Geological History of Summit County
The Last 30 Million Years

a discussion with
Joe Newhart

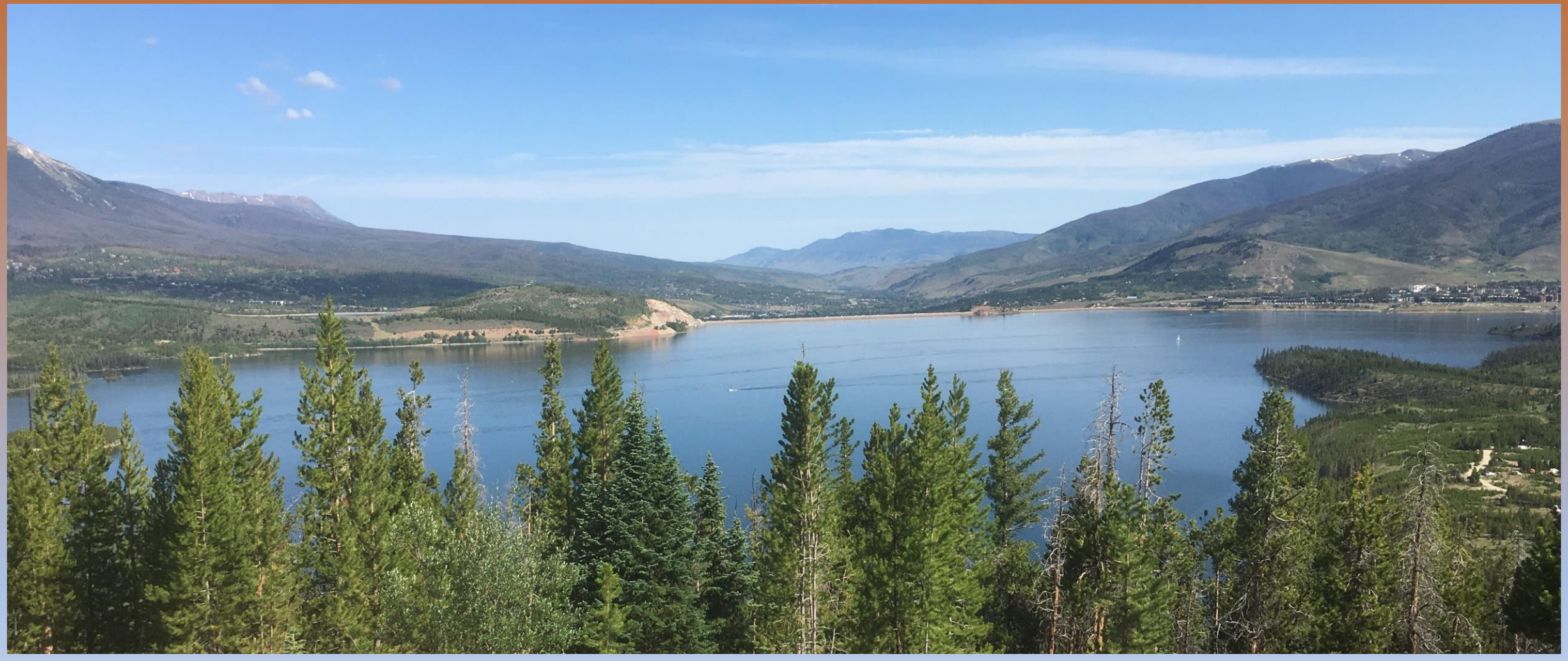
Virtual Field Trip with Three Stops in Summit County

First Stop will be at Sapphire Point Overlook.

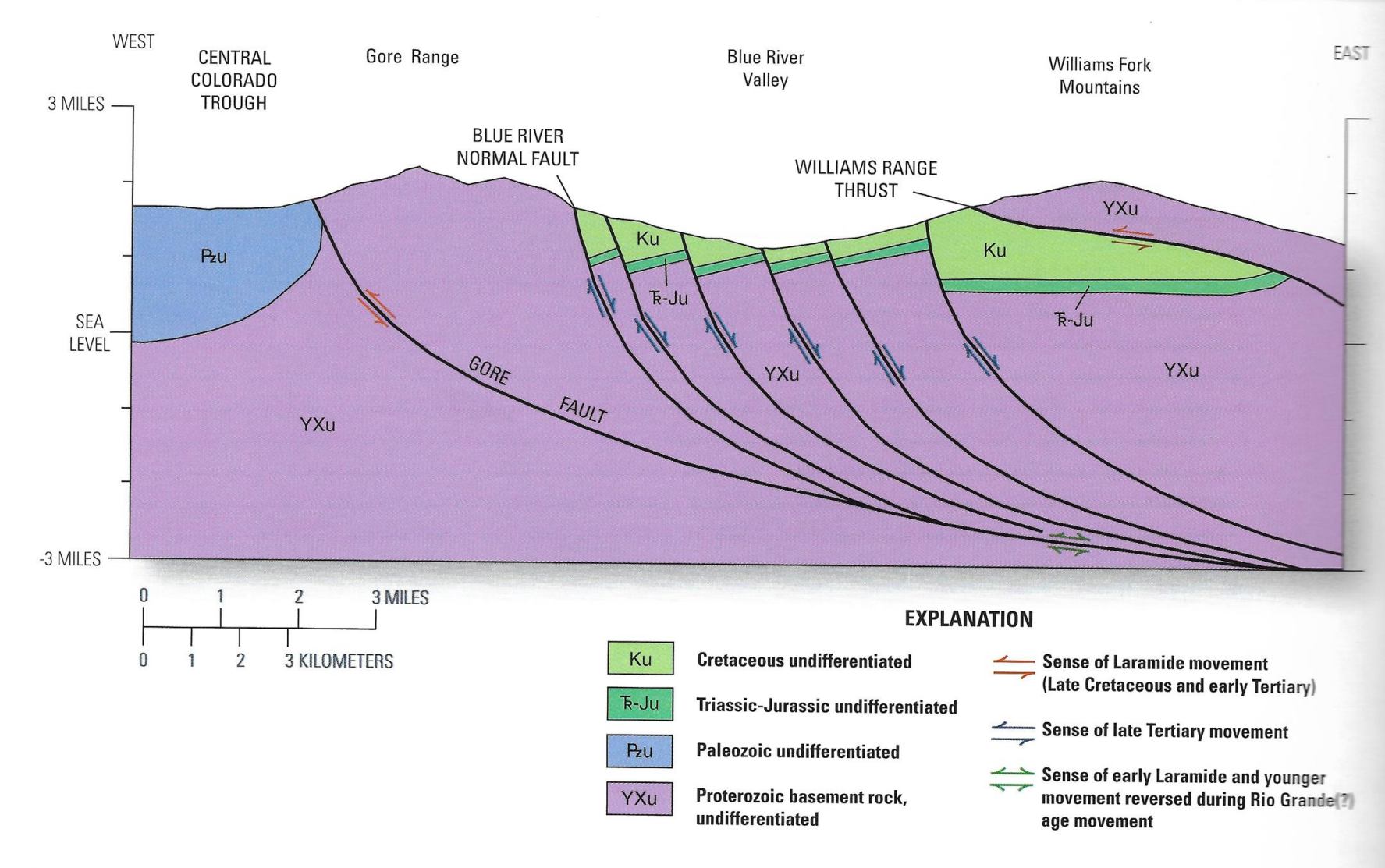
Second Stop will be at Dillon Overlook.

Third Stop will be at Mayflower Gulch.

Photo of Blue River Valley from Sapphire Point



Formation of the Blue River Valley – 28-11 mya



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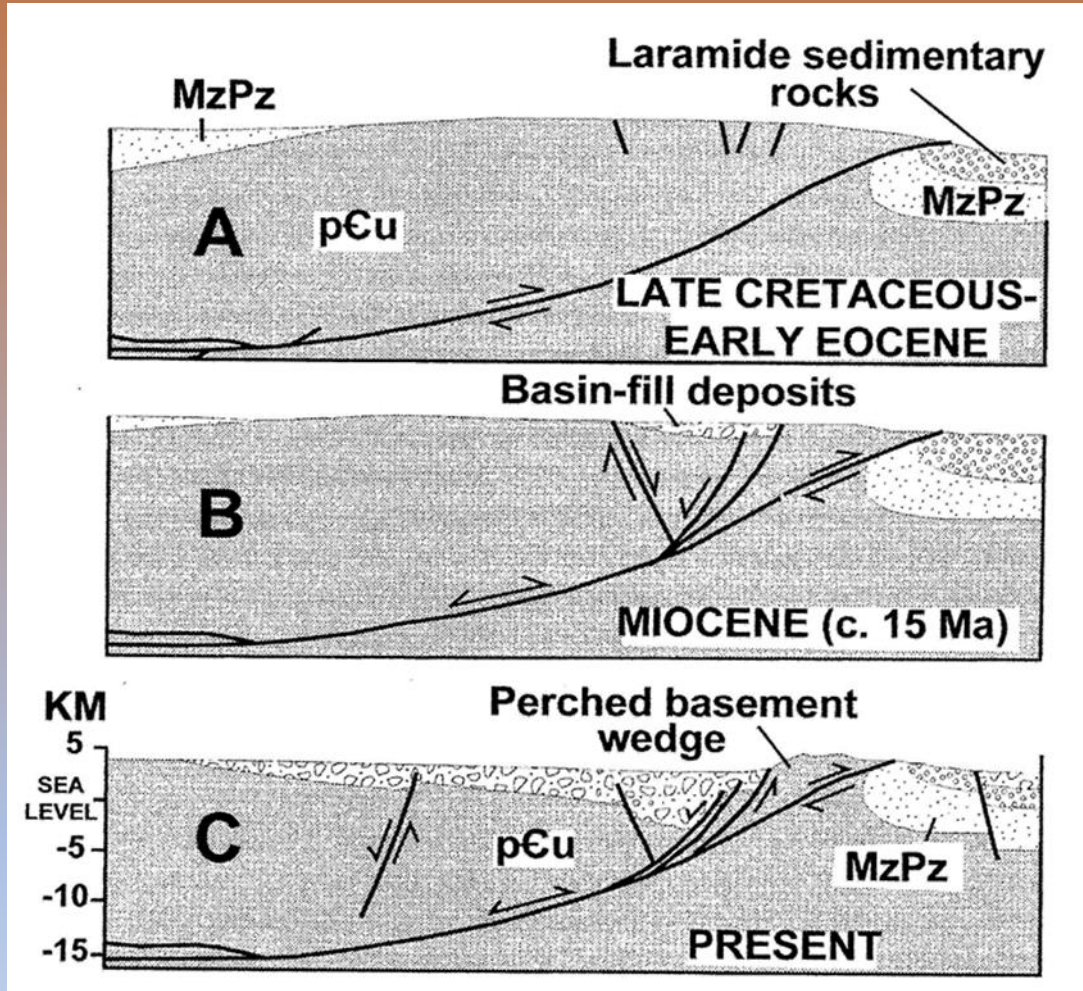


- **Schematic diagrams showing major tectonic elements during the evolution of Laramide uplifts and gravitational collapse during Neogene extension.**

- **The oldest sediments in these extensional basins are the Troublesome Formation present in Kremmling and have been dated as slightly younger than 28 mya.**

Map of the Colorado portion of the Rio Grande rift and other associated Neogene basins

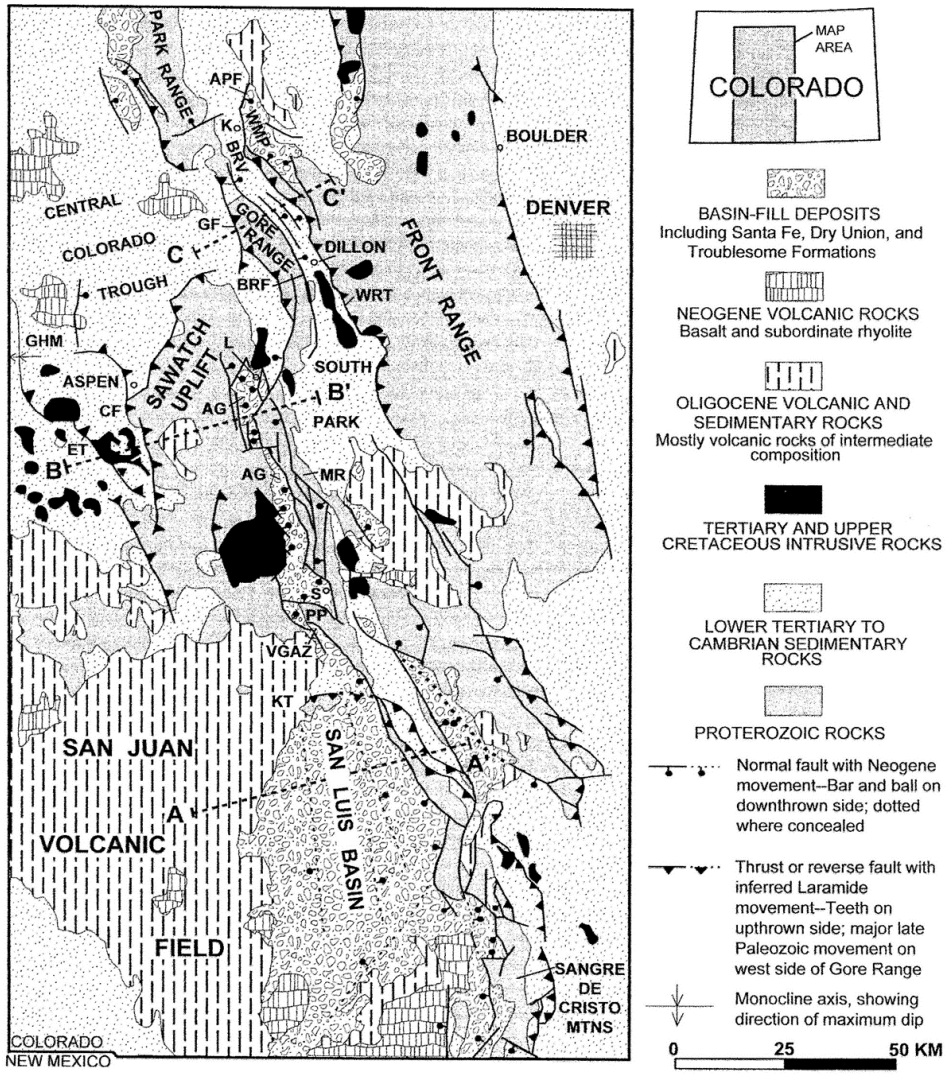
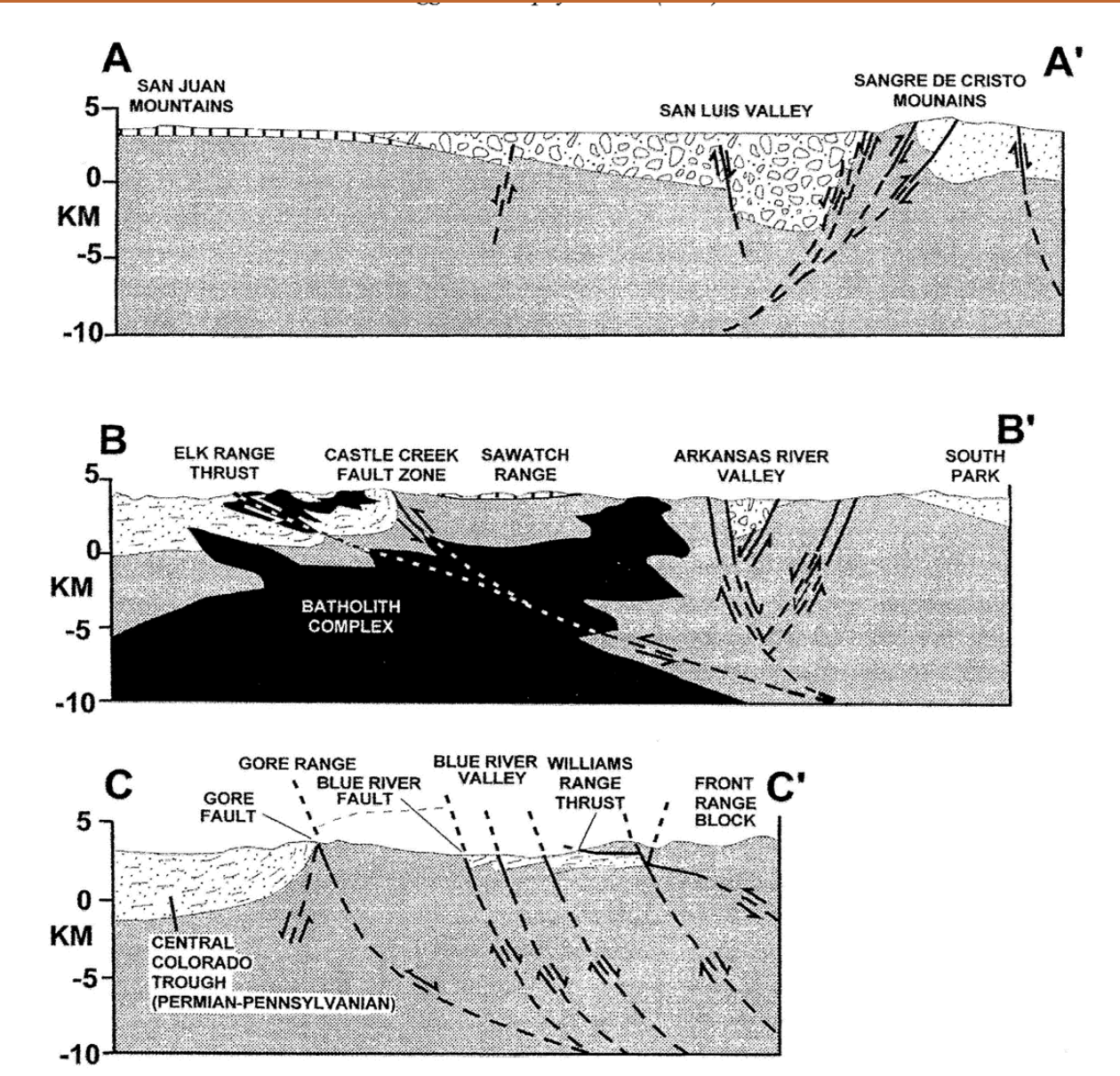


Fig. 1. Map showing major tectonic features of the Colorado portion of the Rio Grande rift, simplified and modified from Tweto (1979). Cross-sections *A–A'*, *B–B'*, and *C–C'* are shown in Fig. 3. *AG* = upper Arkansas River graben; *APF* = Antelope Pass normal fault; *BRF* = Blue River normal fault; *BRG* = Blue River graben; *CF* = Castle Creek fault zone; *ET* = Elk Range thrust zone; *GF* = Gore fault; *GHM* = Grand Hogback monocline; *K* = Kremmling; *KT* = Kerber Creek thrust; *L* = Leadville; *MR* = Mosquito Range; *PP* = Poncha Pass; *S* = Salida; *VGAZ* = Villa Grove accommodation zone; *WMP* = western Middle Park basin; *WRT* = Williams Range thrust.

Note the locations of the Cross Sections

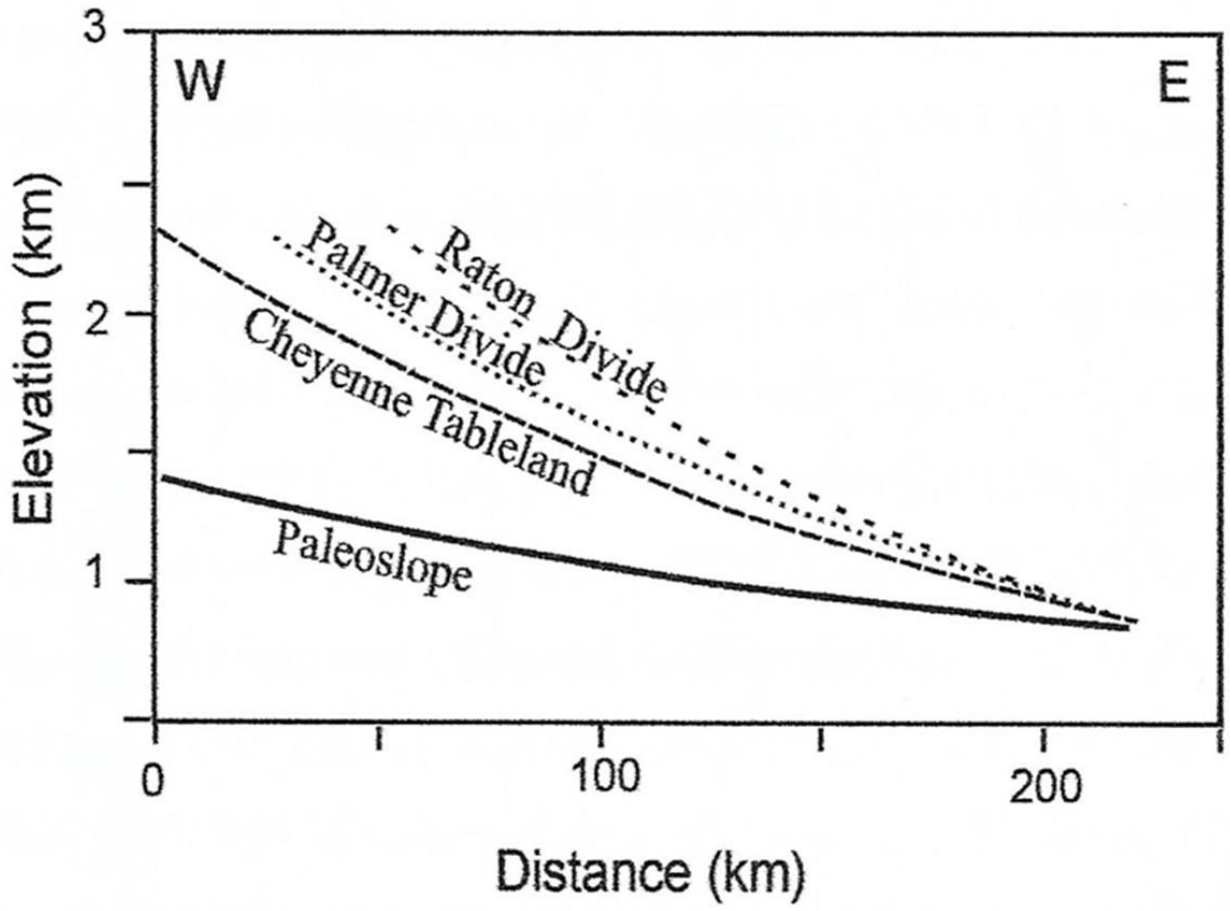
- **A-A' – San Luis Basin**
- **B-B' – Arkansas River Valley**
- **C-C' – Blue River Valley**

Cross Sections Associated with Map



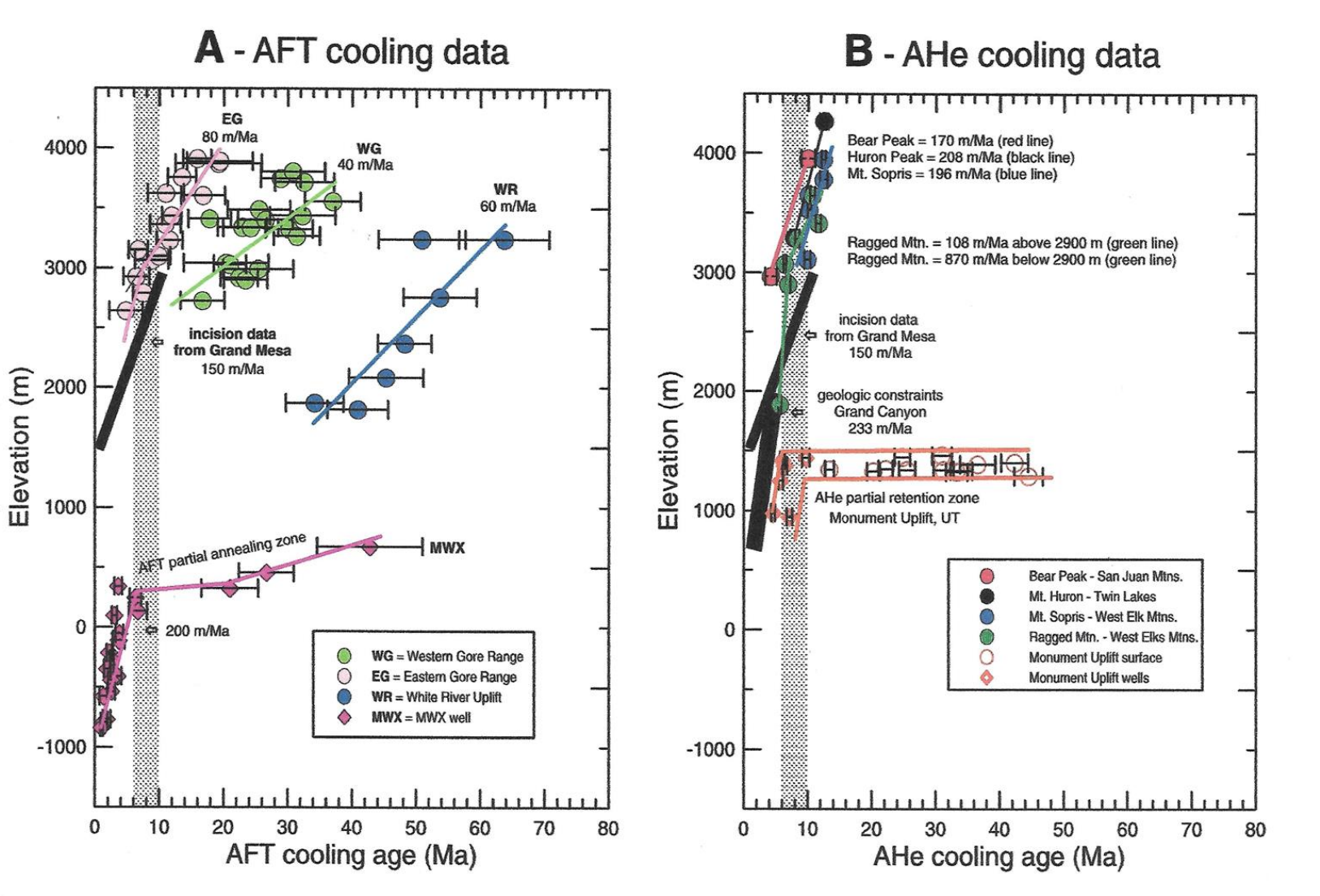
- **San Luis Valley is the Northern extension of the Rio Grande Rift.**
- **Arkansas River Valley and Blue River Valley have a thinner valley fill and are most probably the result of gravitational collapse of the Laramide compressional event.**

Miocene Uplift of the Colorado Plateau and Great Plains - 6–10 mya



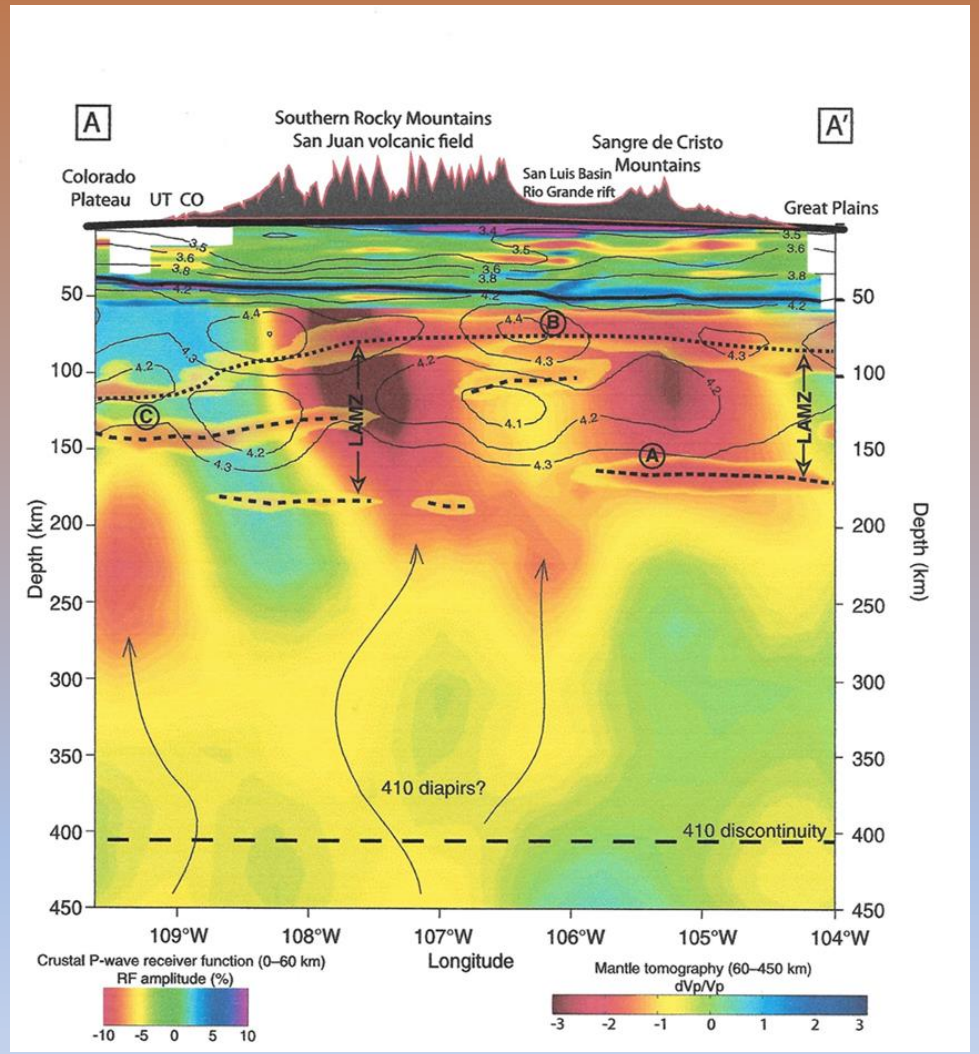
- **Diagram ilustrates the gradients of Major Interfluves in Western Great Plains**
- **Modern gradients are significantly greater than the paleo-slope calculated from preserved gravels of the Miocene-Pliocene Ogallala Formation. This difference indicates tilting up to the west of 1-2 km or 3000-6500 ft.**

Upper Colorado River System Uplift and Exhumation



(A) Apatite fission track cooling histories and exhumation rates. Data show cooling episodes in the Laramide – mid-Cenozoic and the onset of rapid incision/exhumation since 6-10 may. (B) Age-elevation transects (U-Th)/He cooling data indicate rapid exhumation since 5-10 mya.

Recent Studies Have Postulated Possible Mechanisms for Uplift

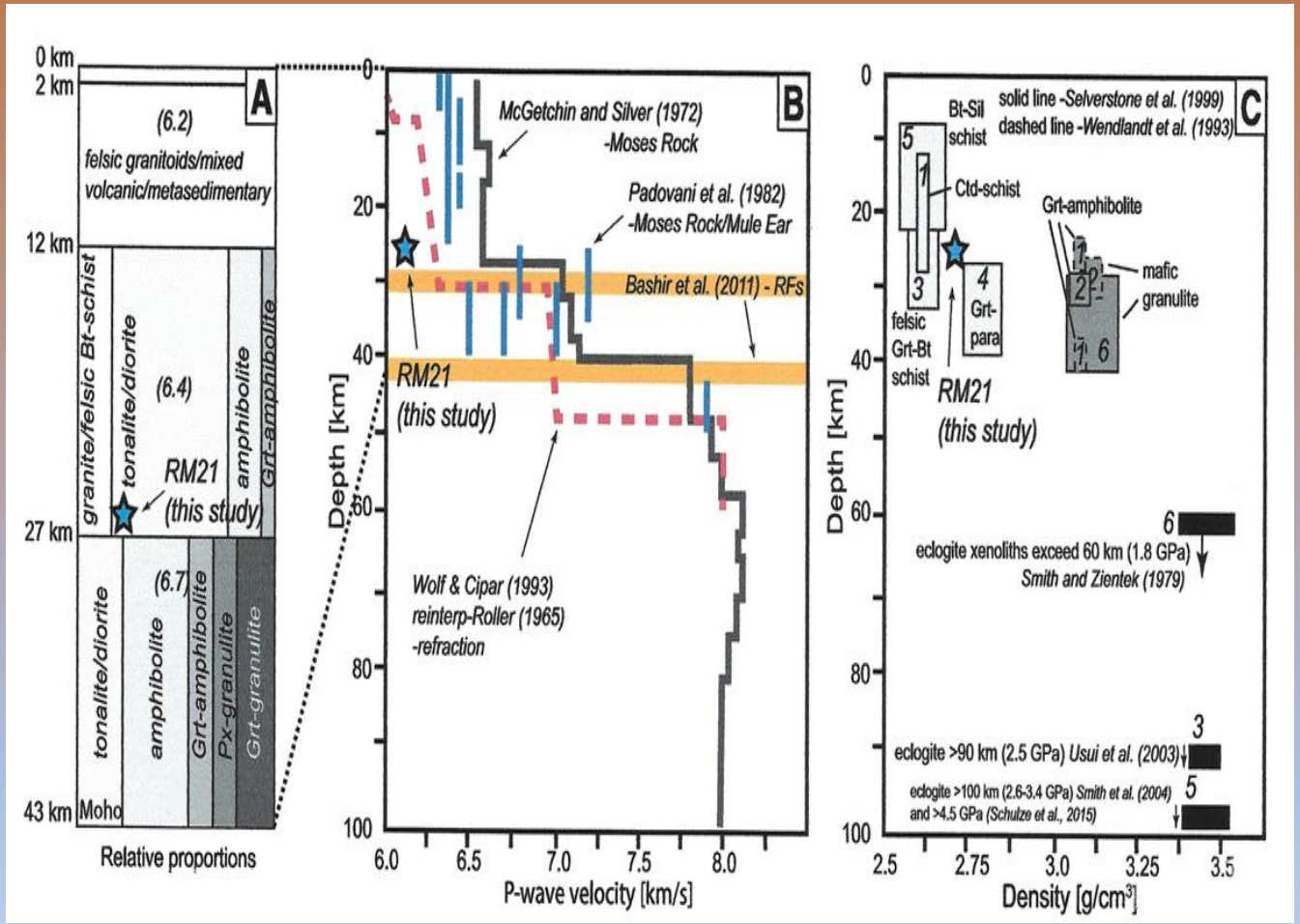


Colorado Rockies Experiment and Seismic Transects

- Tomographic imaging shows lower velocity mantle under the highest topography and surface wave velocity contours show low-velocity crust under highest topography. Low velocity pipes in the deep mantle suggest the influence of 410 km discontinuity diapirs.

- Anomalous heat flow started with foundering of Farallon Plate and Rio Grande Rift 30 mya.

Recent Studies Have Postulated Possible Mechanisms for Uplift



Crustal Hydration

- Crustal structure for the Colorado Plateau near the Four Corners from geophysics and xenolith compilations. Hydrated minerals in the sample are of lower density than normal.
- This study indicated that the hydration occurred in the Late Cretaceous at the onset of flat subduction.
- Another study concluded that the hydration occurred during the Laramide. The lower density of the crust would support an uplift of approximately 2 km.

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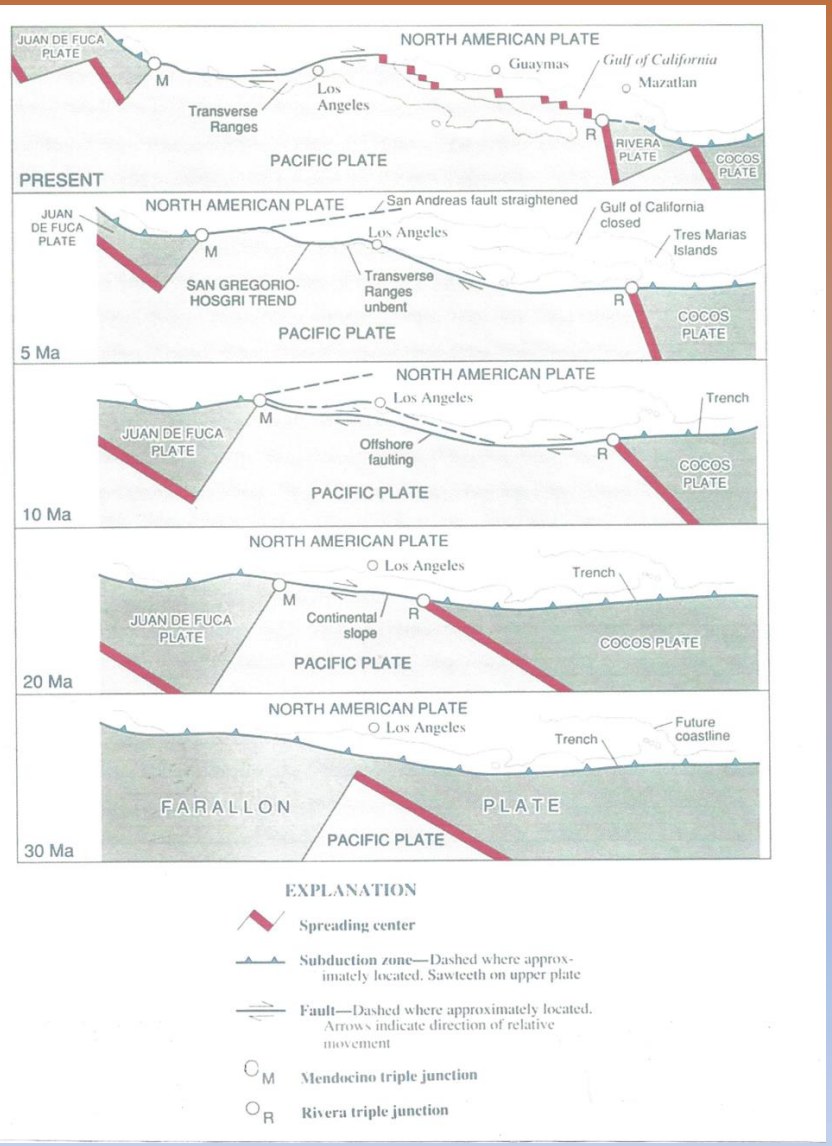
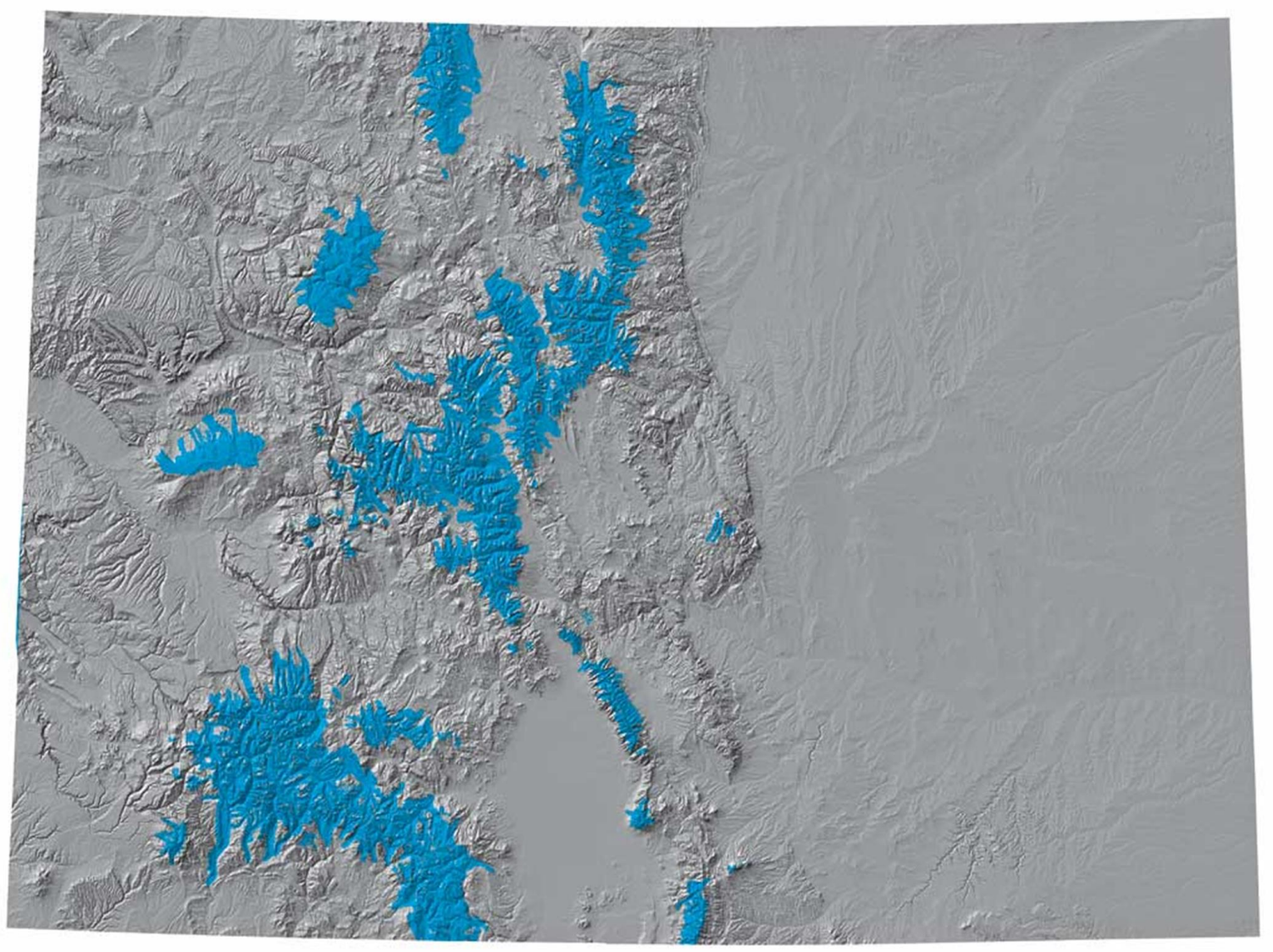


Changes in Plate Tectonics

- **At 30 mya the Pacific Plate spreading center impinged the North American Plate changing the tectonics from subduction and compression to strike –slip motion at 20 mya.**

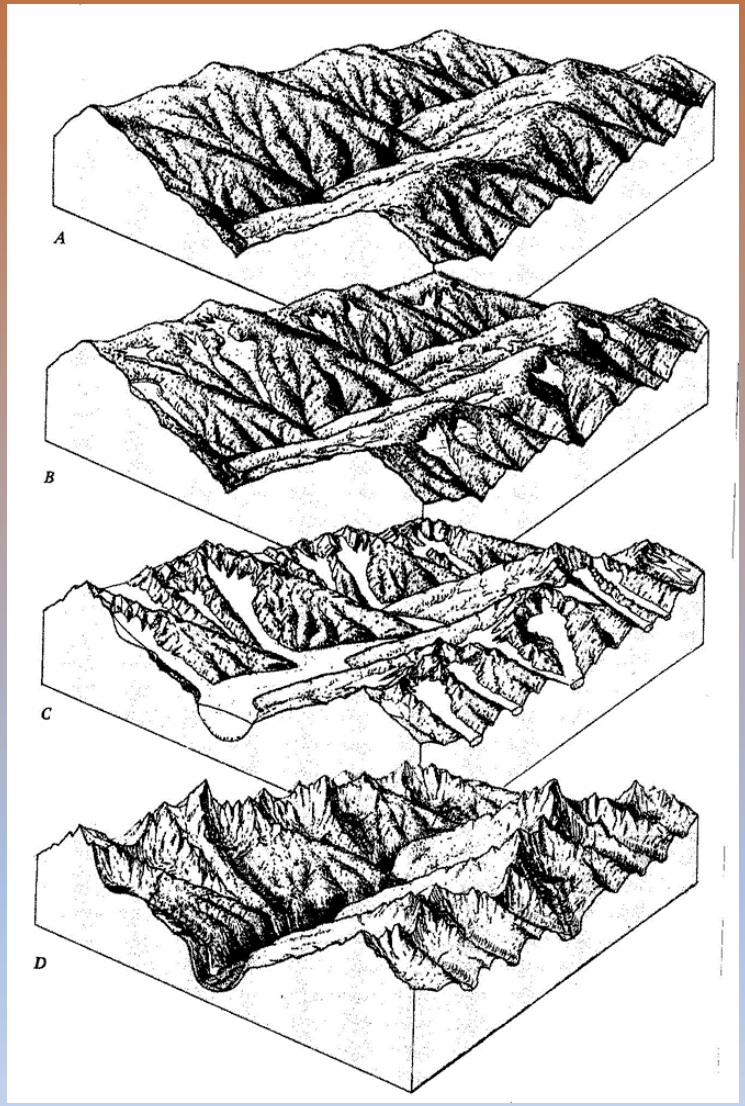
- **This change initiated extension in the Great Basin which accelerated at 10 mya.**

Pleistocene Alpine Glaciation in Colorado



- Global climatic cooling began about 2.6 mya and intensified about 900 kya resulting in glaciation
- The blue area on the map illustrate the area in Colorado that were glaciated during the Pleistocene.
- The map is courtesy of the Colorado Geological Survey.

Development of Glacial Landforms



A. Mountain Highland before Glaciation

B. Growth of Firn Banks and Small Glaciers

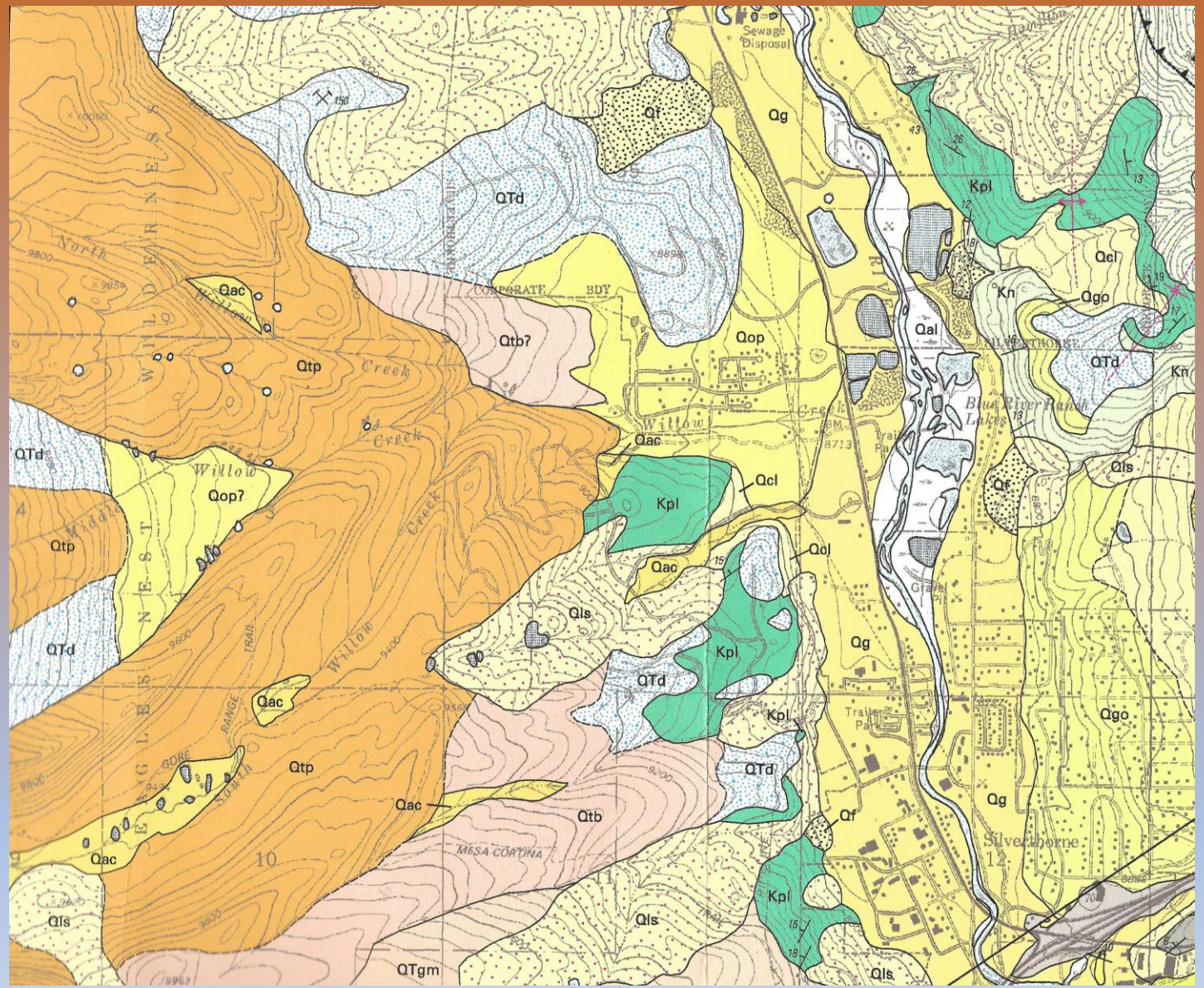
C. Development of a Network of Valley Glaciers

D. Area after Glaciation showing glaciated U-shaped Valleys, Hanging Valleys, Cirques and Aretes

Stop Two – Dillon Overlook

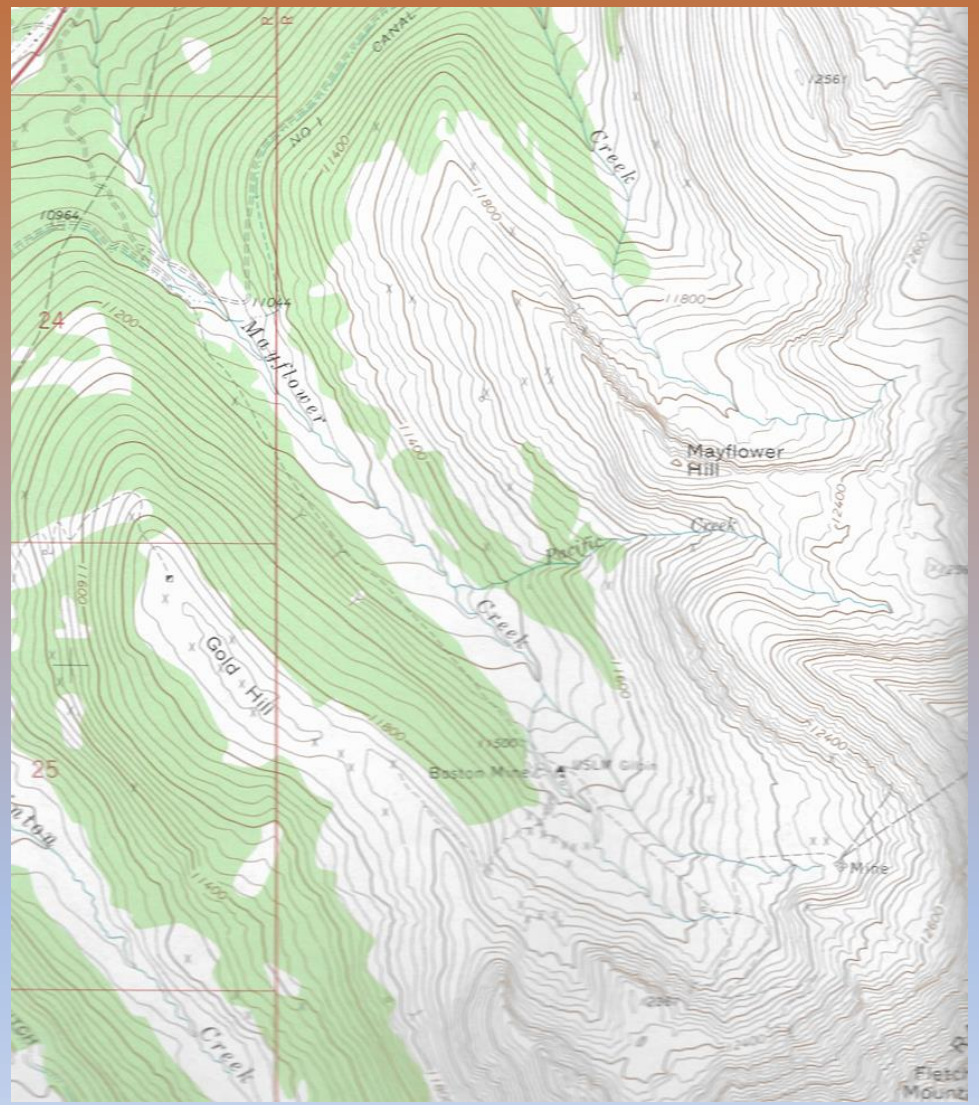
- Glaciated U-Shaped Valley between Buffalo Mountain and Red mountain,
- Glacial striations are present along the trail above South Willow Falls.

Stop Two – Dillon Overlook

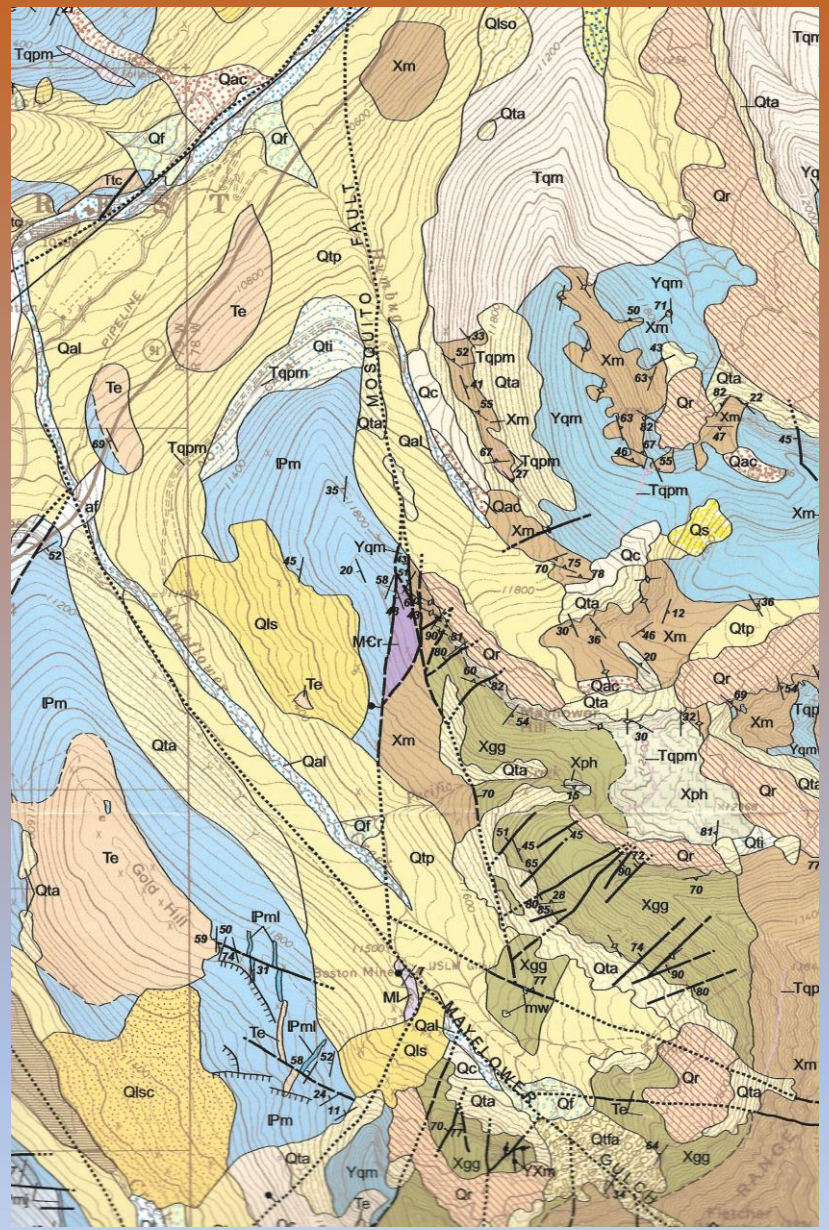


- Portion of the Geological Map of the Dillon Quadrangle.
- This map illustrates the two phases of alpine glaciation in the Rockies
  - Bull Lake glaciation 190-120 kya.
  - Pinedale glaciation 30-12 kya.
- There were 4 periods of continental glaciation in North America during the Pleistocene.
- One of the earlier glacial periods may represented by the Mesa Cortina gravels of late Pliocene/Early Pleistocene age. The Mesa Cortina gravels were mined for placer gold in the 1860s and 1870s.

Stop Three – Mayflower Gulch



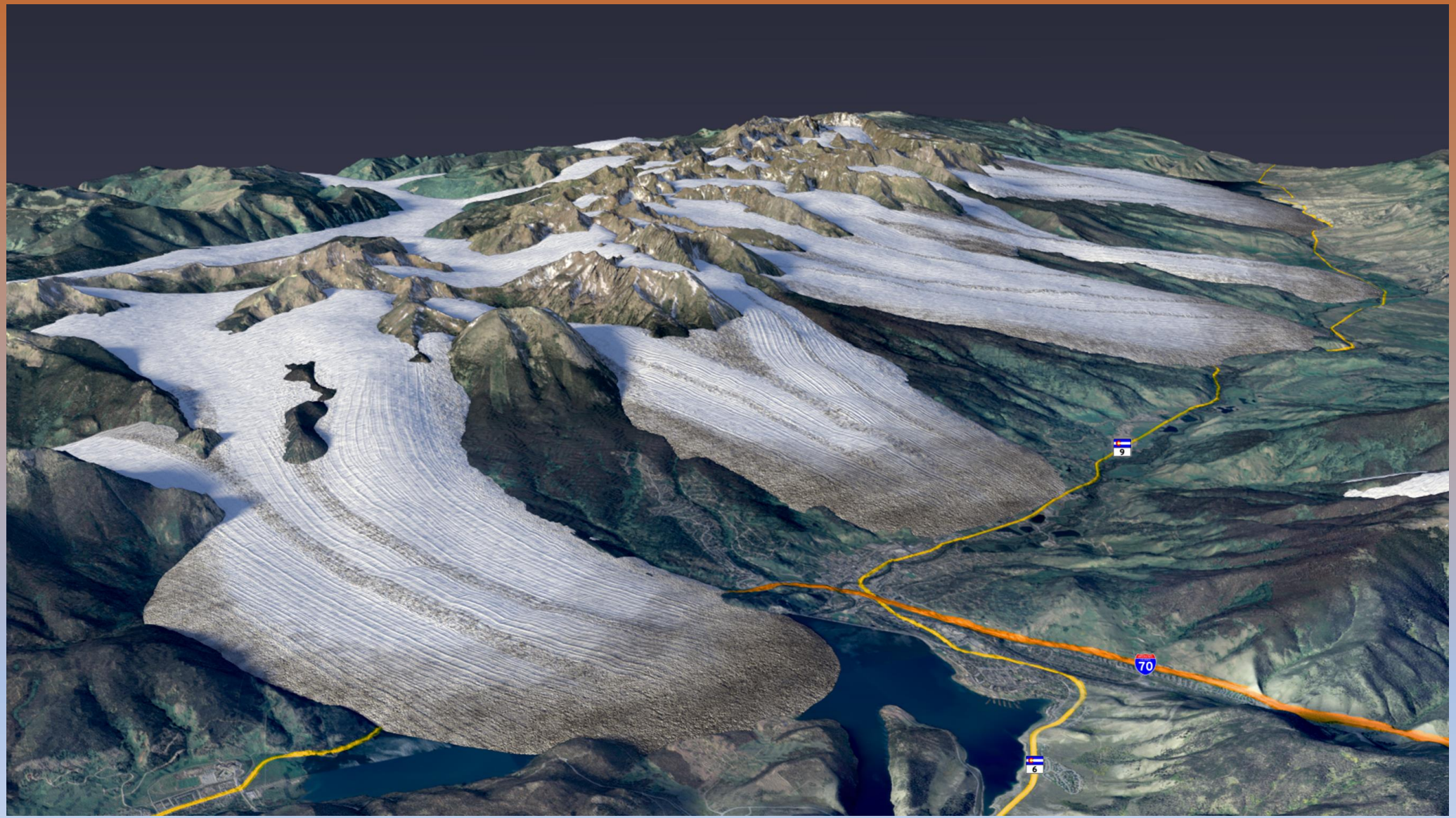
- **Topographic Expression of Glaciated Valley.**
- **Note the well-defined headwall of the cirque and the flat valley floor.**



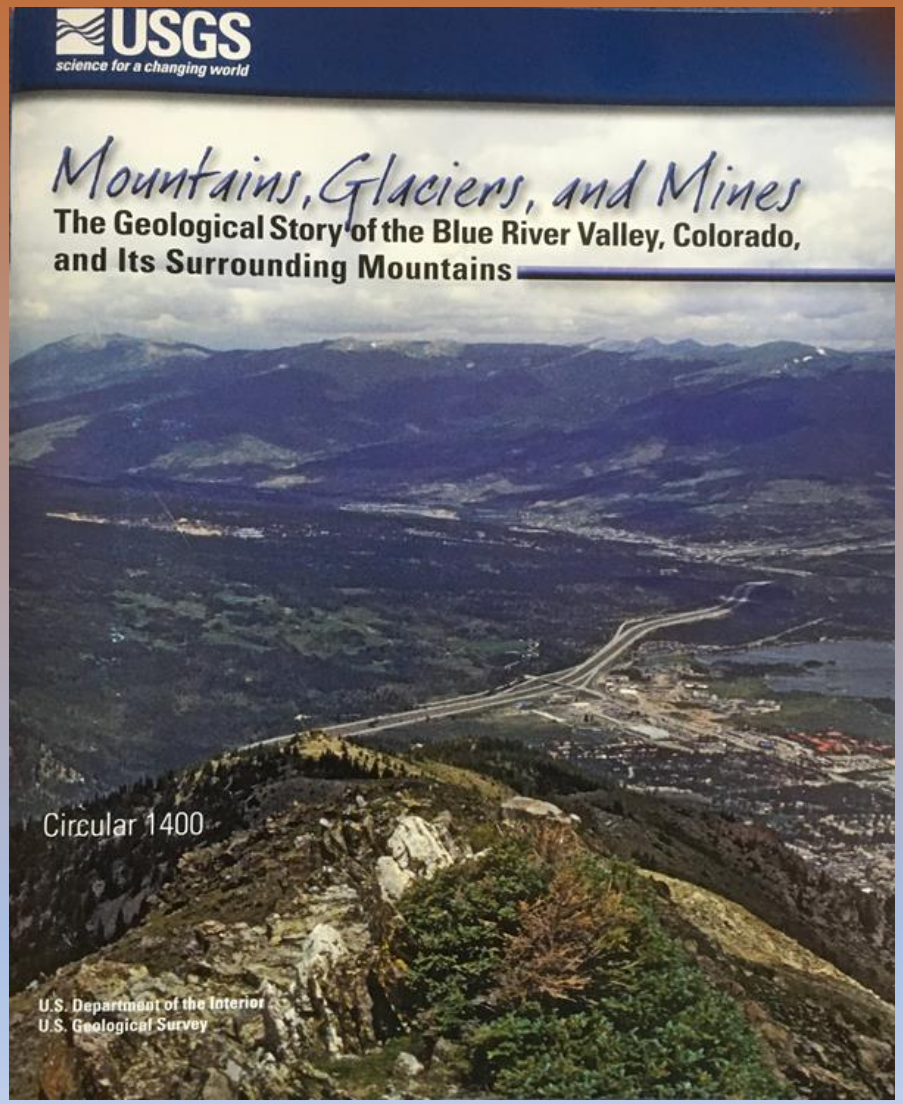
Stop Three – Mayflower Gulch

- Portion of Geological Map of the Copper Mountain Quadrangle
- On the map the Pinedale glacial tills occupy the valley floor and indicate that the glacier turned to the northeast as it exited Mayflower Gulch and traveled as far as Wheeler Flats at Copper Mountain.
- Younger Talus and landslide deposits cover the Pinedale till along the edges of the gulch.

Glaciation in the Gore Range



Further Reading



- **Circular 1400 published by USGS in 2016.**
- **Good general discussion of what has been covered in the three webinars.**
- **Can be downloaded from the USGS Website**
- **http://dx.doi.org/10.3133/cir1400**