UNIQUE ASPECTS OF UAV (5 storys)

#1- occupies one of 5 rift zones in the world that split the continental crust, and is the highest elevation, so only one with mountains above treeline (other rifts in East Africa; Baikal (Siberia); Rhine Rift (Switzerland-Germany); Taupō (New Zealand) are all lower).

#2- UAV rift basin was once (late Tertiary; 20 Ma to 5 Ma?) contiguous with SLV and Arkansas River flowed south through Poncha Pass. The gravels are still there, composed of rocks from the Collegiate Peaks. But the river was defeated by rise of Sangre de Cristo horst (Maysville-Salida fault system), and river forced east to Front Range.

#3-UAV is such a narrow rift, that Ice Age glaciers (past 2 Ma) from Sawatch Range flowed down and blocked Arkansas River multiple times, creating an ice-dammed lake upstream. At the end of each Ice Age the glacier tip started to melt and thin, then the dam was breached (floated). This caused rapid dam failure and the lake emptied in days. The outburst flood carried huge boulders downstream creating flood terraces, all the way down to Royal Gorge.

#4- the whitewater rafting industry exists because of these glacial outburst floods. WHY?

The oversized boulders from the outburst flood are much, much larger than a low-gradient stream like the Arkansas should have in its bed, which should be softball to bowling ball size. Those would not cause white water.

But the catastrophic outburst floods laid down car- to house-sized boulders, and the post-glacial currents have been too small to move them. The water is forced to flow around or over them, creating white water. The water is white (turbulent) but not that fast, giving the appearance of danger without the actual danger.

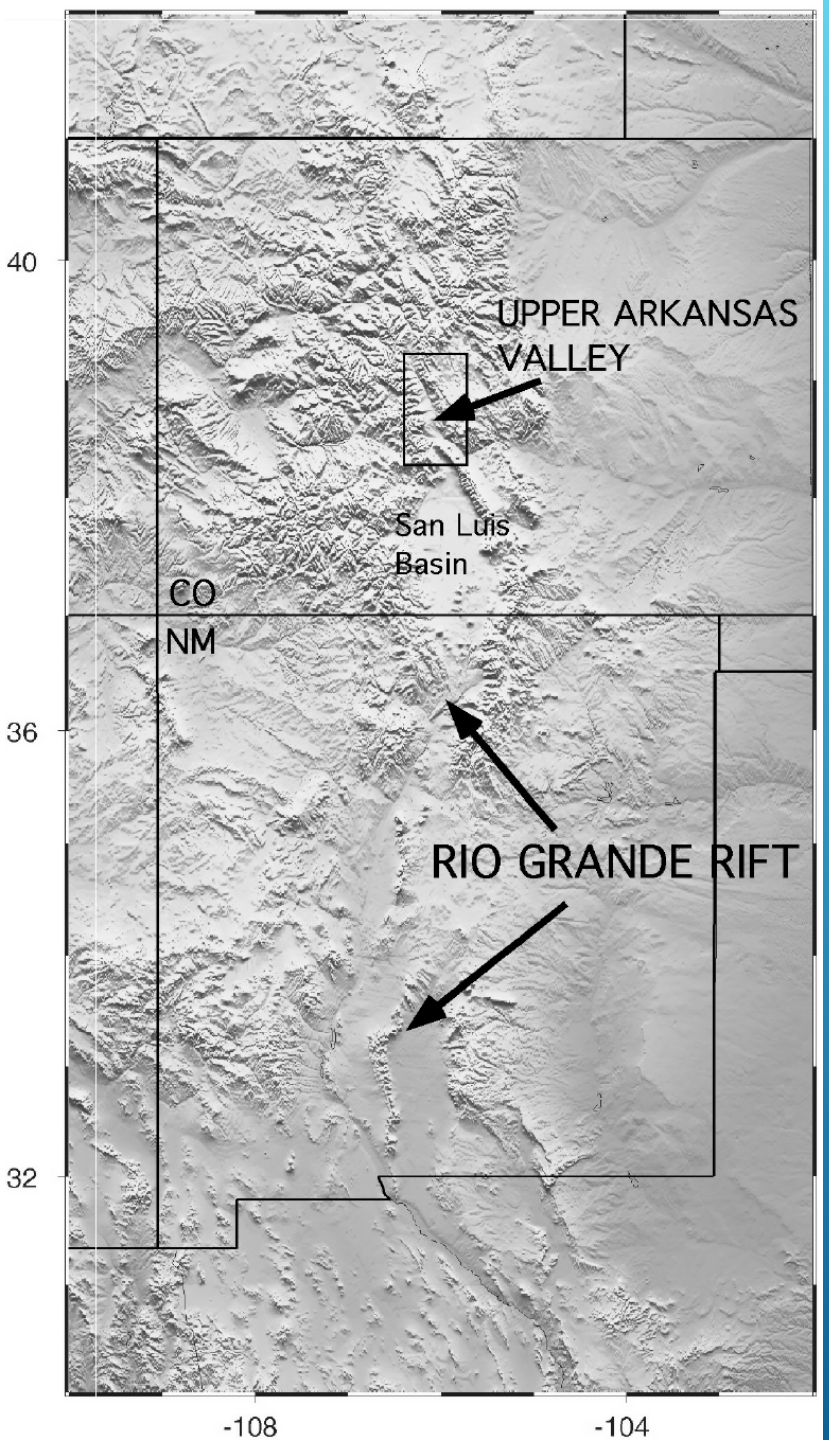
Elsewhere in Colorado, you only find car-sized boulders in the beds of steep headwaters streams high up in the mountains, with very rapid flow, resulting in Class 4 and 5 whitewater. That is expert terrain, not suitable for a family-oriented rafting industry.

#5- Mt. Princeton Geothermal Area may be the first in Colorado to generate geothermal electricity, with water/rock temperatures reaching up to 175º at depths of only 60-160 feet.

That's because Mt Princeton used to be a volcanic caldera (like present Yellowstone) back 35 to 25 Ma. Most if its eruptive rocks were removed by erosion, after creation of the Rift and uplift of the Sawatch Range, starting 20 Ma.

But key eruptive deposits are preserved along US 24 /285 from Buena Vista to Trout Creek Pass (Triad Ridge parallel highway to S); also in South Park.

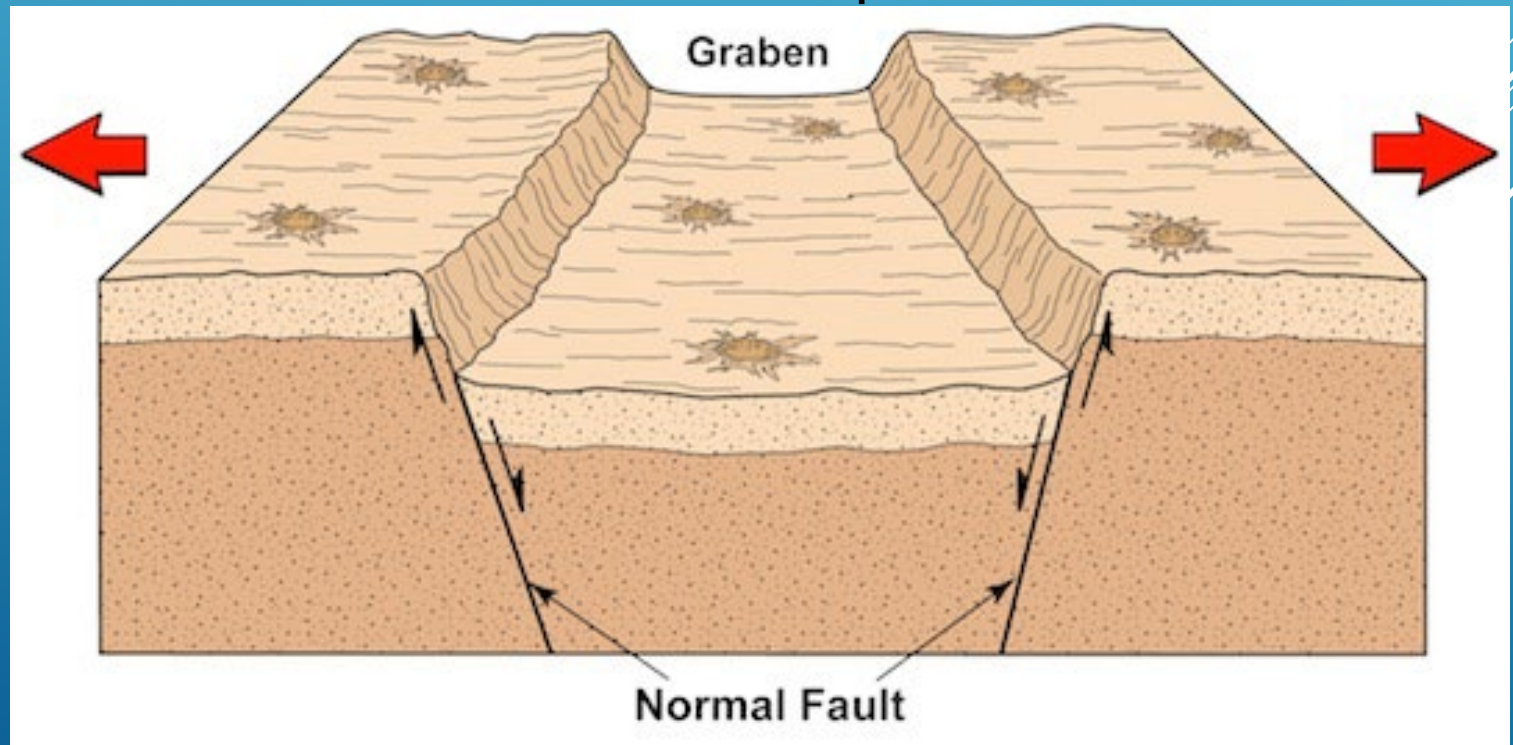
On the Collegiate Peaks, uplift and subsequent erosion have been so great since 20 Ma, that all the caldera's eruptive rocks are now gone, and surface rocks today are the congealed magma body (Mt. Princeton Batholith) that underlay and fed the volcanoes at 20 Ma. So we had our own Yellowstone once, and some of that heat still exists at the toe of Mt. Princeton…



#1- highest-elevation Rift Zone

-but how deep is the basement-rock bottom of the graben (i.e., the rocks exposed in the flanking mountains)? Or, how thick is the sediment washed into the graben during the past 20 Ma?

-In UAV ~5000 ft of sediments washed in. But in SLV, deep holes have >8,000 ft of seds. Therefore, without the seds the graben bottom is below sea level, and could be part of Gulf of Mexico…… Or a mile-deep lake like Lake Baikal….

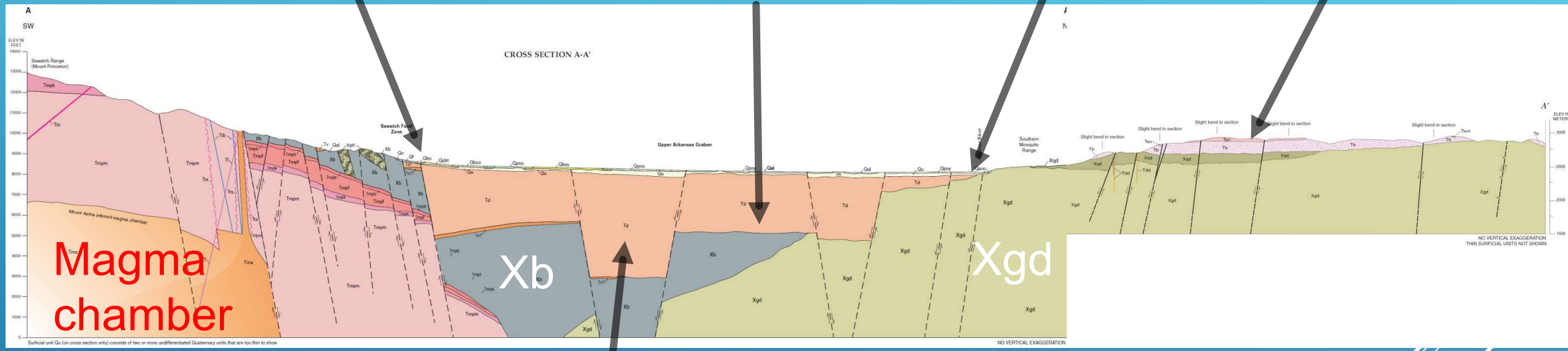


Sawatch fault

Small horst

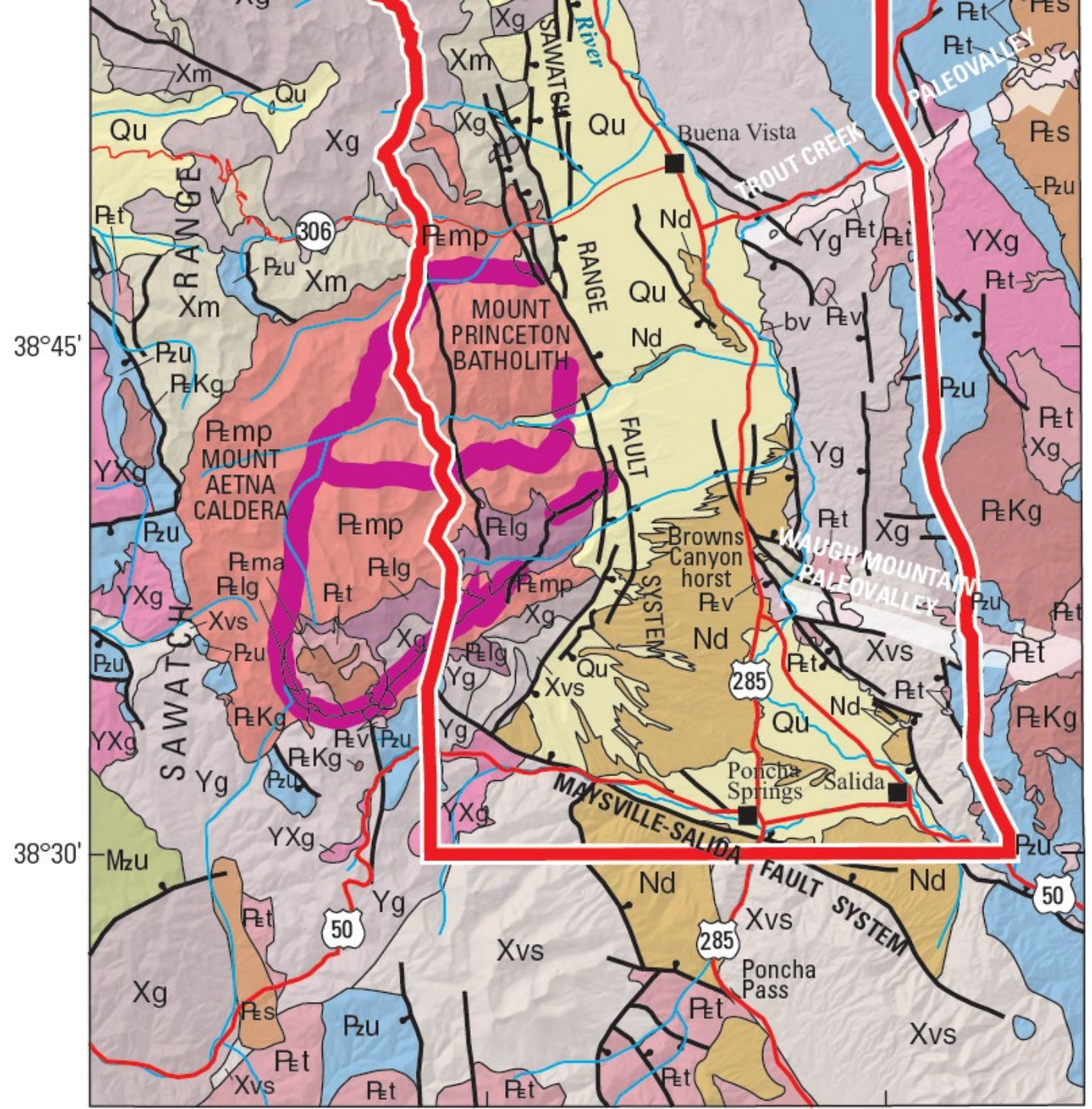
Ark River

Triad Ridge welded tuffs



Deepest part of graben
Ancestral Ark River gravels
(big aquifer)

Published cross-sections of the Buena Vista W quad (left) and Buena Vista East quad (right)



#2- UAV rift basin was once (late Tertiary; 20 Ma to 0.5 Ma?) contiguous with SLV

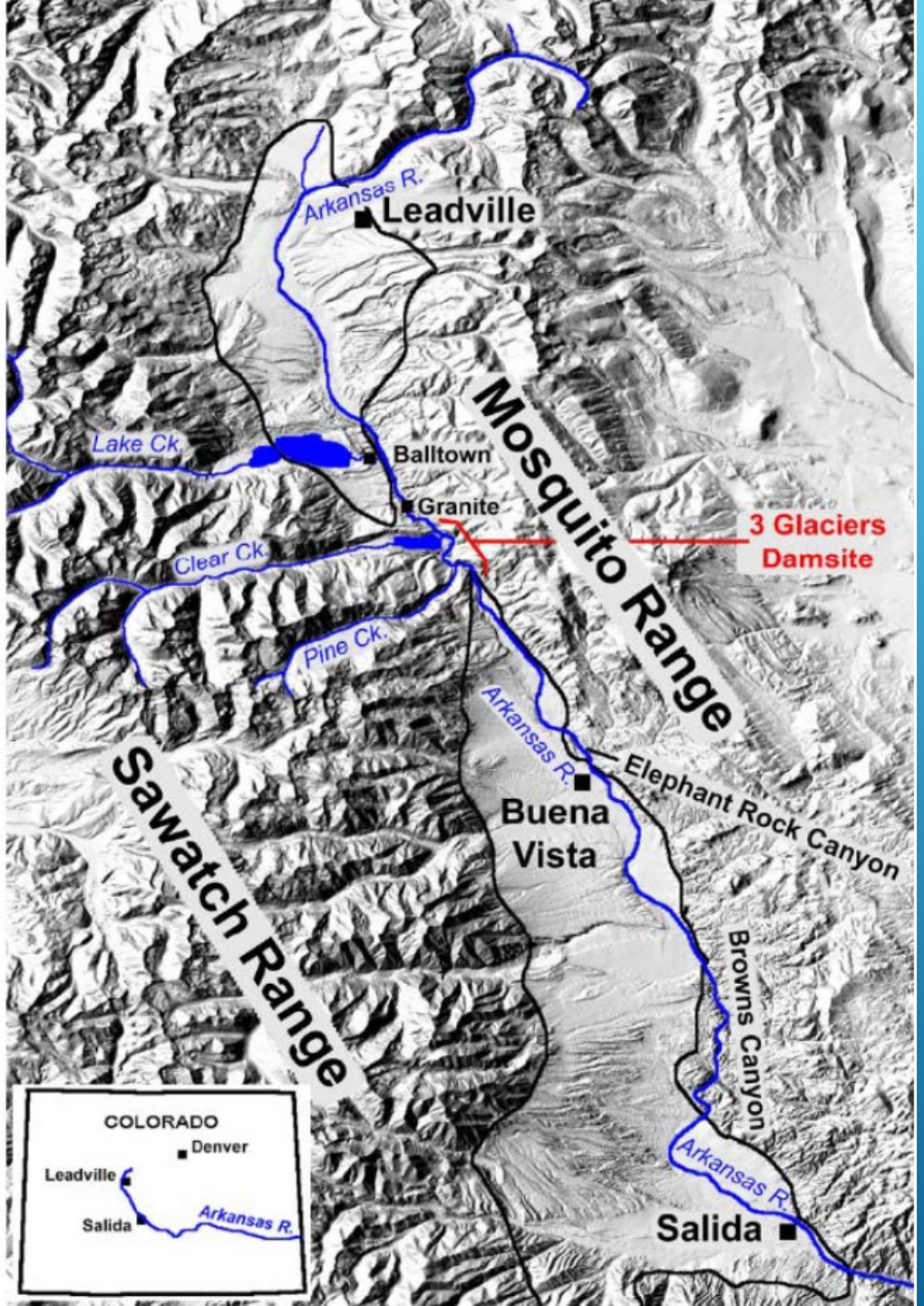
- Perched atop Poncha Pass are thick, ancient gravels (Nd) from a south-flowing stream
- Because the gravels are pieces of the Mt. Princeton batholith, we know it came from the N (ancient Arkansas River)
- But the rise of the Sangre de Cristo Range along the Maysville-Salida FZ defeated the stream (probably created a lake for awhile)
- Then a stream east of Salida eroded headward and captured the lake, which turned the Arlansas R to the E, where it cut the present canyon

#3-Ice Age glaciers flowed down and blocked Arkansas River multiple times

-ice dams created lakes upstream

At end of each glacial episode, the ice dam collapsed and lake emptied

-resulting flood swept house-sized boulders down to Royal Gorge

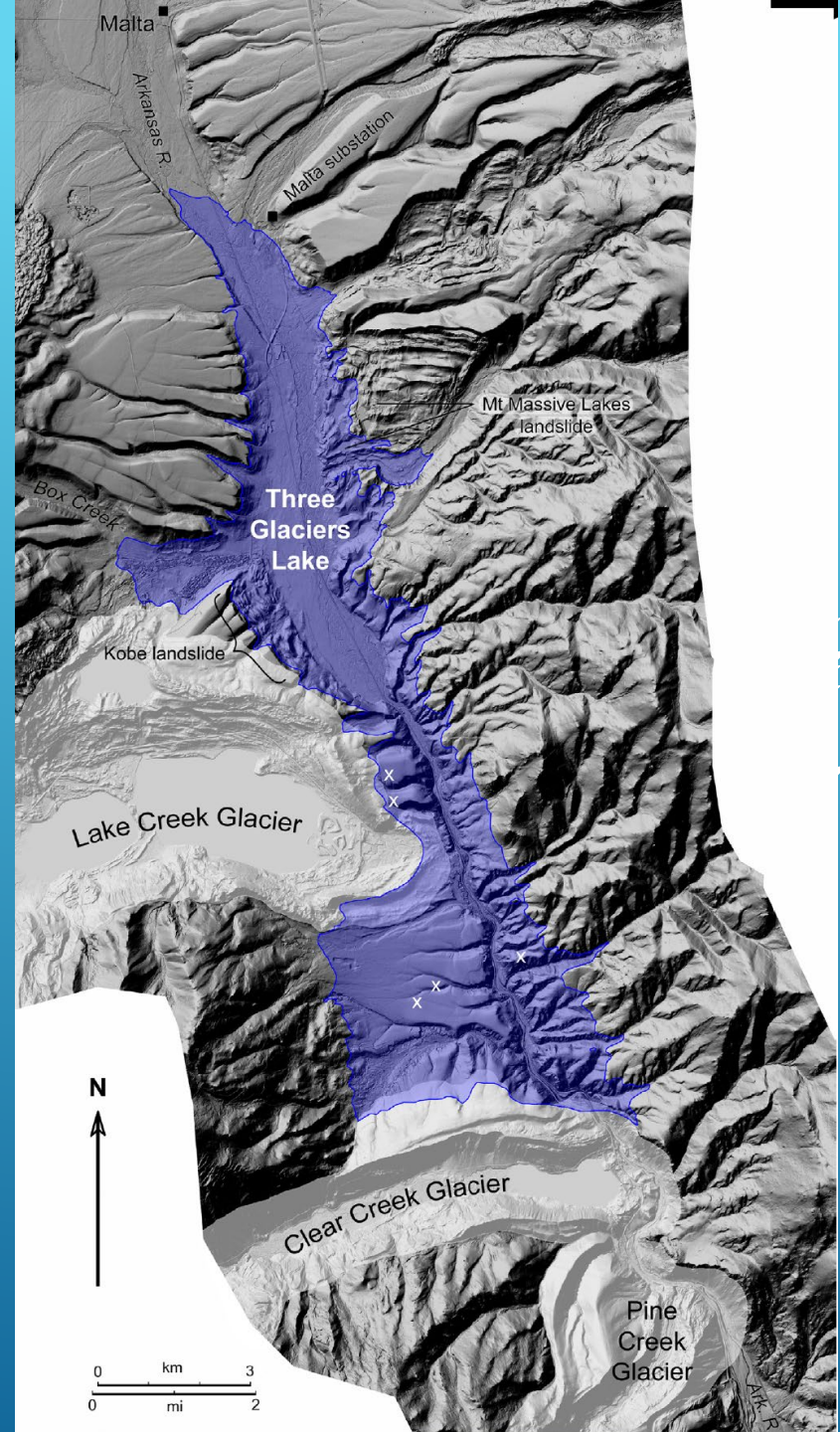


THE DAM AND LAKE

1-Ark River temporarily dammed by glacier snout; formed Three Glaciers Lake (right).

2-Lake existence inferred by Glenn Scott, USGS, in 1960s, from flood boulders

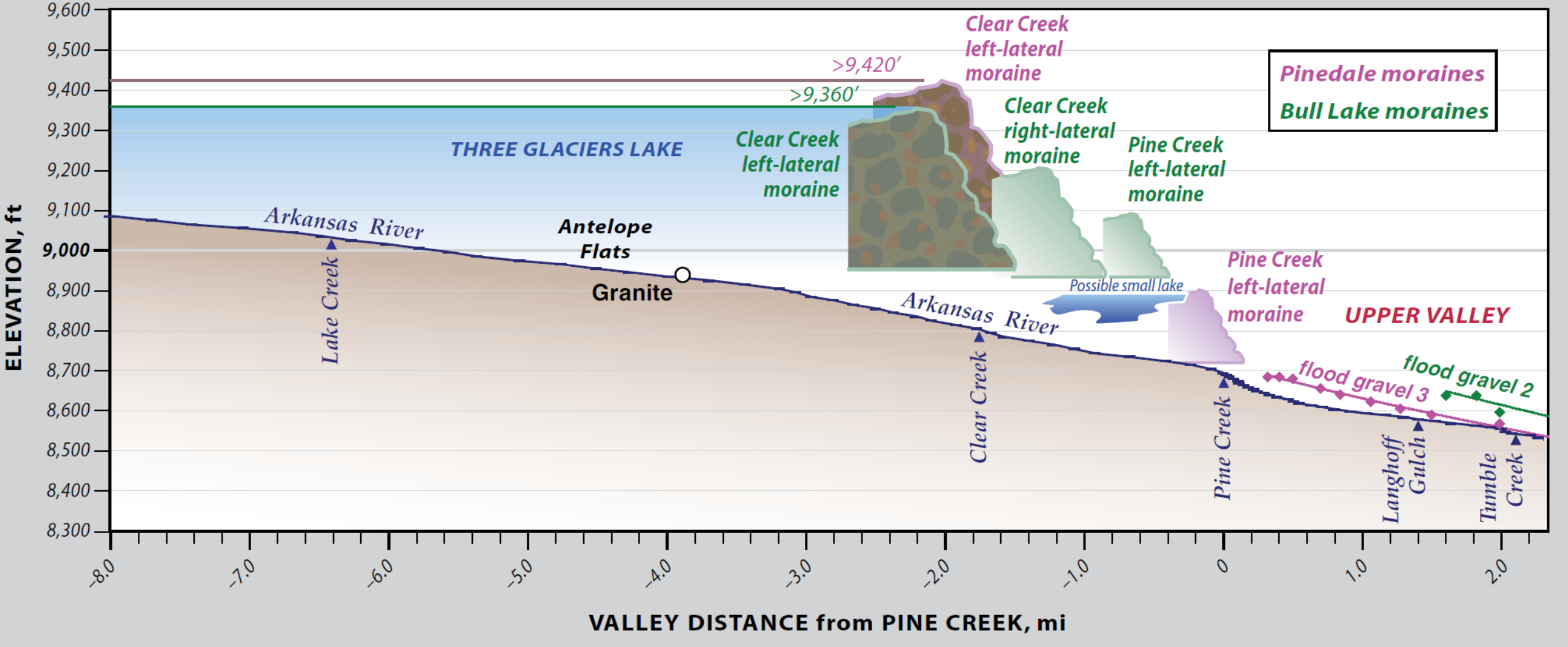
3-Lake elevation inferred by Keenan Lee, CSM, in 2006 but he couldn't find shorelines or other lake evidence



THE DAM

1-In youngest Ice Age (Pinedale, 35 ka to 15 ka), Clear Creek lateral moraines were highest and probably formed dam (9360-9420 ft)

2-Searching these elevations up the River from Twin lakes, found shoreline landforms and lake deposits in 2008 (CGS Leadville South quad).



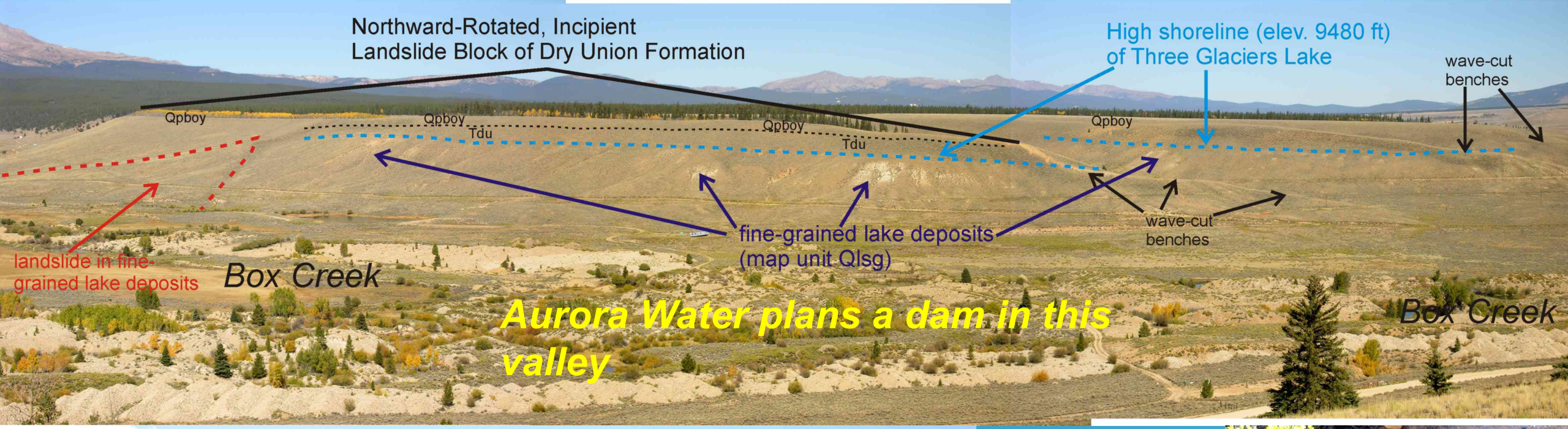
THE DAM AND LAKE

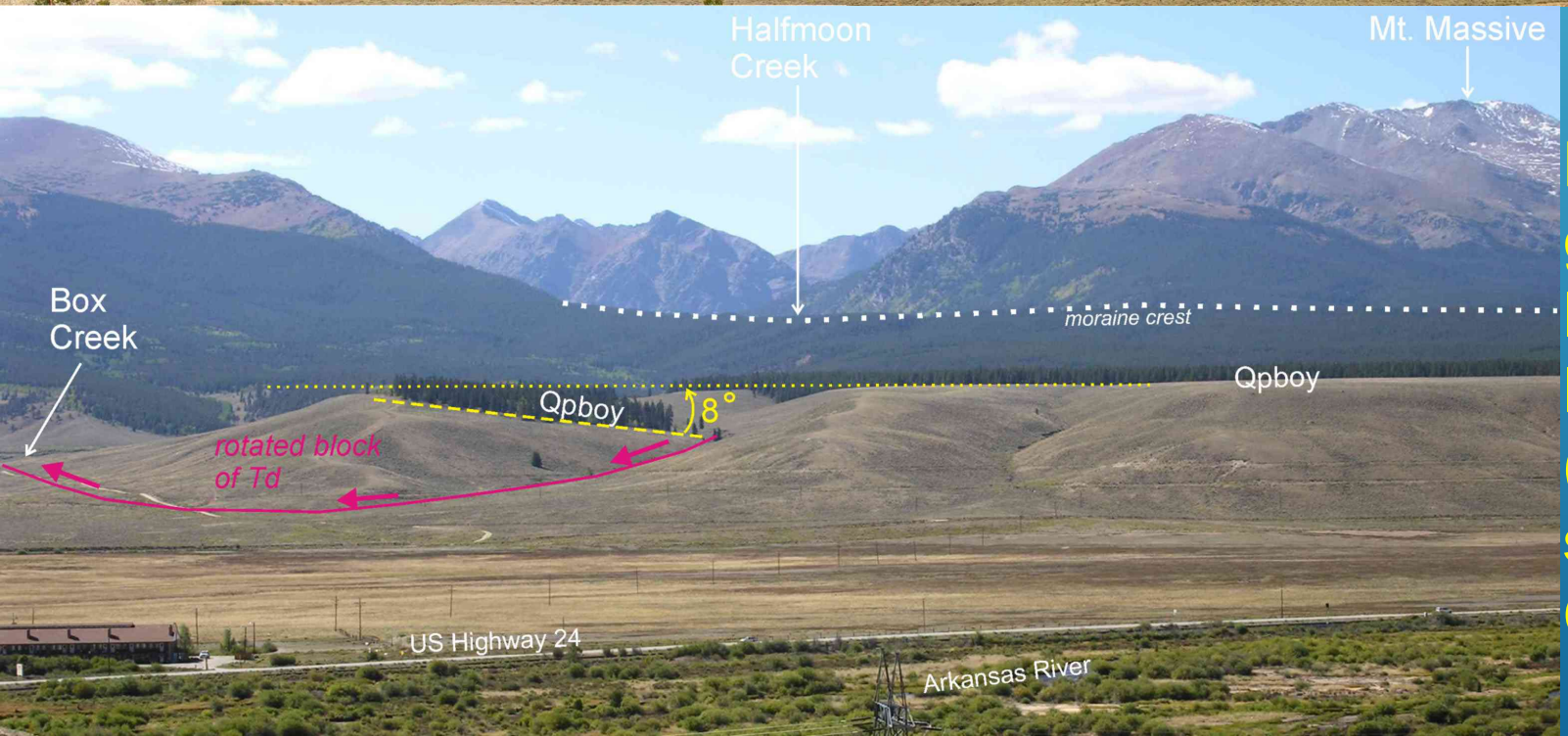
1-More evidence of rapid lake draining; the Kobe Landslide (middle ground)

2-is a peculiar slide type, wider than long, sliding on a very gentle slope

3-only found historically where dams have collapsed and reservoirs drained

4-called “rapid drawdown landslides” by geologists





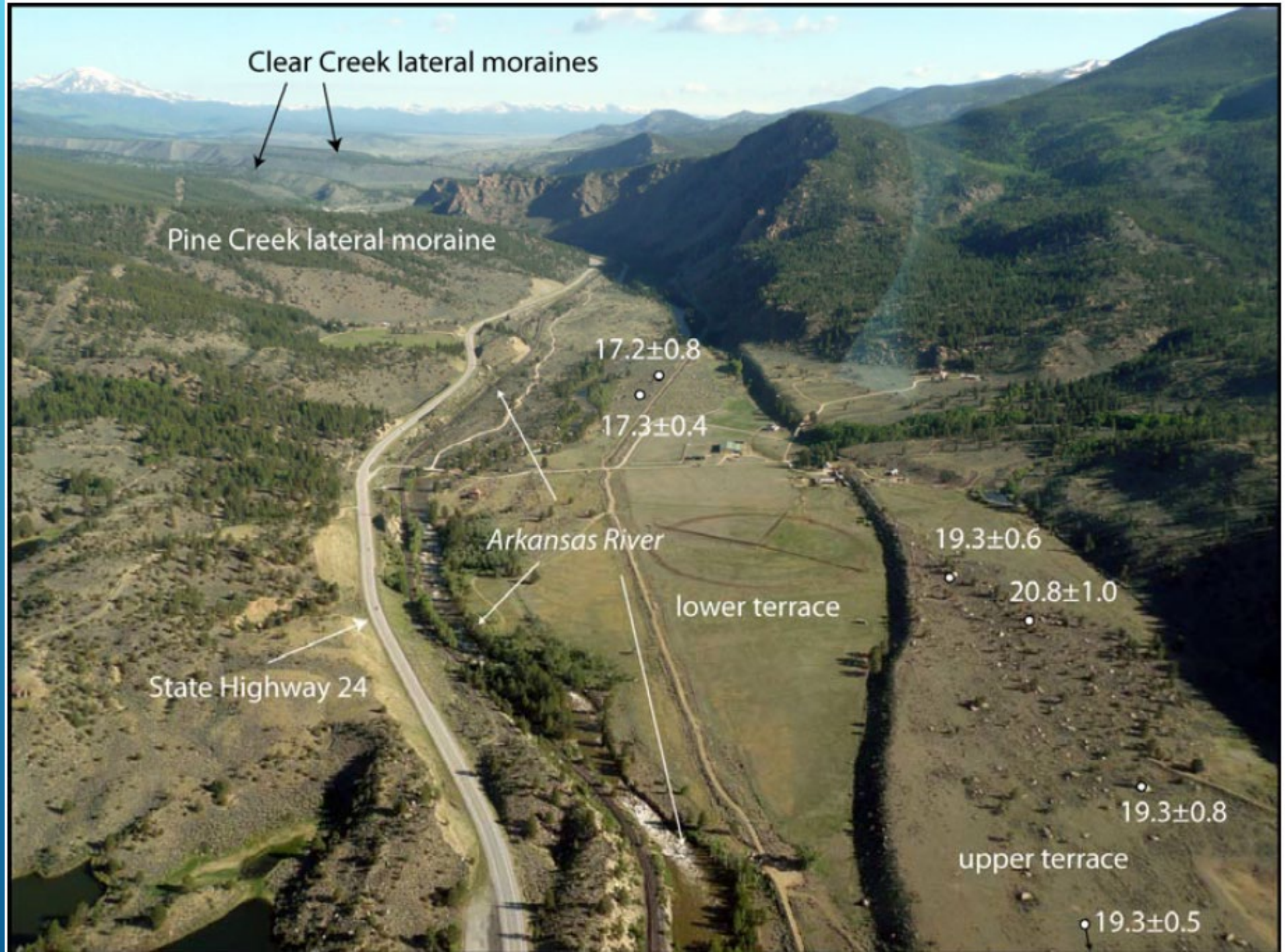
Fine-grained, laminated lake beds (right) on N side of Box Creek valley

For some reason, all the large rural subdivisions in the UAV north of Twin Lakes are on landslides (Mt. Massive Lakes, Empire Gulch)

View of Mt. Massive Lakes landslide, looking south from the headscarp. Notice how far the landslide material slid out from the scarp, on a very flay slope. Like most landslides, the surface is composed of chaotic hummocks and closed depressions. The developer diverted water from a nearly creek and filled the closed depressions with water, creating a scenic chain of real-estate lakes. But adding water to landslides is usually considered a big NO-NO in engineering…

Helicopter photo of flood boulder terraces just downstream of the Pine Creek lateral moraine. View to north up the River.

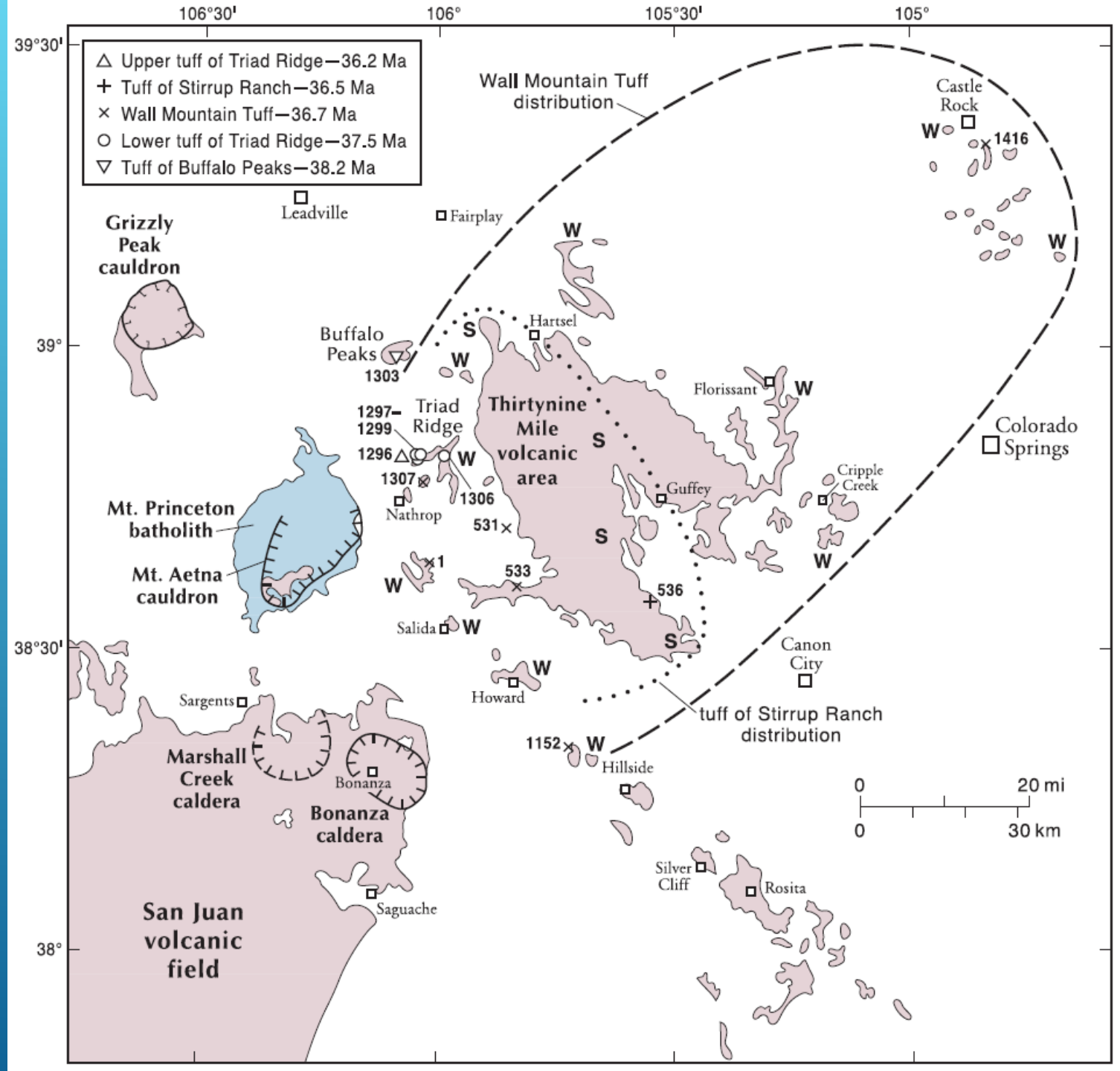
USGS dated the higher flood terrace at 19-20 ka, and the lower terrace at 17 ka. Two outburst floods in the same glacial episode!



#5- Mt. Princeton Geothermal Area may be the first in Colorado to generate electricity

THE BACKSTORY: Before the Rift the UAV was a Yellowstone (explosive calderas). Related to the San Juan calderas. The extrusive volcanics (welded ash-flow ruffs) can still be found in the 39-mile Volcanic Area of South Park.

The best evidence for the Mt. Princeton being the source of the volcanics is the preserved Tuff of Triad Ridge



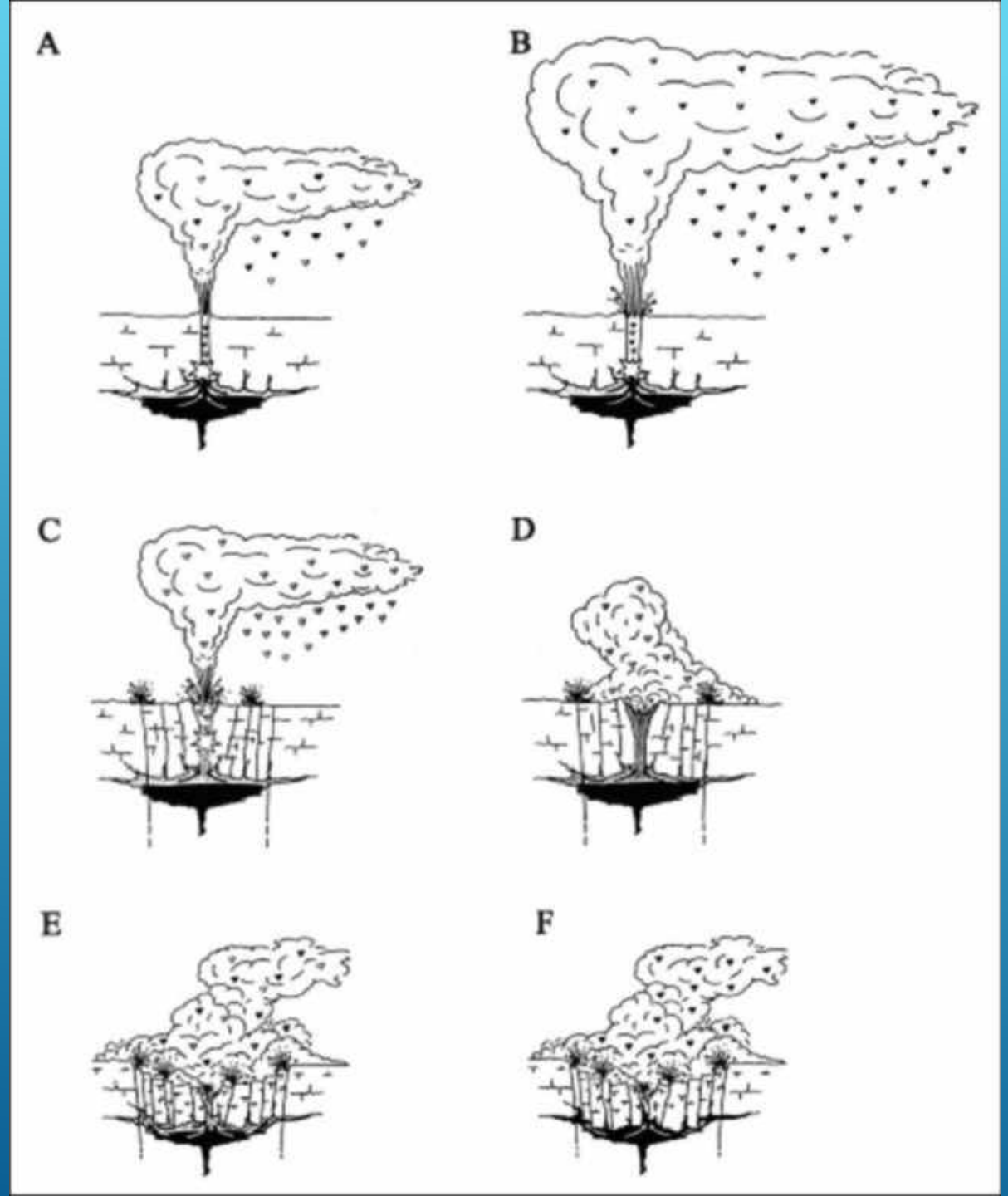
Triad Ridge (far left) is composed of volcanic rocks (tuffs) erupted from the Mt. Princeton caldera about 36 Ma (16 Ma before the Rift began forming). Tuffs were deposited in a broad, pre-existing paleovalley eroded into Precambrian granites (below the dashed yellow line). When paleovalleys are filled with volcanic rocks harder than surrounding rocks, later erosion cuts deeper around the volcanics than into them. This is called a topographic inversion

A more famous topographic inversion in Colorado is Grand Mesa, west of Grand Junction. The top of Grand Mesa is a 10 Ma basalt, which was erupted upstream and flowed down the ancestral valley of the Colorado River. Over the past 10 Ma the softer surrounding rocks (mainly shales) have been eroded down much faster than the resistant basalt. Today the topography is inverted; what used to be a valley is now a mesa.

A) Plinian phase: contemporaneous tapping of the two magmas;

C) Plinian phase: enlargement of the conduit, rising of the fragmentation level, and tapping of the shallower magma alone;

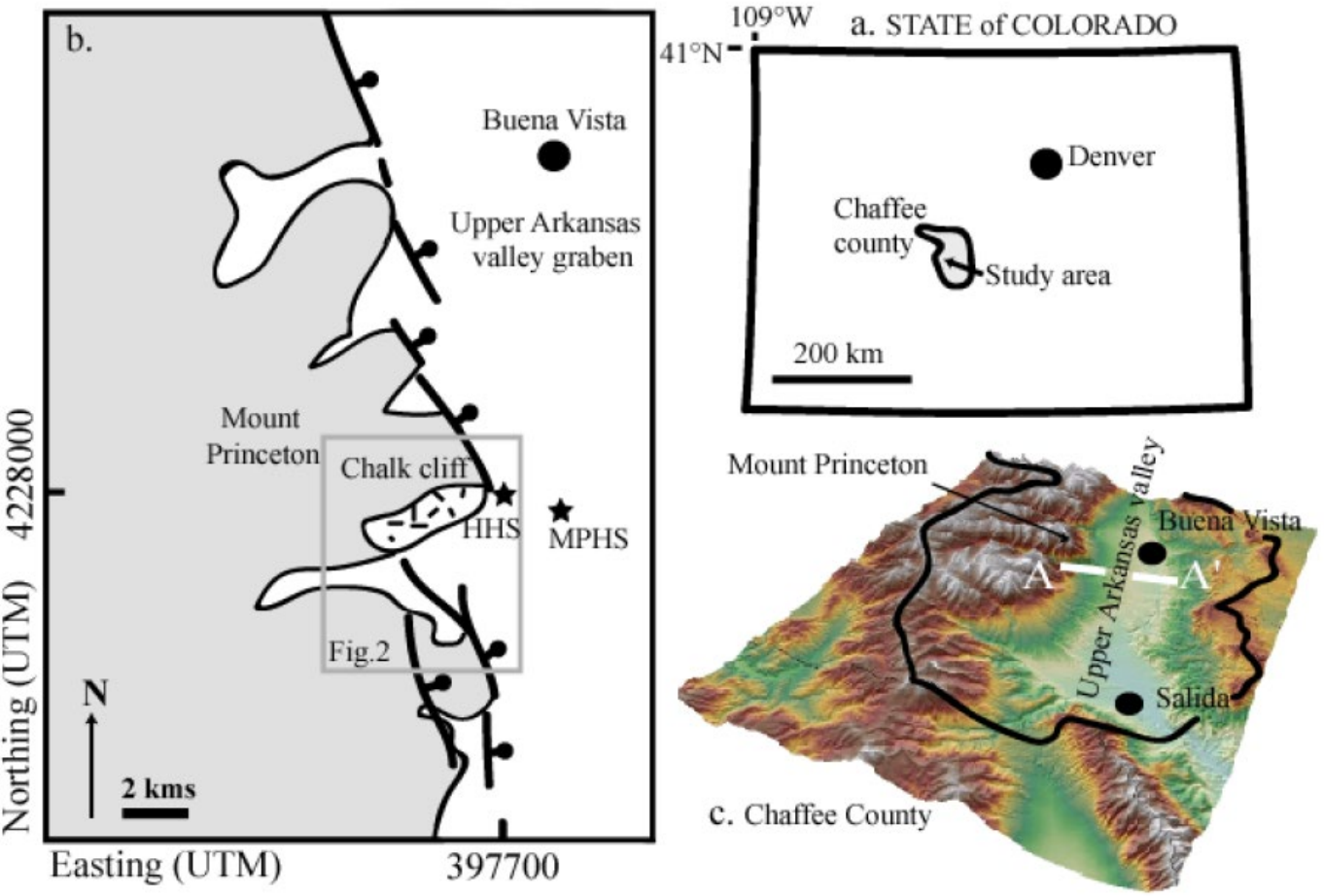
E) Main caldera collapse phase: reaching of the maximum mass discharge rate, mingling and simultaneous tapping of both magma layers



B) Plinian phase: increase of eruption column

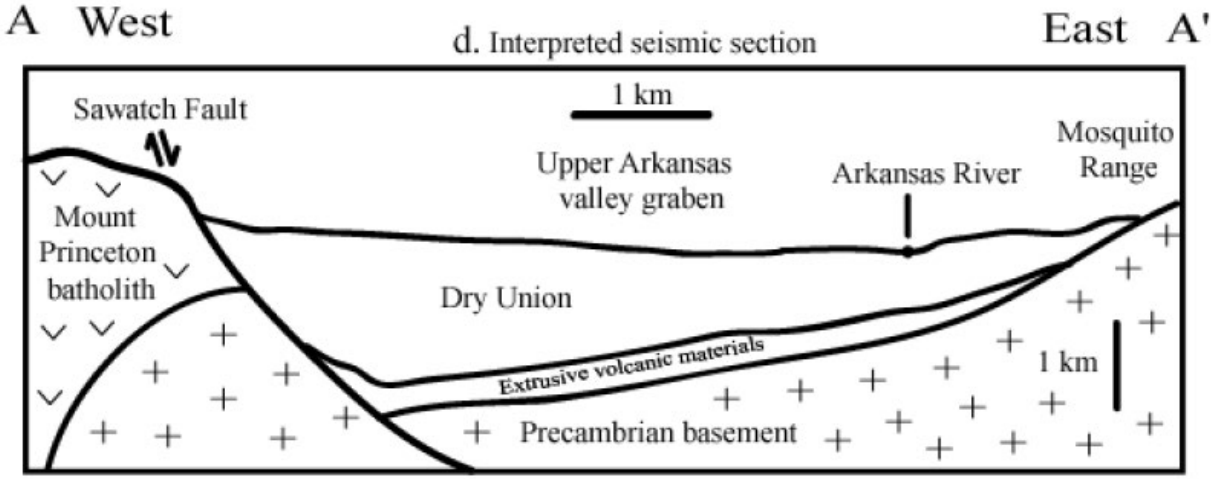
D) Eruption column collapse and multi-vent eruption phase: tapping of the shallower magma alone, and beginning of caldera collapse; IGNIMBRITES!!

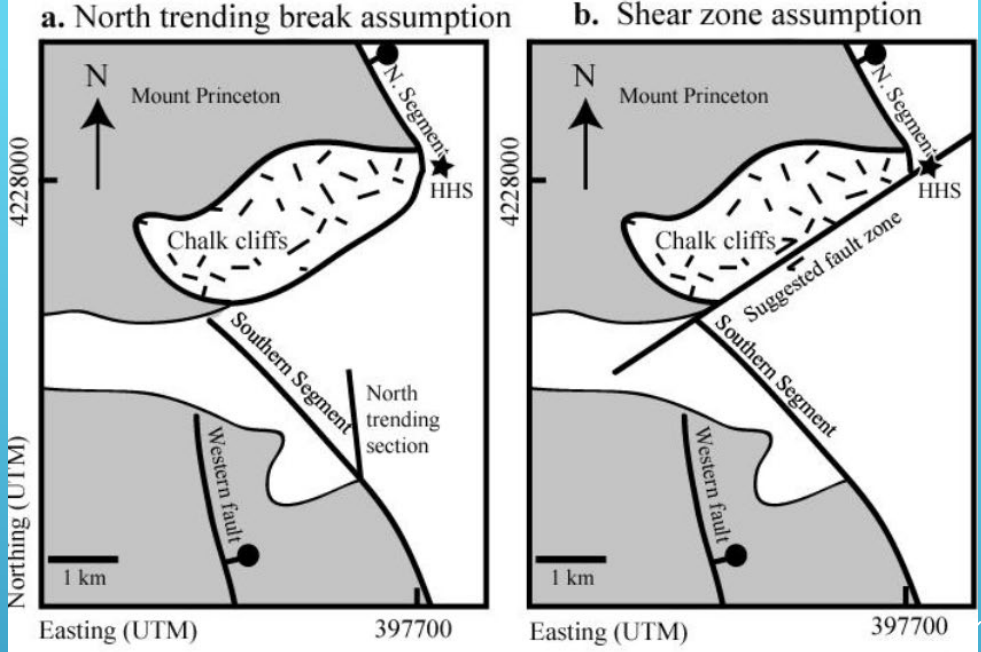
F) Fading of the eruption: tapping of the deeper magma alone.

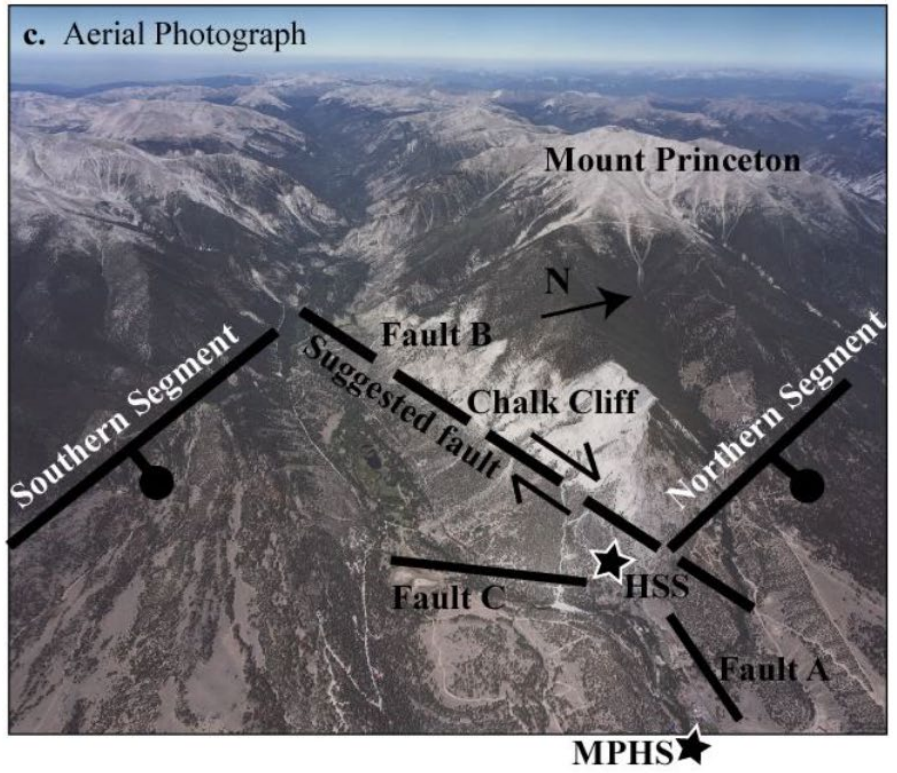

b.
Buena Vista
Upper Arkansas
valley graben
Mount
Princeton
Chalk cliff
HHS
MPHS
Fig.2
N
2 kms
Northing (UTM) 4228000
Easting (UTM)
397700

109°W
41°N
a. STATE of COLORADO
Denver
Chaffee
county
Study area
200 km

Mount Princeton
Buena Vista
A
A'
Upper Arkansas valley
Salida
c. Chaffee County


A West
East A'
d. Interpreted seismic section
1 km
Sawatch Fault
Upper Arkansas
valley graben
Arkansas River
Mosquito
Range
Mount
Princeton
batholith
Dry Union
Extrusive volcanic materials
1 km
Precambrian basement

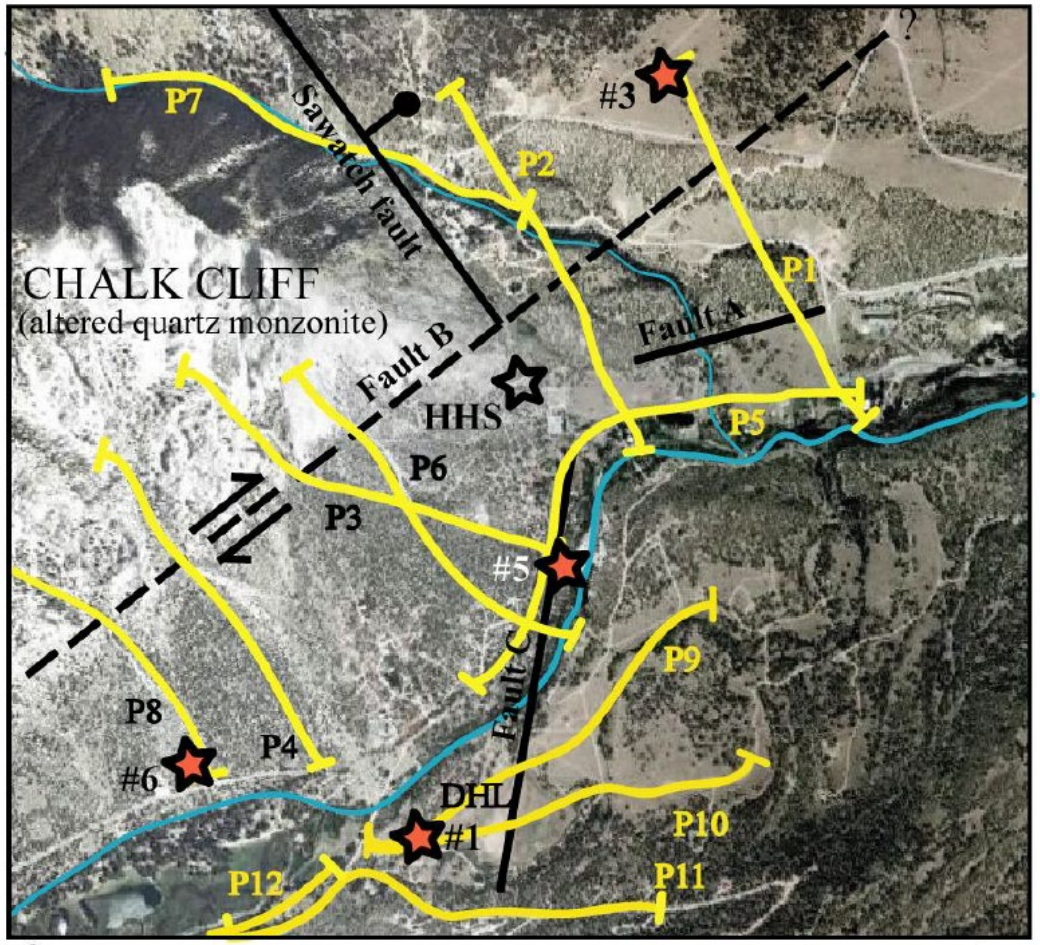

a. North trending break assumption
b. Shear zone assumption
N
Mount Princeton
N. Segment
HHS
Chalk cliffs
Suggested fault zone
Southern Segment
North
trending
section
Western fault
1 km
Northing (UTM) 4228000
Easting (UTM)
397700


c. Aerial Photograph
Mount Princeton
N
Fault B
Suggested fault
Chalk Cliff
Southern Segment
Northern Segment
Fault C
HSS
Fault A
MPHS

Mt. Princeton Hot Springs
Colorado's only candidate
for hi-temp geothermal
(steam to electricity)

20C=68F
40C=104F
60C=140F
80C=176F

Position of the resistivity profiles and geothermal wells



Temperature map (in °C) at 20-50 m