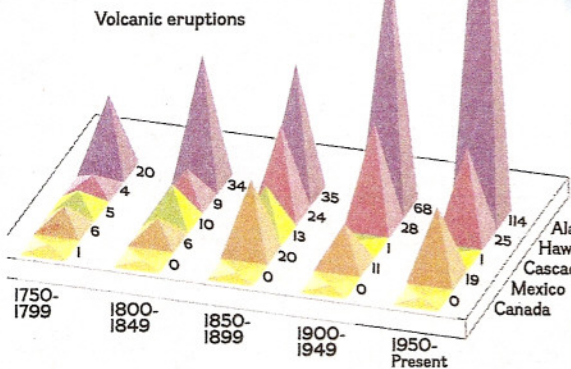


Frequent eruptions of fluid lava from Mauna Loa and Kilauea—two of Earth's most active volcanoes—threaten large areas of Hawaii's Big Island.

Stratospheric ash clouds carried by the jet stream can seriously threaten air travel, particularly in the commercially busy and volcanically active northwestern corridors that pass near Alaska.



Based on 250 years of historic records, the region has experienced 454 volcanic eruptions—391 of those in what is now the U.S. The apparent rise of occurrences in Alaska is due to better reporting. Though quieter in the 20th century than in the 19th, the Cascades could come to life any time.

VOLCANOES: DANGEROUS NEIGHBORS

Two thousand years. It's a blink in geologic time but hardly factors when planning where to build a home or plant a field. Perhaps it's time to reconsider. In Canada, Mexico, and the U.S., 91 volcanoes have been active within the past 2,000 years—74 in the U.S. alone, ranking it third in the world as a volcanic hot spot. Most occur above subduction zones, where ocean plates dive beneath the continent, creating chaos underground. Of particular concern: Mexico's Popocatepetl, which

became active in 1994, threatens the 22 million people who live within 60 miles. In the Cascades, Mount Rainier looms steep, icy, and subject to debris flows that could reach Puget Sound. Geologists monitor young calderas such as Wyoming's Yellowstone and California's Long Valley, which have recently been showing seismic activity. Tougher to monitor but still hazardous are areas called monogenetic fields, where destructive cones like Mexico's Parícutín can rise suddenly.



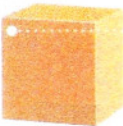
Tick Tock



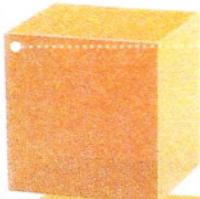
Mount St. Helens, 1980 / 0.24 cubic mile



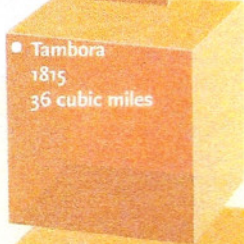
Mount Pinatubo, 1991 / 2.4 cubic miles



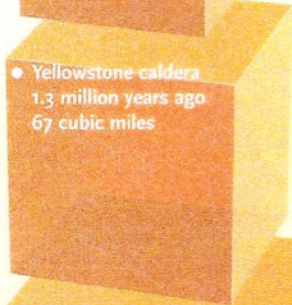
Krakatoa, 1883 / 4.3 cubic miles



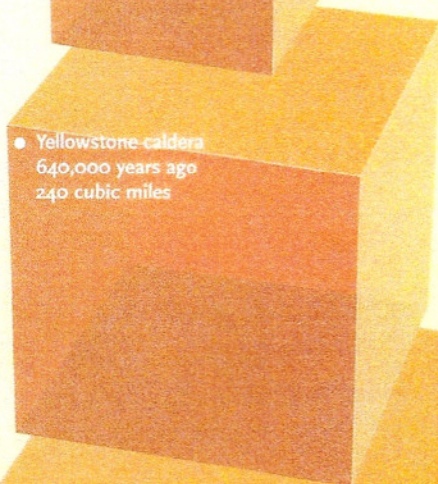
Mount Mazama (Crater Lake, Oregon)
~7,700 years ago / 18 cubic miles



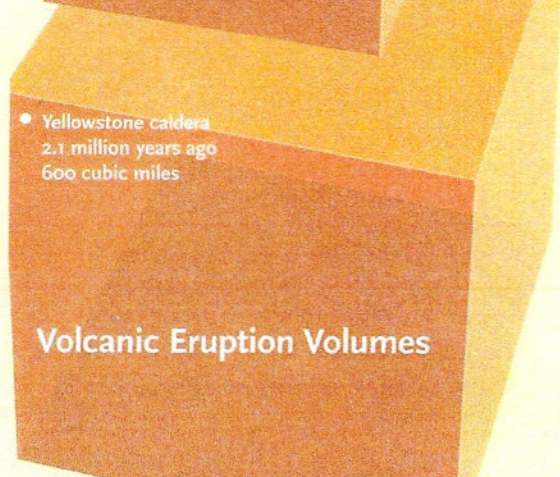
Tambora
1815
36 cubic miles



Yellowstone caldera
1.3 million years ago
67 cubic miles



Yellowstone caldera
640,000 years ago
240 cubic miles



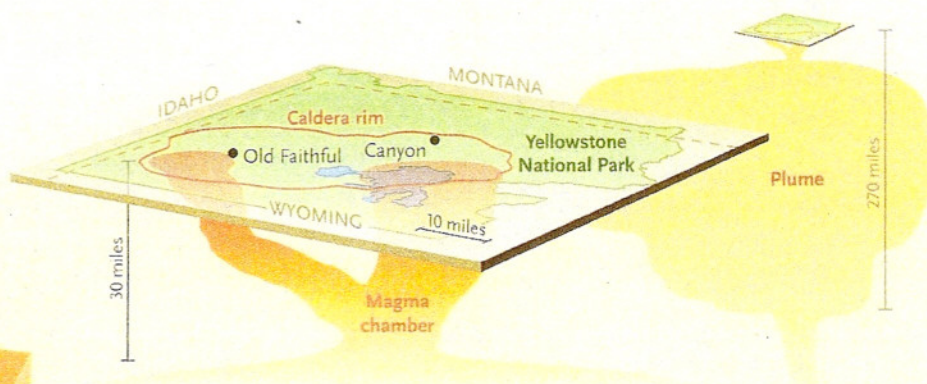
Yellowstone caldera
2.1 million years ago
600 cubic miles

volcanoes

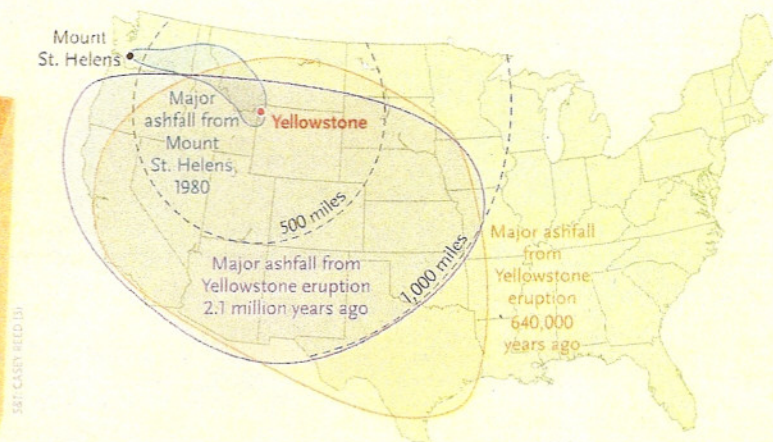
This material blotted out the Sun, cooling the planet for at least several years. If Yellowstone blows its stack next year, at least half of the U.S. will be buried under volcanic ash, and the vast amounts of atmospheric material will snuff out agriculture around much of the world, perhaps culling the human population by tens of percent.

The last three Yellowstone eruptions were spaced roughly 700,000 years apart, which sounds ominous. Fortunately, there is no large-scale ground deformation or greatly increased seismic or geyser activity that signals an impending supereruption. Given the rarity of these cataclysms, we're probably safe for tens of thousands of years.

And that's a good thing. About 74,000 years ago, Lake Toba, a 20-by-60-mile-wide supervolcano on the Indonesian island of Sumatra, exploded and perhaps gave *Homo sapiens* its closest shave with extinction. Genetic studies






YELLOWSTONE TIME BOMB The Yellowstone caldera is about 45 miles across. A magma chamber containing hundreds of cubic miles of molten rock underlies the National Park. If the supervolcano vents this material into the atmosphere, it will precipitate a global ecological crisis that will radically alter the course of civilization.

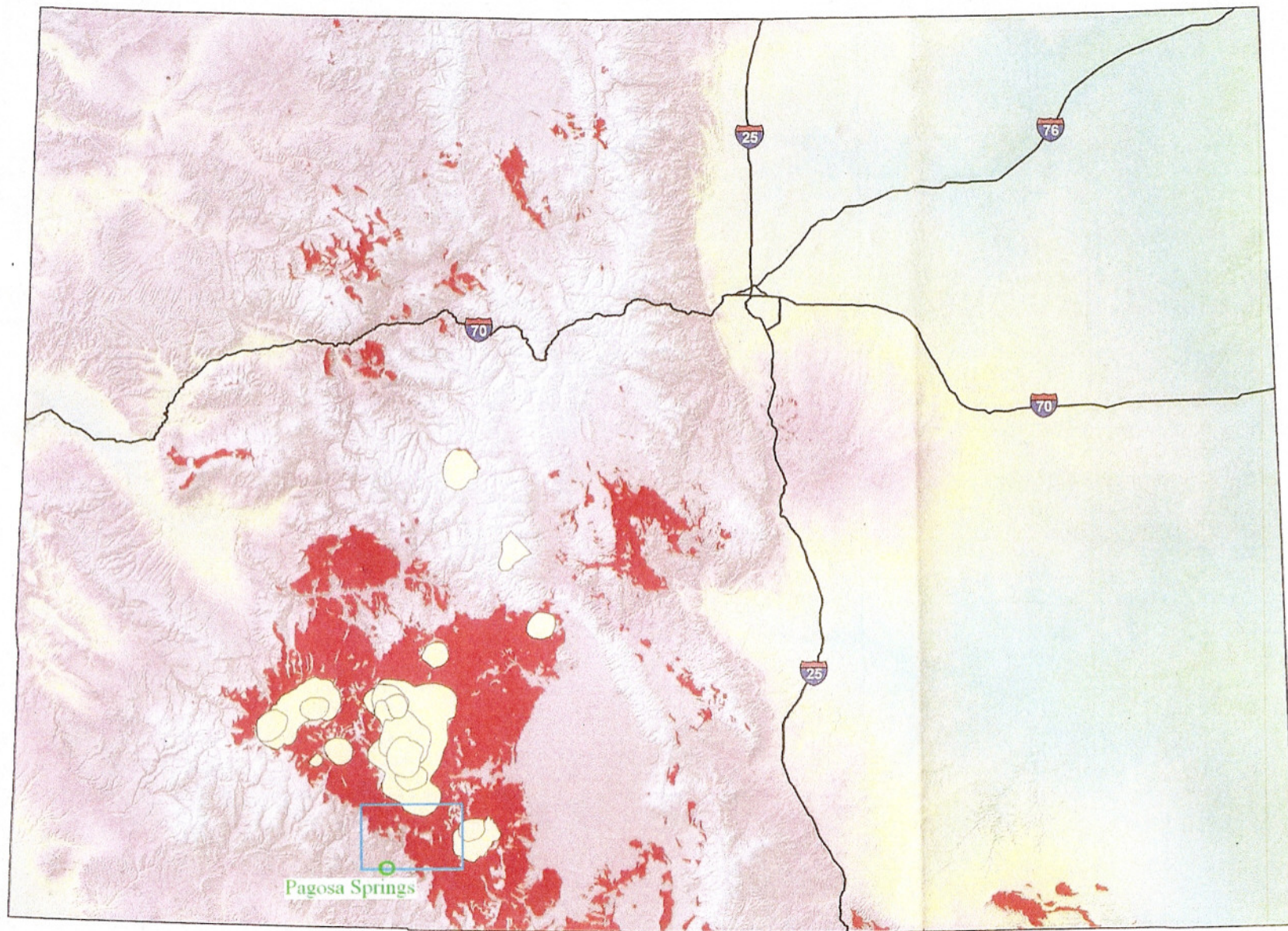


ASHFALL COMPARED The 1980 Mount St. Helens eruption devastated 600 square kilometers of forest, but its volume of ejected material was puny compared to a Yellowstone supereruption.

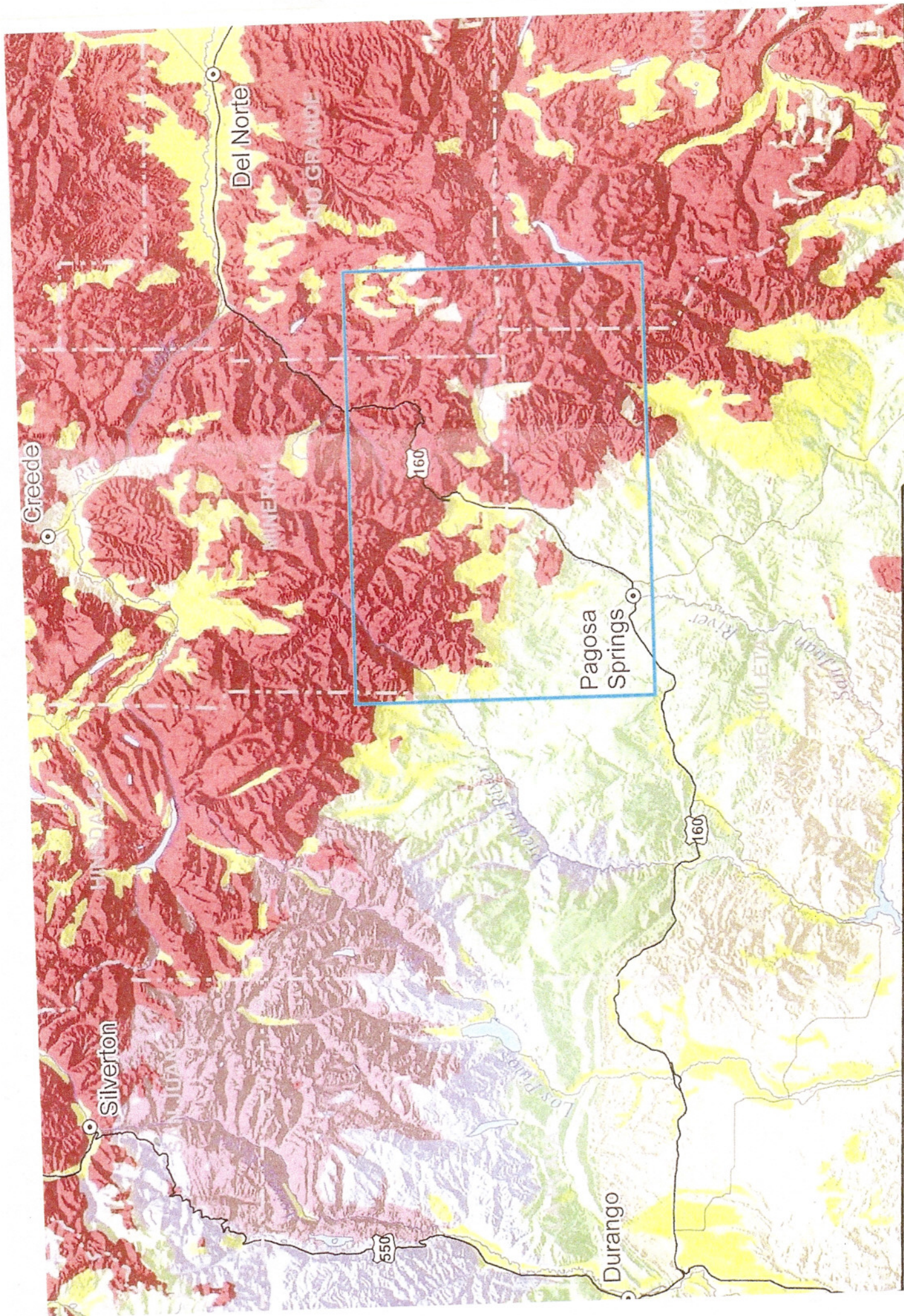
Volcanic Eruption Volumes

GEOLOGIC TIME YEARS AGO ERA/PERIOD	ROCK FORMATIONS THICKNESS NAME LOCATION		GEOLOGIC EVENTS PAGOSA COUNTRY WORLDWIDE		LANDFORM & ECOLOGY PAGOSA COUNTRY WORLDWIDE	
The red line below represents the last 12,000 years. All recorded human history would fit within the topmost 1/2 of the thickness of the line.						
12,000 - Today 1.8 Million QUATERNARY		Sediments & landslides Everywhere	Interglacial period begins- warming climate Drying climate, less rain & snow end heavy erosional period; modern landscapes are formed	Glaciers melt- first people settle Pagosa Modern mountains & valleys Yellowstone-type landforms & ecology		
5 Million TERTIARY		Glacial till East Fork valley Travertine Hot Springs Volcanic breccia Wolf Creek summit	Ice Age, Hot Springs- intense glacial erosion of old volcanic mountains begins to carve out local landforms Last local volcanic eruptions end	Glaciers fill East Fork, upper San Juan River valleys up to 1/2 mile deep with ice Isthmus of Panama connects N. & S. America Worldwide climate changes- Ice Age begins First humans? Red Sea opens		
10 Million		Volcanic & intrusive igneous rocks Jackson Mountain Wolf Creek Pass Trujillo-Pinon Hills	Rio Grande Rift stops spreading Minor volcanic eruptions continue Jackson Mountain erupts; probable fissure eruptions in Archuleta dike swarm (Pinon Hills) Jackson Mountain laccolith; Blanco Basin & Archuleta dikes intruded into fractures	Antarctic ice sheet expands greatly Wet, cool climate; wetlands & geysers dominate across Pagosa area Periodic volcanic eruptions continue to cause local devastation Forests recover		
15 Million		Volcanic rocks & sediments deposited between eruptions				
20 Million		Gold, silver, base metal ores & gangue minerals Summitville Lake City Silverton Creede	Hydrothermal mineral deposits form within volcanic centers	Caldera eruptions end; local minor volcanism destroys local forests; slow recovery of ecology 21 MA-Summitville hydrothermal ore deposits form 22 MA- Lake City caldera eruption 27 MA- Silverton caldera eruption 28 MA- Creede, Platoro, Summitville caldera eruptions		
25 Million						
28.8 Million		Fish Creek Tuff Treasure Mountain Wolf Creek Pass	La Garita Caldera eruption: 1,500 cubic miles of rock blown across North America- 10,000 times as powerful as Mt. St. Helens 1980 eruption	Four Corners ecology devastated; 20,000 square miles destroyed by blast & falling debris- forest fires, choked rivers, smothered plants & animals		
30 Million		Treasure Mountain Tuff Wolf Creek Overlook Treasure Mountain San Juan River cliffs: the Boot Jack East Fork cliffs: the Clamshell	Giant volcanoes reach 20,000 feet; largest eruptions on Earth Creation of the San Juan Volcanic Field Rio Grande Rift opens: volcanoes build across the Four Corners area	Extreme ecological change- intense eruptions destroy forests, followed by recovery, followed by destruction over many cycles of thousands of years First elephants Ecozones change as mountains raise the land and alter weather patterns		
35 Million						

Volcanic Rocks of Colorado



Distribution of Volcanic Rocks of Colorado: Volcanic rocks have been important in Colorado through the ages. However, most that are preserved at the surface today were erupted during the Cenozoic Era. A significant volume of the volcanic rocks preserved in Colorado are tuffs, erupted as ash flows during caldera formation about 36 to 25 million years ago. Colorado is home to twenty calderas (tan), including the world's largest (the La Garita caldera). The ash flows erupted from the La Garita caldera (Fish Canyon tuff) form the greatest volume of ash-flow tuffs in the world—more than 1200 cubic miles. Beginning about 25 million years ago, basaltic volcanism became the dominant type of eruption in Colorado. The youngest basalt flow in Colorado erupted 4,150 years ago.



107°W

