rocky Mountains

a discussion with  
Joe Newhart

# **Virtual Field Trip with Five Stops in Summit County**

**First Stop will be in the Gore Range at Elliot Ridge.**

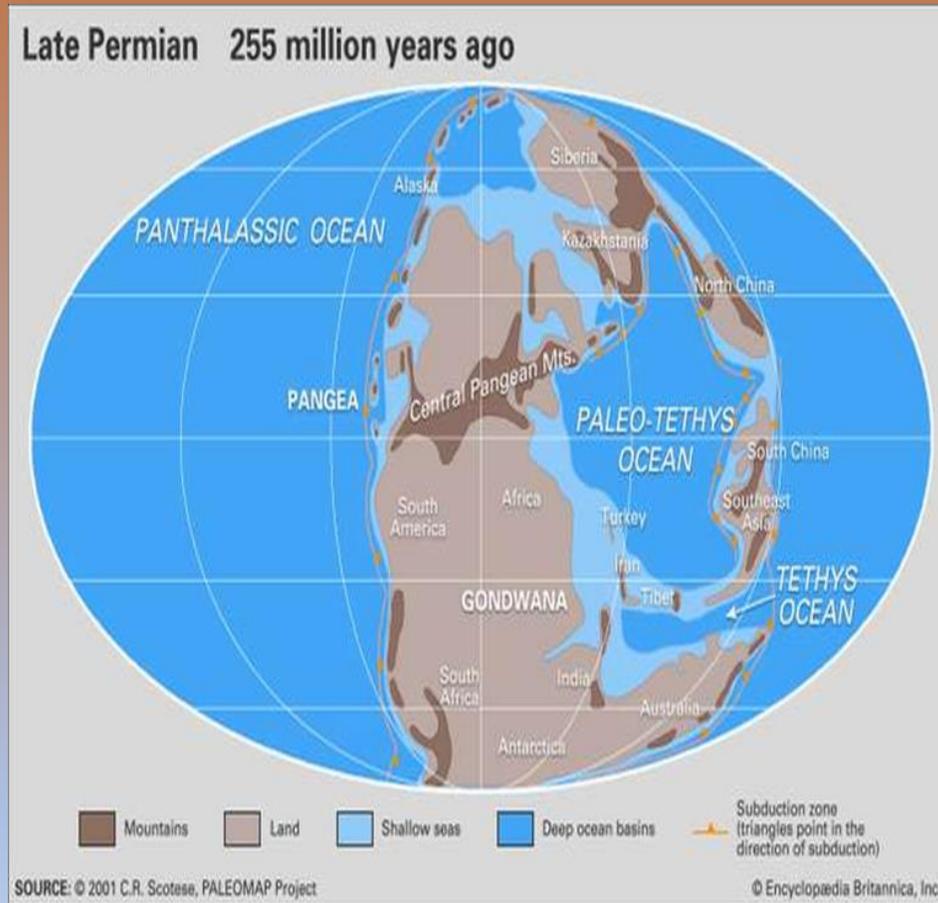
**Second Stop will be at the west end of Dillon Dam.**

**Third Stop will be at Green Mountain Reservoir.**

**Fourth Stop will be at Lower Cataract Lake.**

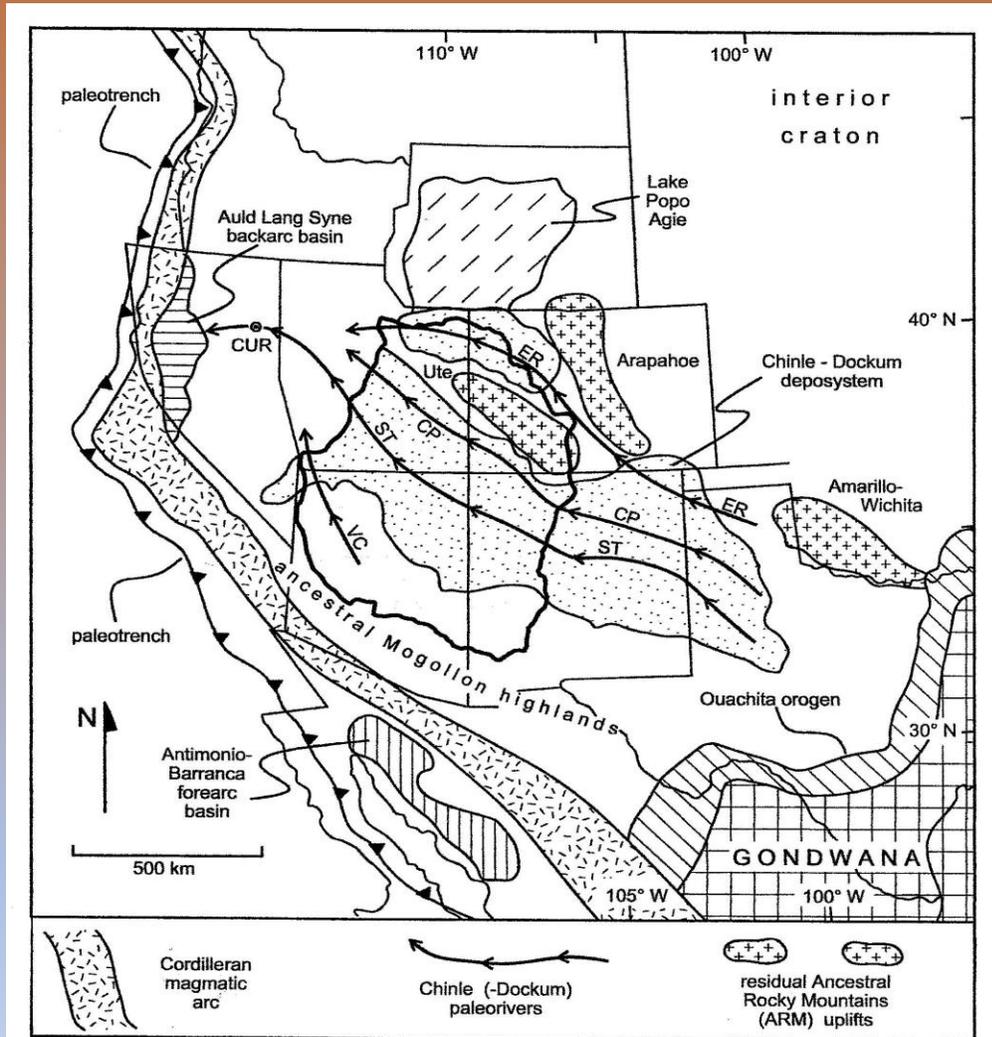
**Fifth Stop will be at Sapphire Point Overlook.**

# Formation of the Pangea Supercontinent



- **Continuing collision of Gondwana (South America-Africa) with North America-Europe formed a new supercontinent.**
- **The suturing formed the Central Pangean Mountains from the continent-continent collision.**
- **These are the Ouachita and Appalachian Mountains of North America.**
- **Along the western continental margin of the North American a subduction margin formed.**

# Triassic Rocks of Summit County



- **During the Triassic, a magmatic arc (like the Andes of Today) was forming along the proto-Pacific margin of the North American part of Pangea.**
- **In the Colorado area, the Ancestral Rocky Mountain uplifts were still predominant.**
- **The interior of the continent was fairly arid and predominant deposition was continental aeolian and river deposits. These are the red Triassic sandstones and mudstones that area seen in the Moab area of Utah.**
- **Note the location of the westward flowing Paleo Eagle River.**

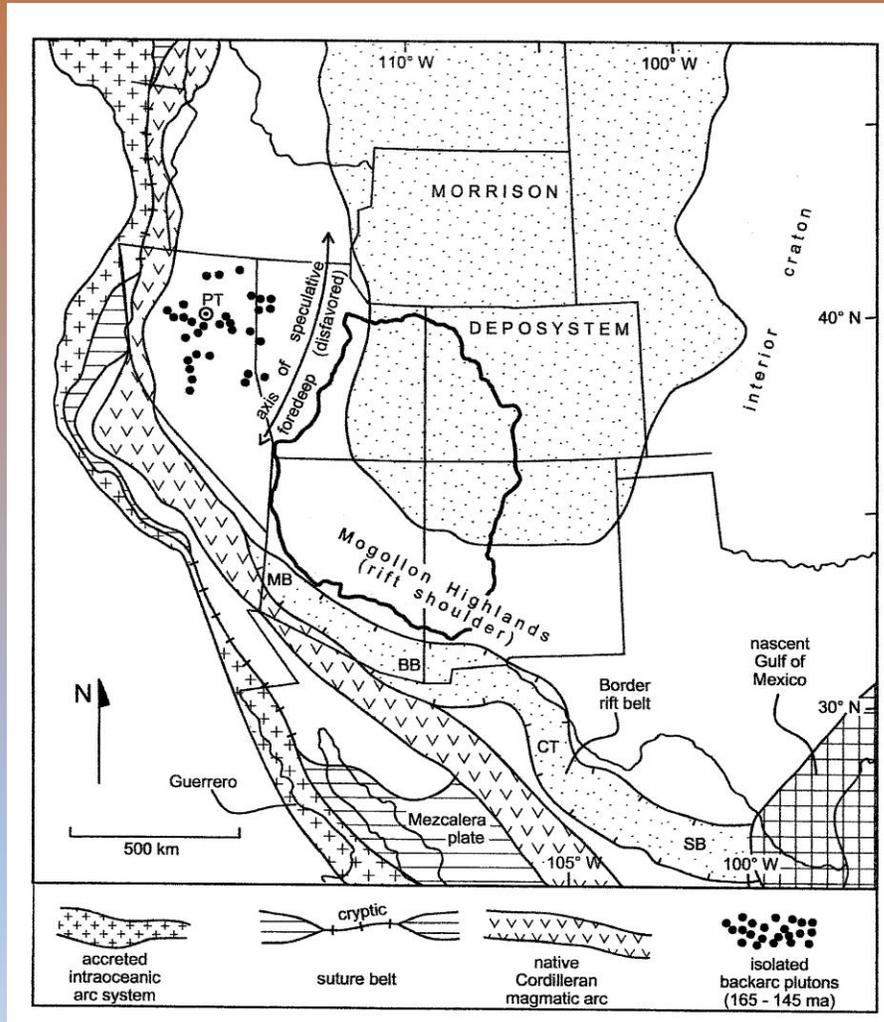
# Stop One

## Triassic Rocks of Summit County



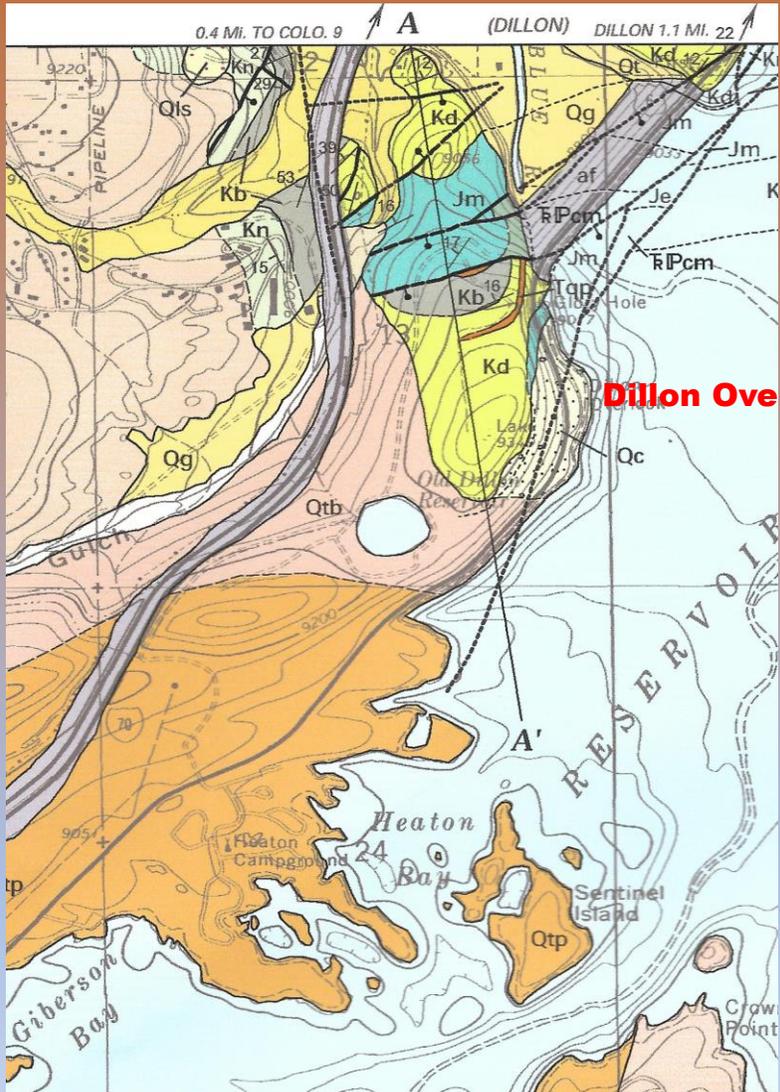
- **USGS geologist next to outcrop of Garta Sandstone Member of the Chinle Formation. Garta consists of about 20 feet of cross-bedded sandstones deposited in the paleo Eagle River drainage.**
- **The USGS has, also, mapped some Chinle Formation at the base of the Dillon Dam.**

# Jurassic Rocks of Summit County



- **The regional setting during the Jurassic in Colorado was an interior drainage system of continental and fluvial deposition.**
- **The Morrison deposystem was named after the outcrops found outside the town of Morrison, Colorado in the Front Range near Denver.**

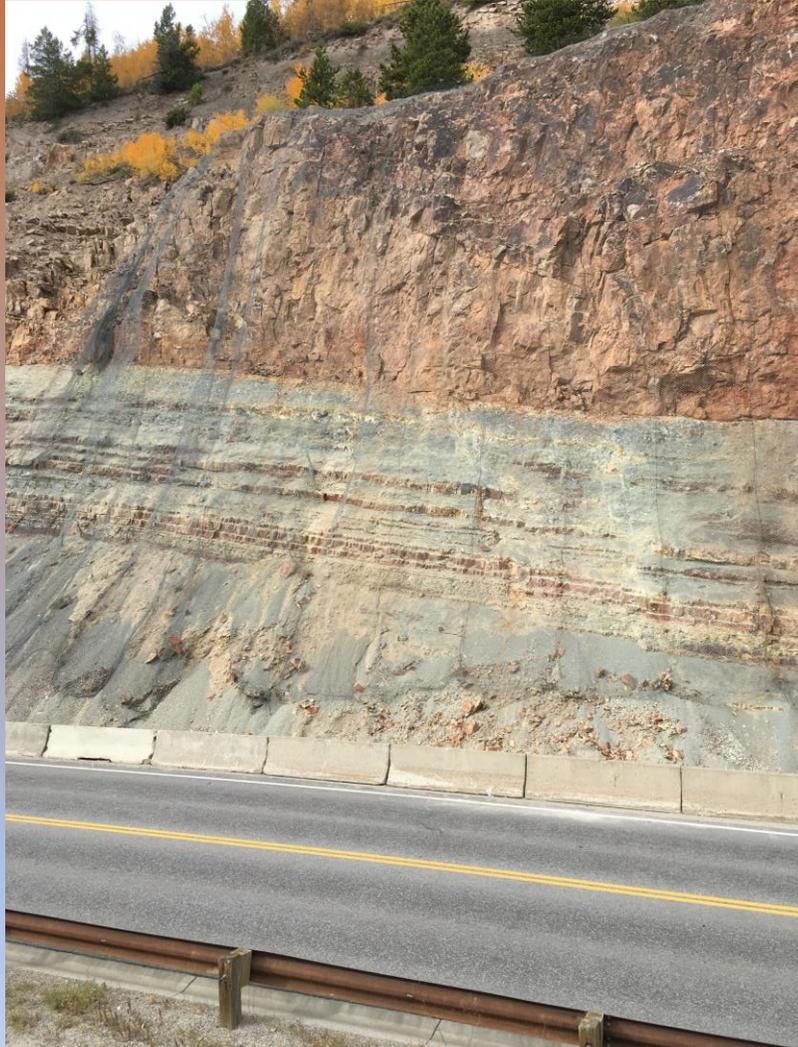
# Portion of Geological Map of Frisco Quadrangle



- **Note the location of I-70 and Dillon Dam Road.**
- **Stop two is at Dillon Overlook parking area at west end of Dillon Dam.**

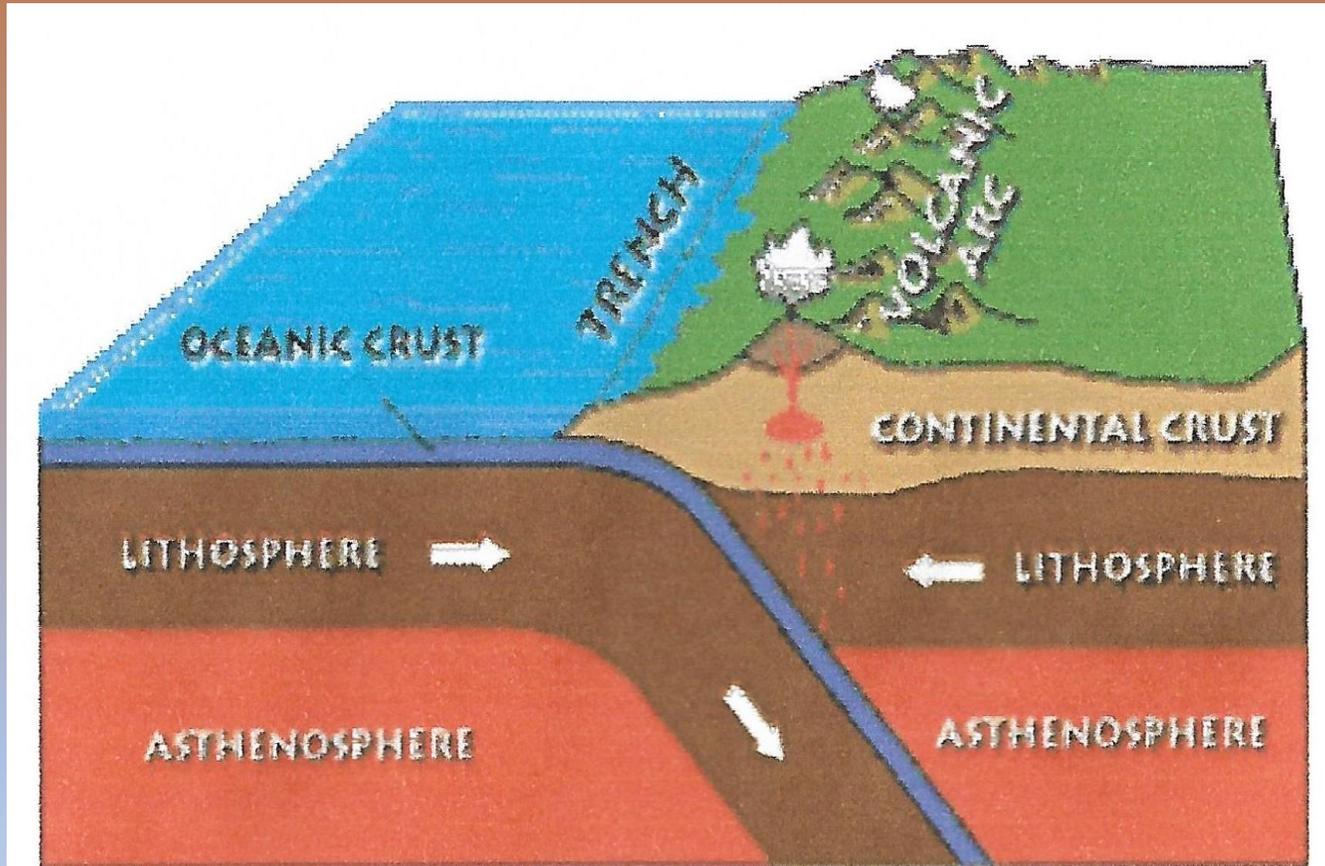
# Stop Two

## Jurassic Rocks of Summit County



- **Photo shows the outcrop of Morrison Formation along the Dillon Dam Road at the western end of the dam.**
- **The Jurassic Morrison Formation in Summit County consists of rocks deposited by slow moving rivers in streams and mud flats and in fresh water lakes.**
- **At the Dillon Dam outcrop, the Morrison Formation is mostly light-gray, greenish gray and maroon claystone lake deposits.**
- **The greenish color is due to iron minerals in the ferrous state as a result of deposition in a reducing environment in the lake bed.**

# Jurassic-Early Cretaceous Subduction



- **Subduction and volcanic arc development in the Jurassic and Early Cretaceous resulted in the formation of mountains by thrusting in Nevada and Western Utah called the Sevier Orogeny.**
- **Down warping of the continental crust formed foreland basin from Eastern Utah and as far east as Kansas.**

# Western Interior Seaway



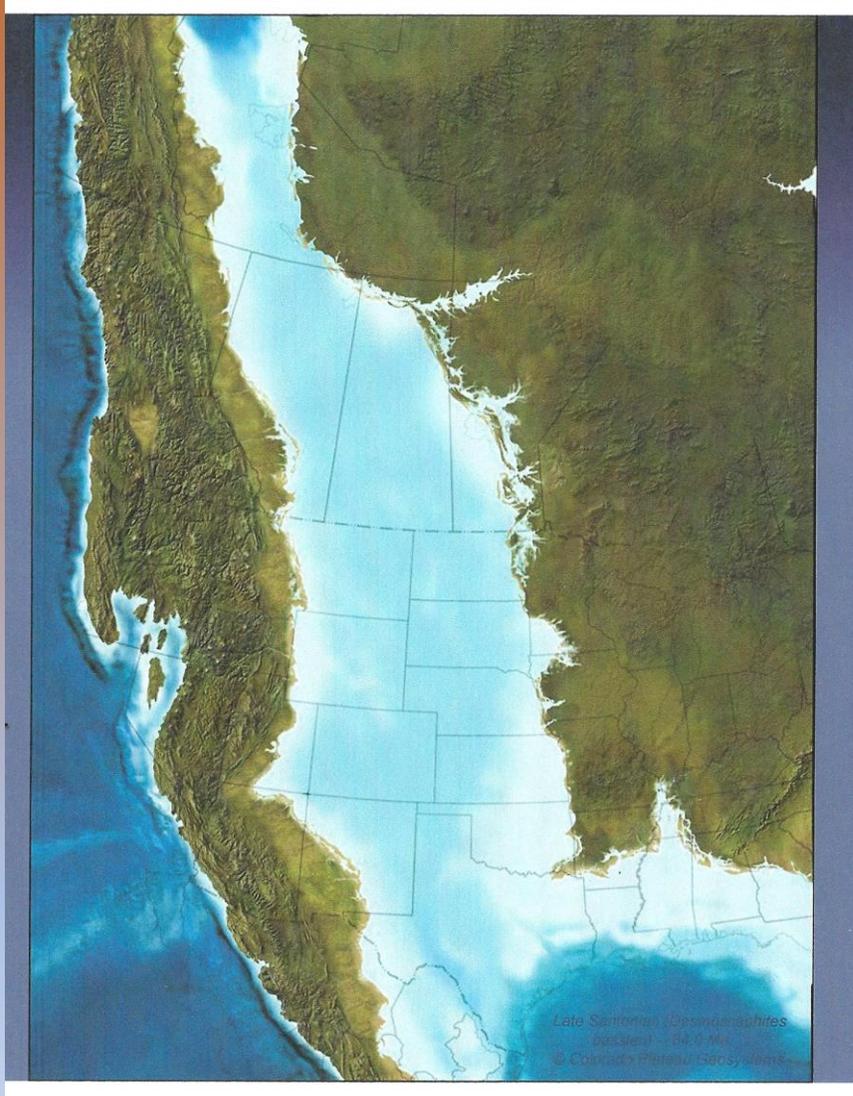
- **Rising sea level in the Cretaceous coupled with the foreland basin formation resulted in a seaway splitting the North American continent.**
- **The deposition of the near shore marine Dakota sandstone is the first manifestation of the seaway in Colorado.**
- **The massive Dakota sandstone lies above the Morrison Formation at the Dillon Dam outcrop.**

# Western Interior Seaway



- **Paleogeographic map of western North America during Dakota sandstone deposition – 99 mya.**
- **From Paleogeography and Paleotectonic of the Western Interior Seaway, Jurassic-Cretaceous of North America, R. C. Blakely, 2014.**

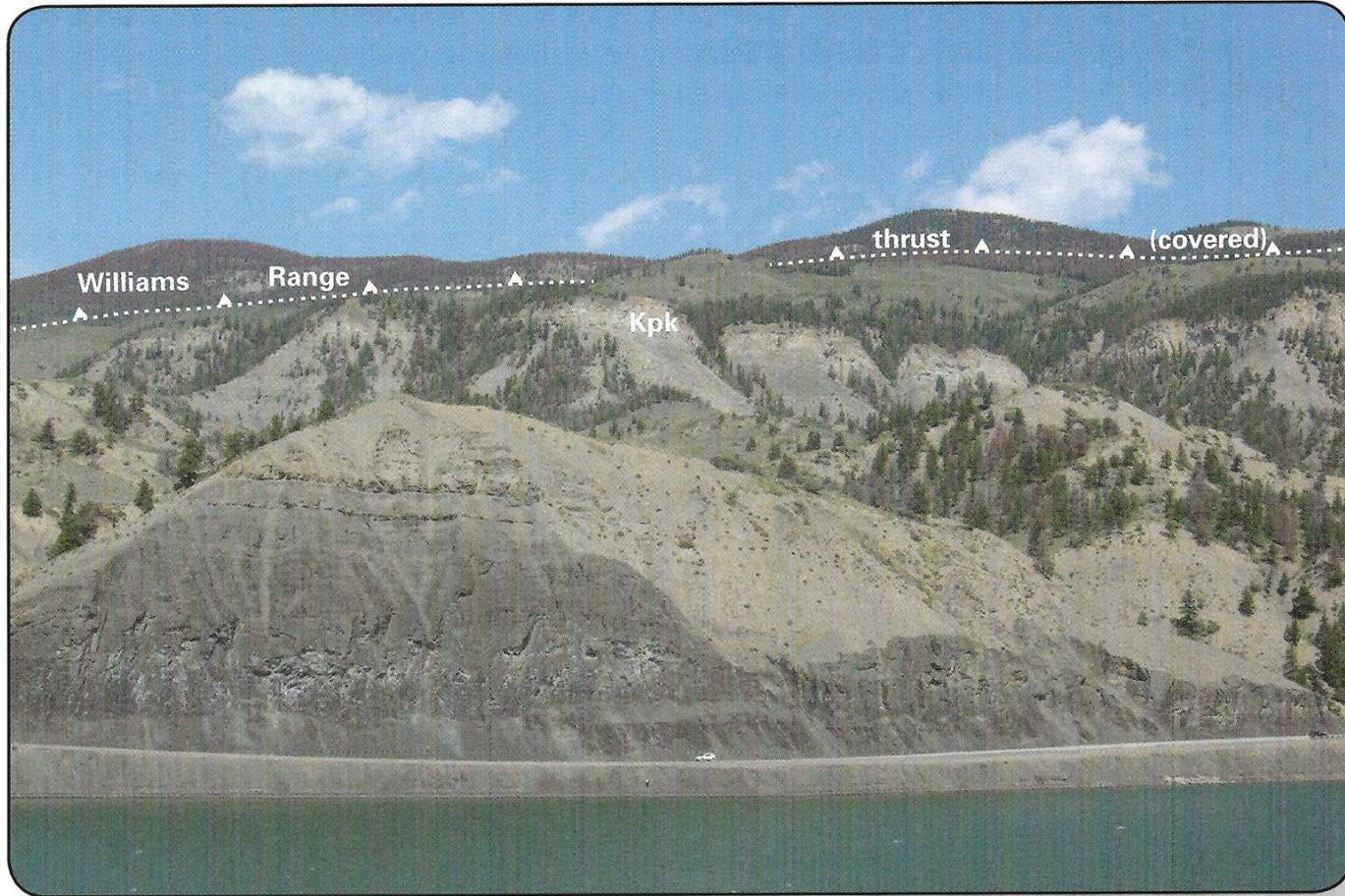
# Western Interior Seaway



- **Paleogeographic map during Pierre shale time – 84 mya.**
- **Maximum extent of the seaway.**

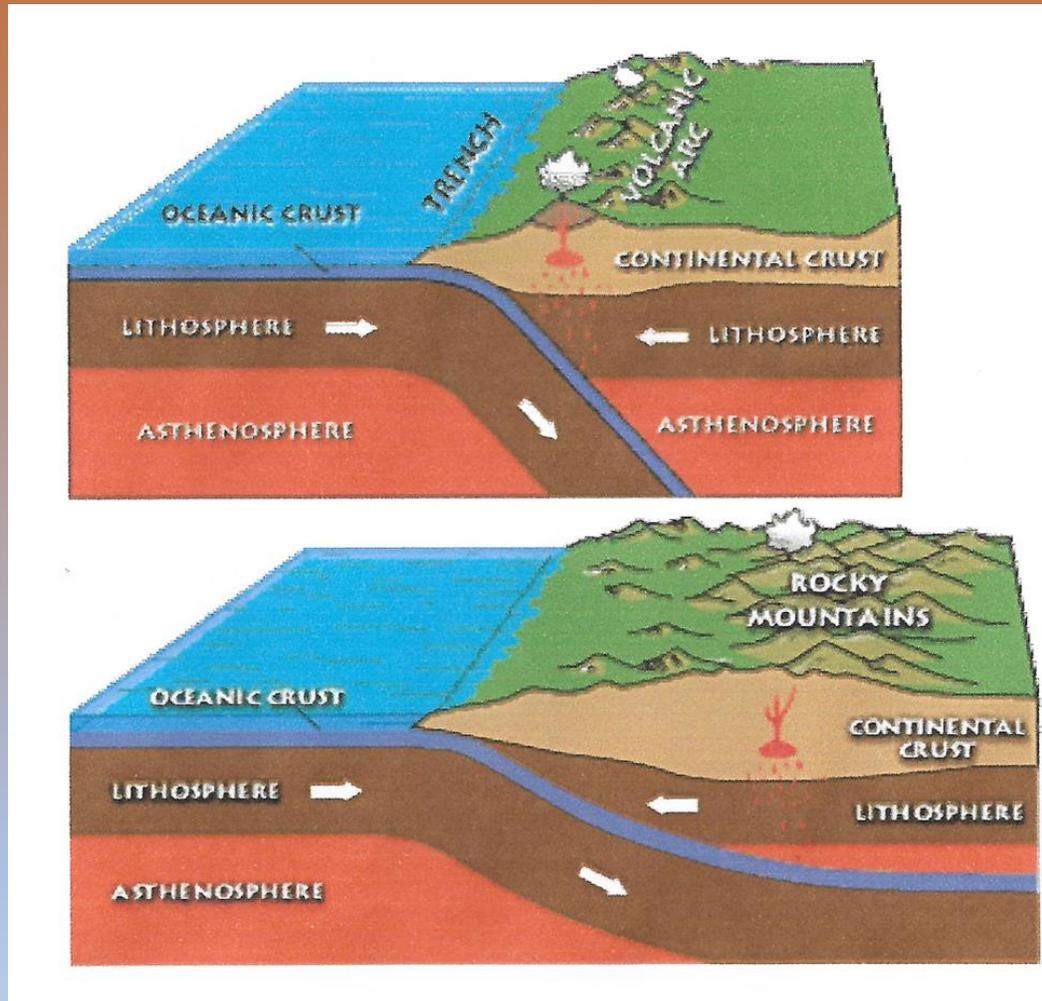
# Stop Three

## Western Interior Seaway



- **Photo of Pierre shale outcrop along Green Mountain Reservoir in northwestern Summit County.**
- **Note the vehicle on Highway 9 for scale.**
- **Pierre shales is dark-gray to black marine mudstone. May have been 8500 feet thick with upper 3300 feet removed by erosion.**

# Laramide Orogeny – Rocky Mountains Uplift



- **Change in subduction to flat subduction (80-75 mya) as a result of subduction of thicker/hotter and more buoyant oceanic crust.**
- **Flattening subduction pushed the area of deformation eastward into the continent forming the Rocky Mountain uplifts.**

# Rocky Mountains Uplifts in Colorado 66-45mya

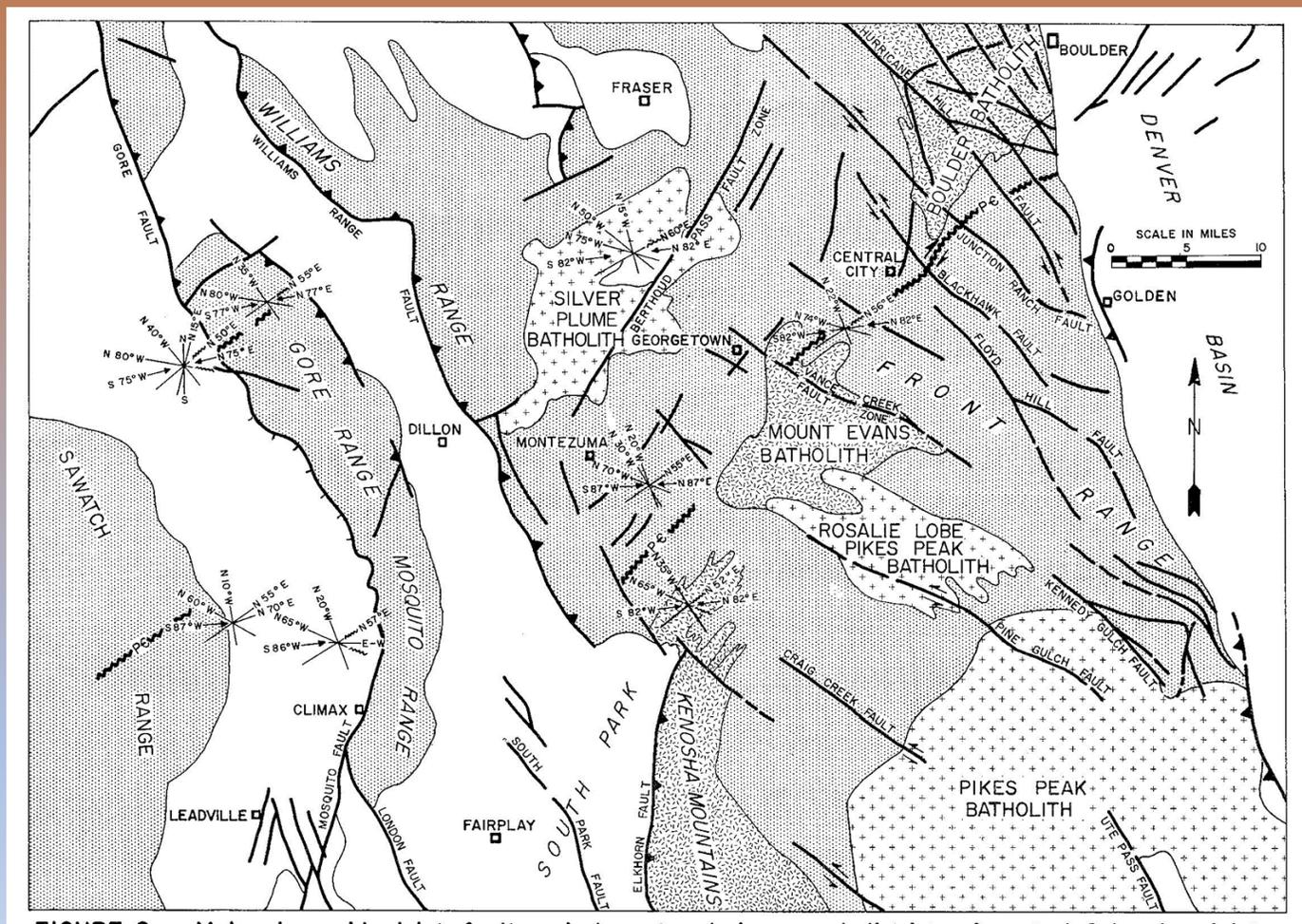


FIGURE 2. Major tectonic joint faults and shear trends in several districts of central Colorado. Joint

- **Deformation/Uplift reached Central Colorado 66 mya as dated by the synorogenic sediments deposited along the Front Range.**
- **Williams Range thrust fault pushed Proterozoic rocks westward over the Pierre shale in Summit County.**
- **Gore Range fault was reactivated.**

# Stop Four

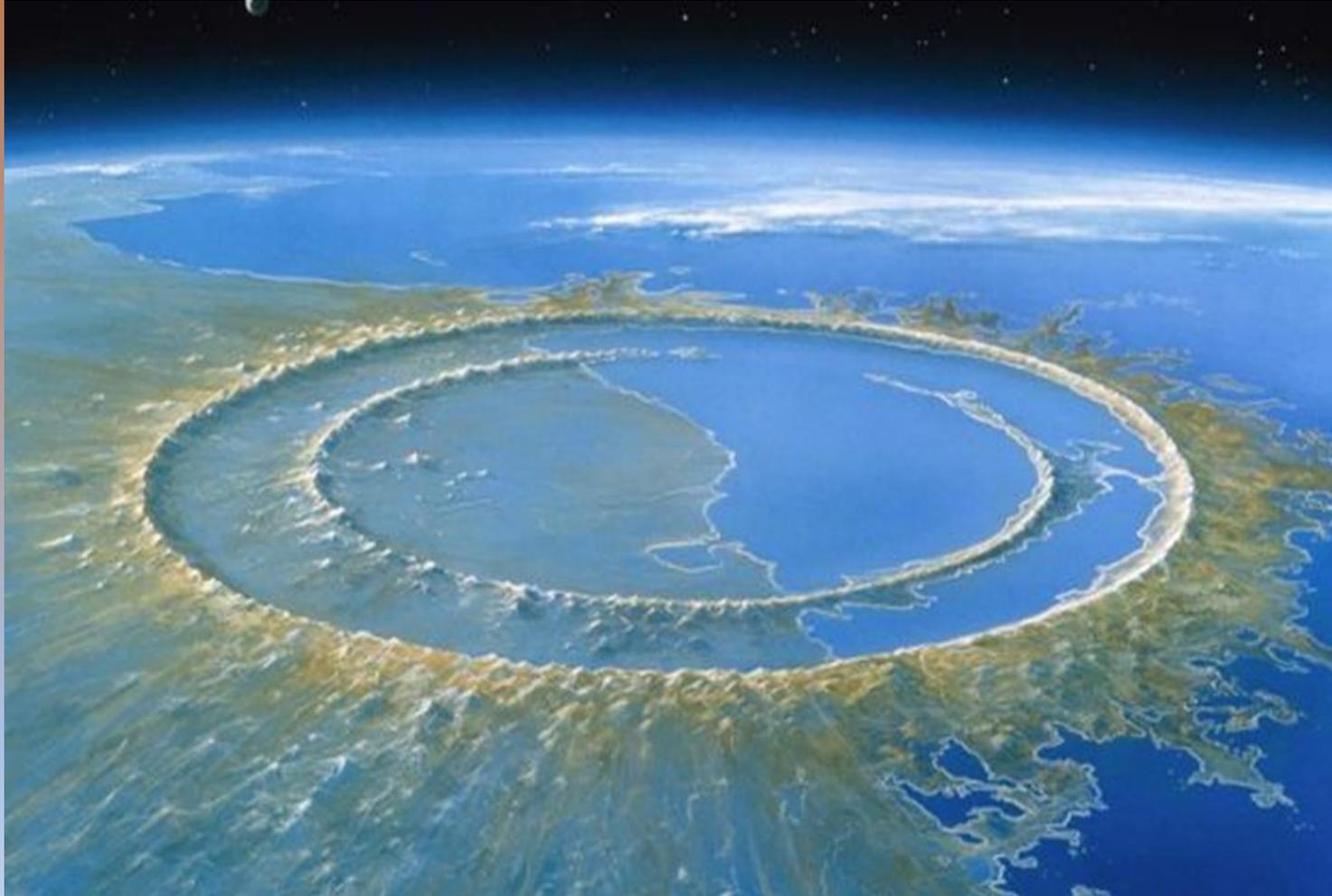
## Folded Dakota Sandstone at Lower Cataract Lake



# End of the Cretaceous Period – 66mya



# Chicxulub Meteor Impact on the Yucatan Marine Shelf



# Cretaceous-Tertiary (K-T) Boundary in Colorado



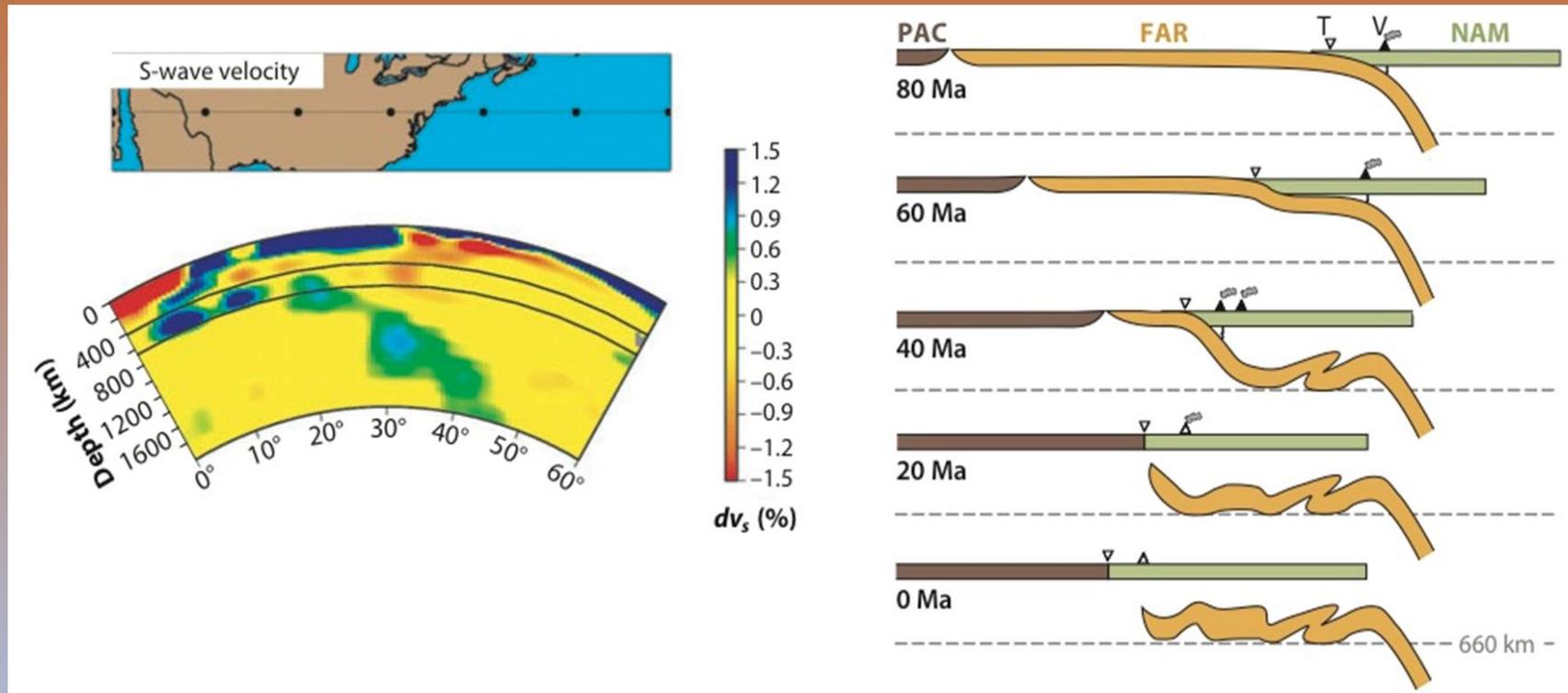
- **K-T boundary at Lake Trinidad State Park.**
- **Photo taken on Long Canyon Trail. K-T boundary is just above the white layer in the overhang shadow.**

# Catastrophic Climate Change



- **The impact of the Chicxulub meteorite sent columns of rock particles into the atmosphere, incinerated the planet's forests and drove tsunamis across the oceans.**
- **Setting up nuclear winter and cooling the climate.**
- **Large percentage of land life was extinguished – the death of the dinosaurs.**
- **Recent study shows that the ocean were acidified within 10-100 years after the impact resulting in marine extinction.**

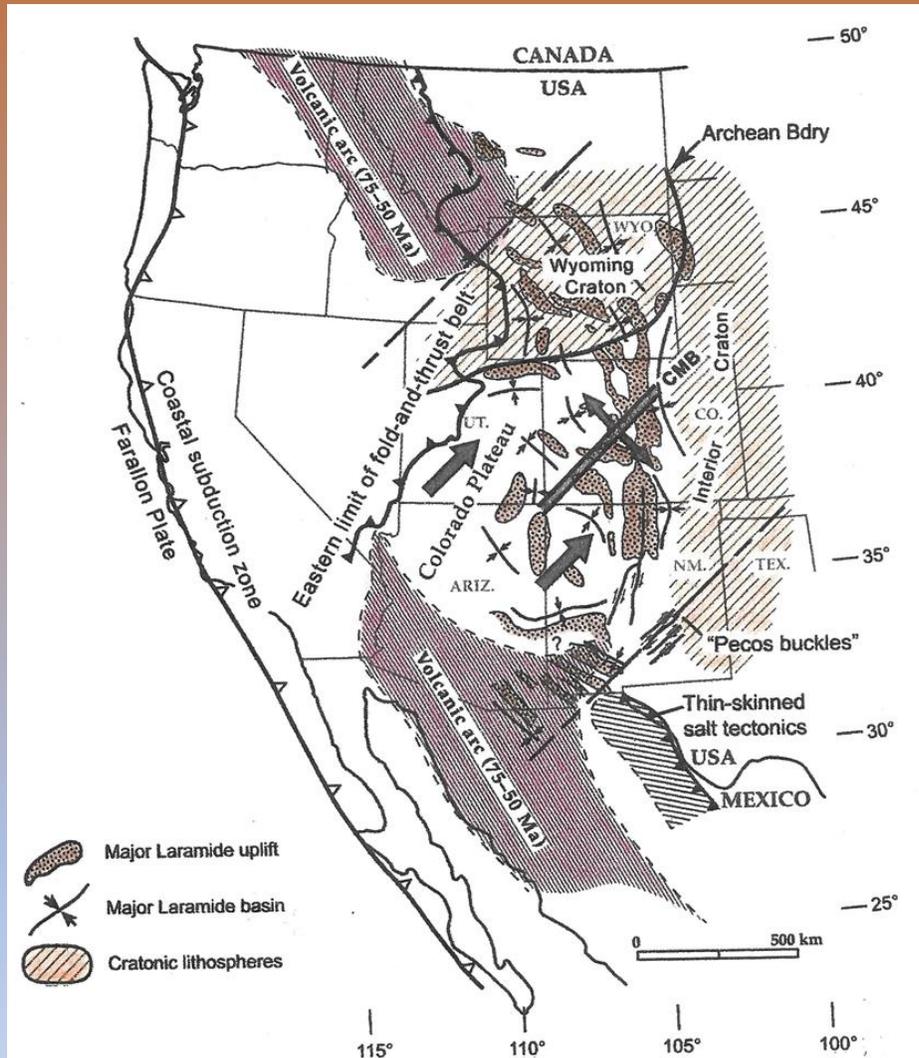
# Subduction of the Farallon Plate 45 mya to Present



**Flat Subduction ended around 45 mya ending the Laramide Orogeny. The subducting Farallon Slab steepened until around 20 mya, when the Pacific Plate impinged on the North American Plate ending subduction and initiating the transform continental margin and Basin and Range extension that is seen today.**

# Stop Five

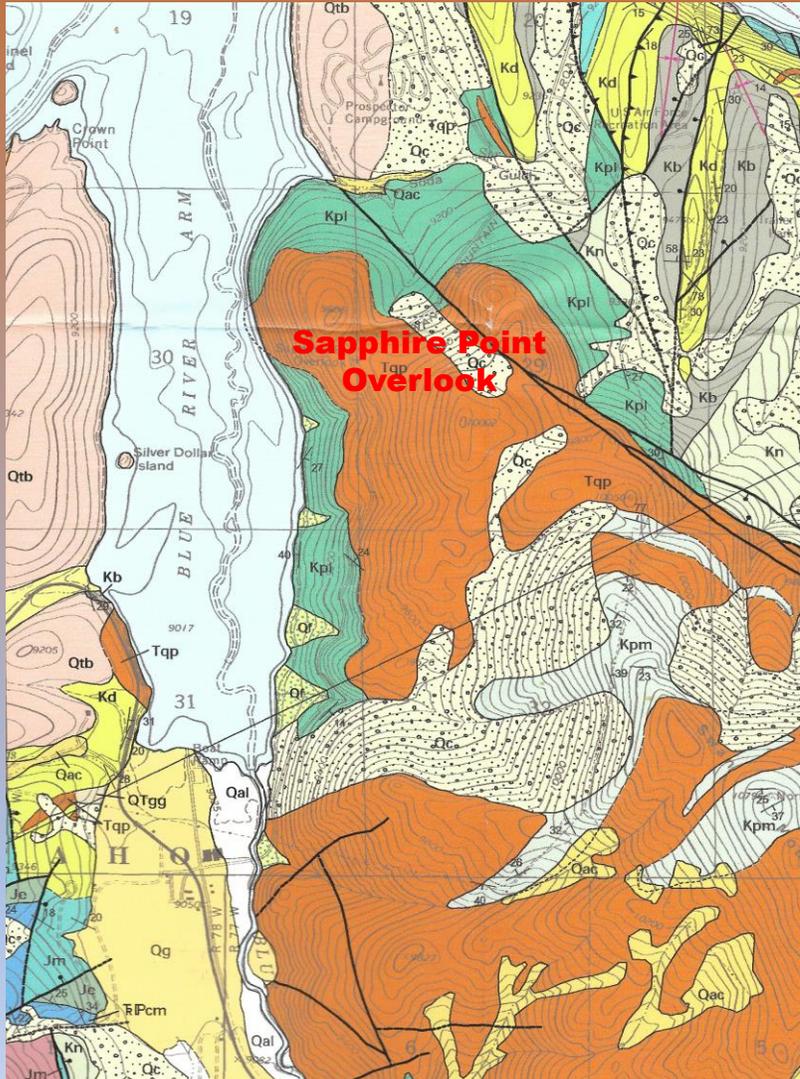
## Formation of the Colorado Mineral Belt



- **Illustration is a paleotectonic map of the western U.S. at the time of Farallon plate foundering - 45 mya.**
- **Large arrows show transport direction of Farallon flat slab. Narrow arrows show oblique stresses that dilated or sheared the slab allowing magmas to rise into the Colorado Mineral Belt.**

# Stop Five – Sapphire Point

## Portion of Geological Map of Frisco Quadrangle



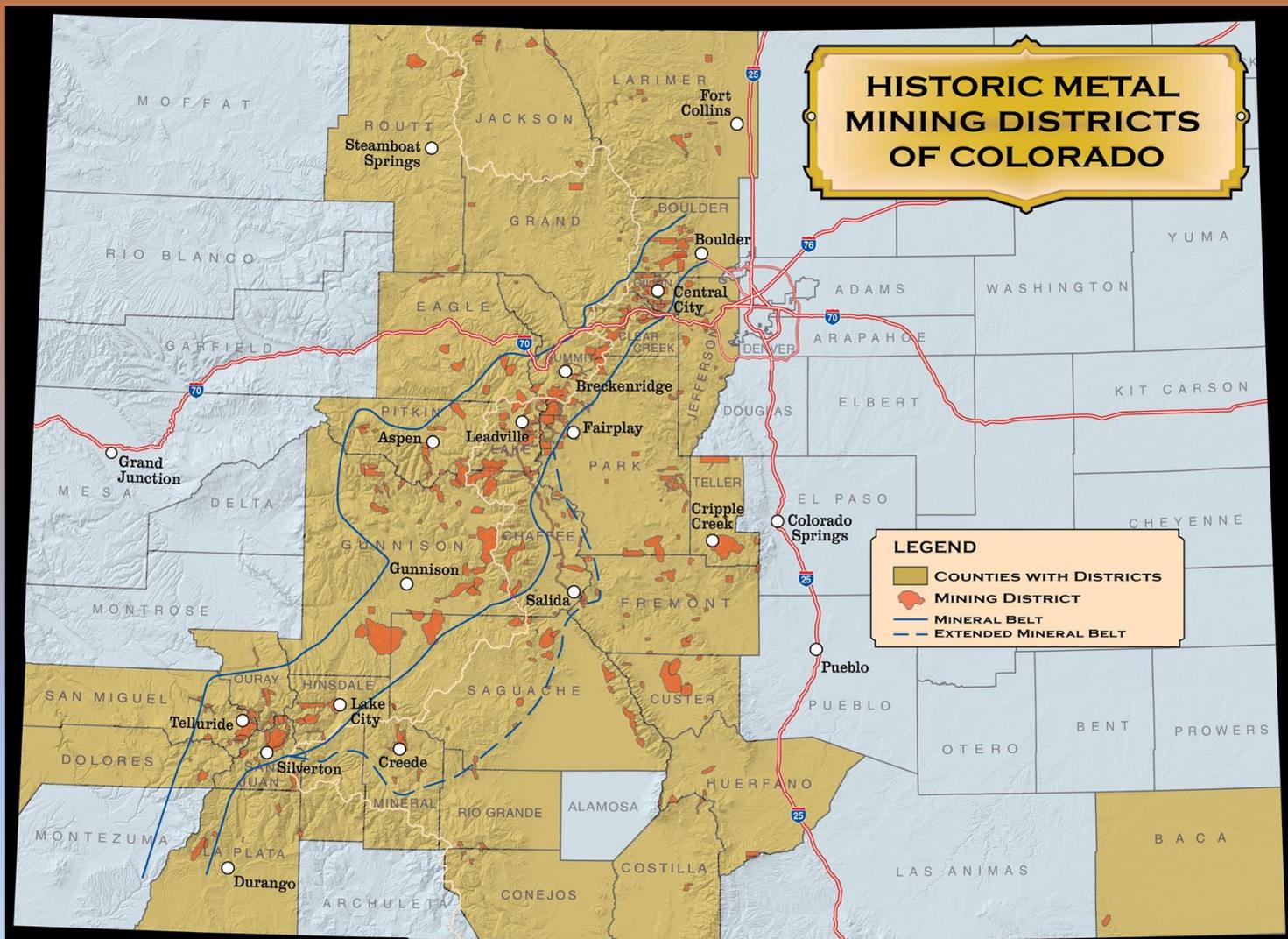
- **The orange pattern on the geological map (Tqp) is the Eocene Quartz monzonite porphyry .**
- **These igneous magmas were intruded into the surrounding rocks at 44 mya.**
- **These magmas carried the minerals which were deposited in the Breckenridge portion of the Colorado Mineral Belt.**

# Quartz Monzonite Porphyry from Sapphire Point



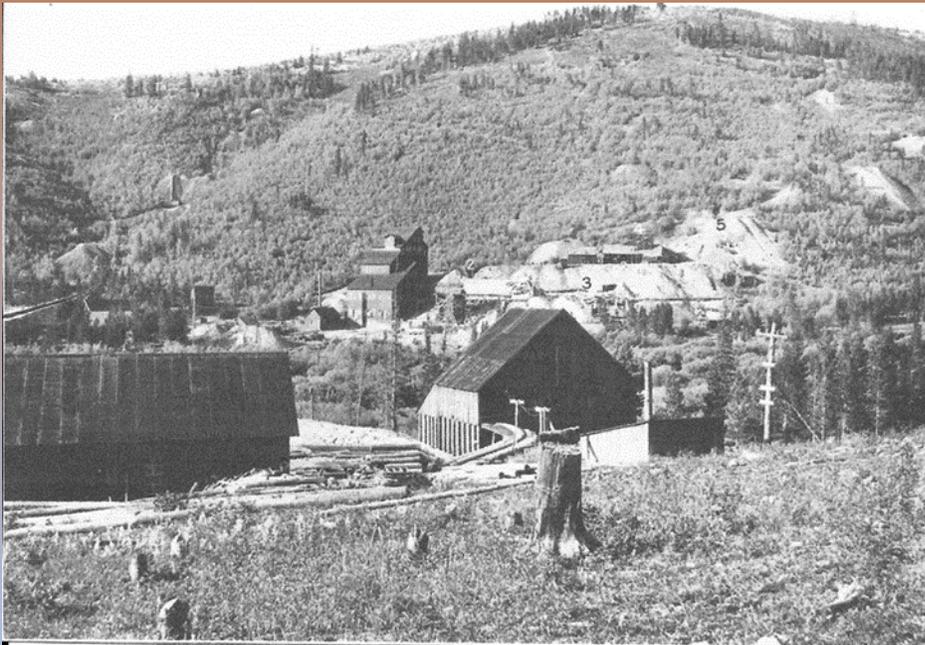
- **Light-gray massive quartz monzonite.**
- **Orthoclase phenocrysts are 2 mm to 4 cm long and comprise up to 20 percent of the rock.**
- **Black minerals are predominantly biotite (mica mineral) and comprise 1-3 percent of the rock.**

# Colorado Mineral Belt

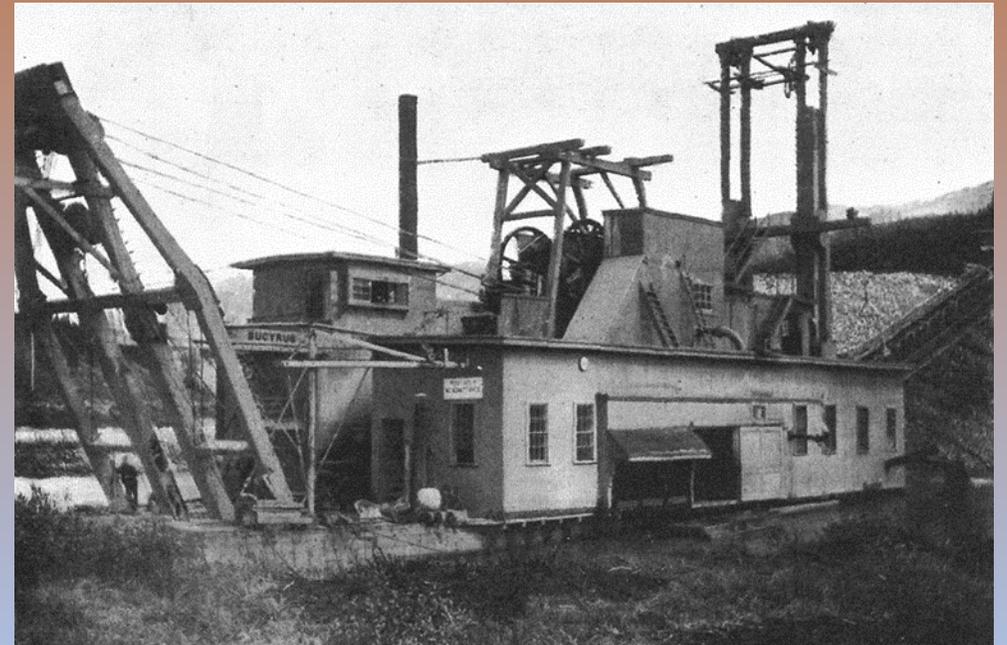


- **Illustration is from Colorado Geological Survey website.**
- **Cenozoic Intrusives and Mineralization occurred in two pulses in Central Colorado at 44 and 30 mya.**
- **Leadville/ Breckenridge mineralization occurred around 44mya.**
- **Climax molybdenite mineralization occurred around 30mya.**

# Breckenridge Mining District



**Wellington Mine in Breckenridge**



**Dredge on the Blue River near Mouth of Swan River**