Geology of the Cave Creek Basin, Chiricahuas:
A Trip Log
John Sumner, 2026

The objective of this Trip Log is to acquaint the interested visitor or resident with the geology of the Chiricahua Mountains and more specifically the Cave Creek area in the vicinity of Portal, Arizona.

Geologically speaking, the Chiricahua Mountains have a bit of everything! There are igneous, sedimentary and metamorphic rocks. There are rock units from every geologic era: Proterozoic (youngest era of the Precambrian eon), Paleozoic, Mesozoic and Cenozoic. There are traces of fault lines and erosion. There are rocks as old as 1.6 billion years (1.6 Ga). Much more recently, huge volcanic eruptions have left dramatic cliffs and lava flows.

To explore the geological diversity of this area, let's start at the Chiricahua Desert Museum, then continue to the town of Portal. From Portal, we'll head up Cave Creek Canyon to the American Museum of Natural History's Southwestern Research Station and the nearby Crystal Cave trail. We'll finish with a bonus stop past the town of Paradise. This trip log will describe the geological features visible from each of five stops along the way.

Figures 1 and 2 help to orient us in space and time.

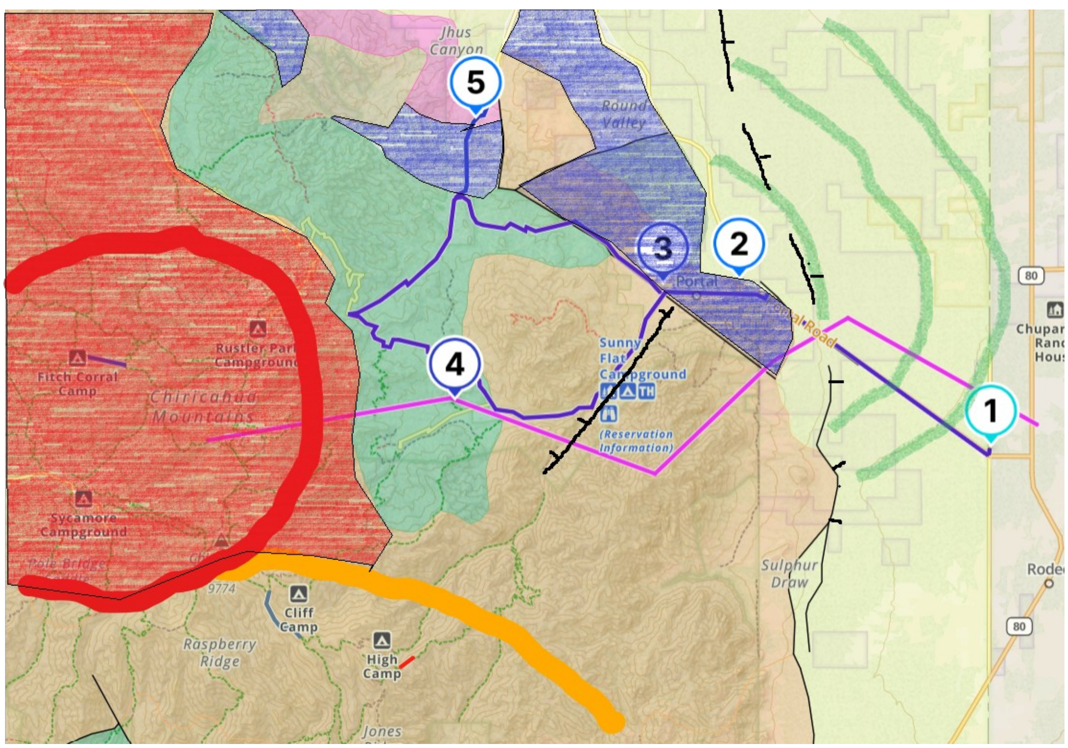
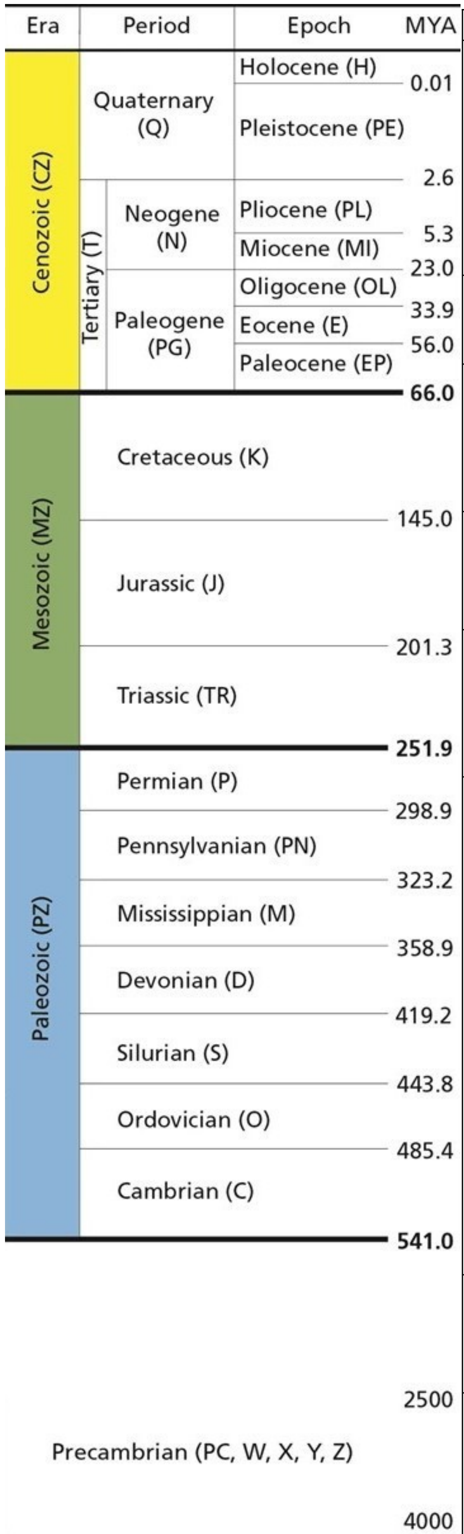


Figure 1: On this base map, the dark blue line shows our route, and numbered circles denote our five stops. Major rock units that we will describe are colored: the Cave Creek alluvial fan in green lines, Bisbee Formation in pale green, Paleozoic sediments in blue, Portal volcanics in tan, Turkey Creek volcanics in red. Black lines mark faults with small dashes indicating the downthrown side. Caldera margins are outlined by bold red and orange lines. The purple line marks a geologic cross section discussed at Stops 1 and 2 and shown in Figure 4.



What we see	What was happening
Fill and alluvium, canyon floors and cliffs; San Simon Valley (Stops 1,2,3)	Basin-Range extension: faulting, valleys drop and mountains rise, erosion
Rhyolitic tuffs and lavas, Portal, Silver, other high peaks (Stops 1,2,3,4)	Calderas with explosive eruptions Laramide Orogeny 75-55 Ma
Unconformity	
Bisbee Formation, sedimentary and volcanic rocks around SWRS (Stops 1,2,3,4)	Crustal Extension associated with Gulf of Mexico formation
Unconformity	
Limestones, sandstones, shales, Limestone Hill (Stops 2,3)	Sediment deposition in shallow seas
The “Great Unconformity”	
Ancient granodiorites and schists north of Paradise (Stop 5)	Mazatzal orogeny, 1.8-1.6 Ga

Figure 2: This timeline, adapted from the Geological Society of America and the United States Geological Survey, gives ages in millions of years for the eras, periods, and epochs defined by geologists. It also relates them to the groups of rocks that we’ll see at each stop. The oldest rocks we’ll see on our trip are igneous, from the Precambrian Eon. They’re

underneath us, only exposed at the surface outside the Cave Creek drainage, north of Paradise. Paleozoic Era sediments make up Limestone Hill and Cienega Ridge just north and east of Portal. Sediments and associated volcanic rocks from the Mesozoic Era – the "Bisbee Formation" – occur around the Southwestern Research Station and Crystal Cave. During the Cenozoic Era, spectacular eruptions from the Portal and Turkey Creek calderas covered the area in a thick layer of rhyolitic flows and tuffs. Subsequent faulting and erosion formed the rugged cliffs above Portal as well as the fantastic rock columns in the nearby Chiricahua National Monument.

Figure 2 also indicates a few of the processes that created the geology that surrounds us. Most of these involve plate tectonics, which we'll discuss at Stop 3. As an example, at the end of the Mesozoic Era, the Earth's crust squeezed as continental plates collided. The resulting period of mountain-building is known as the Laramide Orogeny. At other times, continental plates were thinned and stretched. For example, crustal stretching known as the Basin-Range extension created dramatic relief in the Cave Creek area, as well as the small cinder cones in the San Bernardino Valley about twenty miles south of here. Erosion and faulting associated with Basin-Range extension continues to the present. For example, a major earthquake occurred fifty miles south of here in 1887.

Stop One
Junction of Portal Road with State Line Road (31.87082, -109.04904)
Fans and Alluvium

After a visit to the Chiricahua Desert Museum to admire snakes and lizards, take the road toward Portal and stop at the junction with State Line Road. This is Stop 1 on the map of Figure 1. Here, we are near the middle of the San Simon Valley. To the east are the Peloncillo Mountains and to the west are the Chiricahua Mountains. As Basin-Range extension continues underneath us, the San Simon Valley is actively dropping relative to the two mountain ranges and, as the mountains erode, the mountain ranges are also rising.

The basin between the Peloncillo Mountains and Chiricahua Mountains is actually two valleys. Water from Cave Creek enters San Simon Creek and drains north to the Gila River, then to the Colorado River and finally the Gulf of California. About ten miles to our south, there is an almost-imperceptible divide between the San Simon Valley and the San Bernardino Valley. Washes and streams in the San Bernardino Valley drain south into Sonora to the Rio Bavispe and then the Rio Yaqui, ultimately emptying into the Gulf of California north of Ciudad Obregon.

If we look west to the Chiricahua Mountains (Fig. 3), the mountain tops are at 8000 feet, more than 4000 feet higher than we are. The prominent peak west of us is Portal Peak. The rugged cliffs of orange and yellow contain rhyolitic lavas and tuffs. "Tuffs" are consolidated volcanic ash deposits; "rhyolite" is fine-grained, silica-rich volcanic rock that is chemically equivalent to granite. These rocks were ejected by the Portal Caldera, which was centered southwest of us and is not visible from here. Age dating based on radioactive isotopes (McIntosh and Bryan, 2000) indicates that the lavas and tuffs were deposited 27.6 million years ago (Ma), during the Oligocene Epoch.

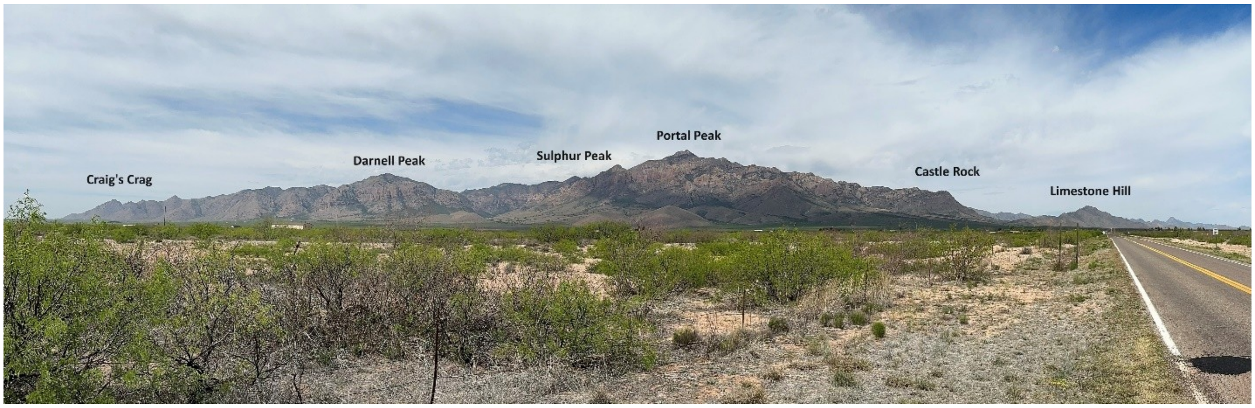


Figure 3: View west from Stop 1. Major peaks from south to north are Craig's Crag, Darnell, Sulphur and Portal Peak, Castle Rock, and Limestone Hill.

At this location, we are at the toe of the Cave Creek alluvial fan. The top of the fan starts about six miles from here, where Cave Creek leaves the Chiricahua Mountains. Beneath us are several thousand feet of alluvial material that has eroded from the Chiricahua Mountains since the caldera eruptions and has since been deposited in the San Simon Valley. Volcanic rocks from the Portal Caldera underlie the alluvium. Figure 4 is a geological cross section showing the sediments underneath us.

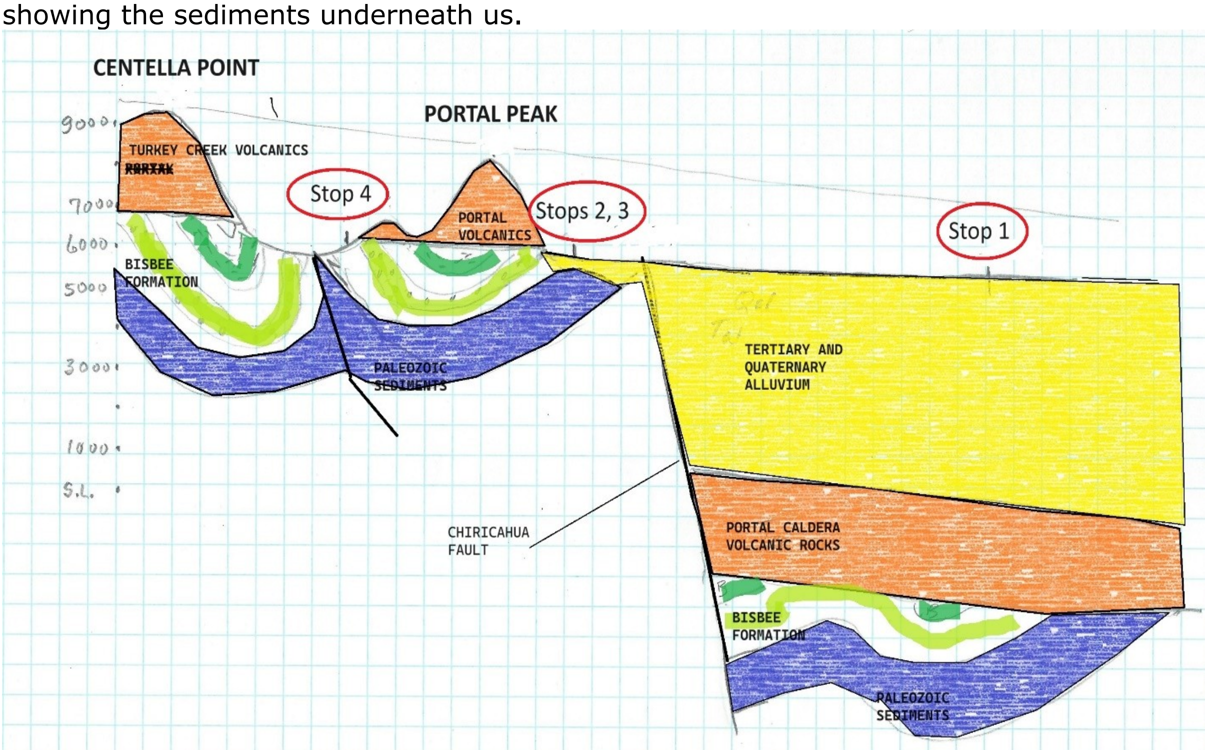


Figure 4: Schematic cross section from Centella Point to the Arizona State Line along the purple line located on Figures 1 and 9. Yellow shows sedimentary fill deposited in the Cave Creek Alluvial Fan during the Tertiary (Neogene) and Quaternary Periods. This deposition continues today. In orange are volcanic rocks from the Oligocene Epoch that make up the Portal and Turkey Creek Calderas. Greens locate the Bisbee Formation sediments and volcanics from the Late Jurassic and Early Cretaceous Epochs; Blue is for Paleozoic Era sediments. The basement (uncolored) contains igneous and metamorphic rocks from the Precambrian Eon.

Stop Two
Junction of Portal Road and Foothills Road
Faults and Unconformities

After driving the 5½ miles up the alluvial fan along Portal Road to the junction with Foothills Road, we will be 500 feet higher. This junction is locally known as Trash Corner (the county collects household garbage here twice a week). Despite this name, the views are extensive. Look back down the alluvial fan into the San Simon Valley. The fan contains an impressive amount of material that has eroded from and then been carried out of the Cave Creek drainage. A quick calculation, assuming 5000 feet of alluvial fill, indicates that there are about 40 cubic miles of material in the fan ($1/2\ \pi r^2$ x thickness, r = 5 miles, thickness = 1 mile). Precipitation drains through Cave Creek Canyon at the surface and underground into this alluvium to accumulate into an aquifer, although it's being extracted far faster. The valleys of southeastern Arizona (including the San Simon valley) look mighty dry, but in a simple way, they could be considered lakes that happen to be filled with alluvial material eroded from the surrounding mountains!

Even though no obvious surface feature was visible, when we were about a mile southeast of Trash Corner the alluvial valley fill thinned abruptly as we passed over a fault that dropped the floor of the San Simon Valley relative to the mountains. This is a "normal" fault, named the Chiricahua Fault and has little horizontal displacement. East of the fault the alluvial fill is over 4000 feet thick, while west of the fault its thickness is less than 500 feet. The location of the fault and the information on the offset or "throw" come from gravity data (Aiken, 1978). Wells in the valley north of Portal drilled through over 8000 feet of alluvium and volcanic tuff. Relative to the peaks at 8500 feet, there are more than 10,000 feet of offset across the Chiricahua Fault.

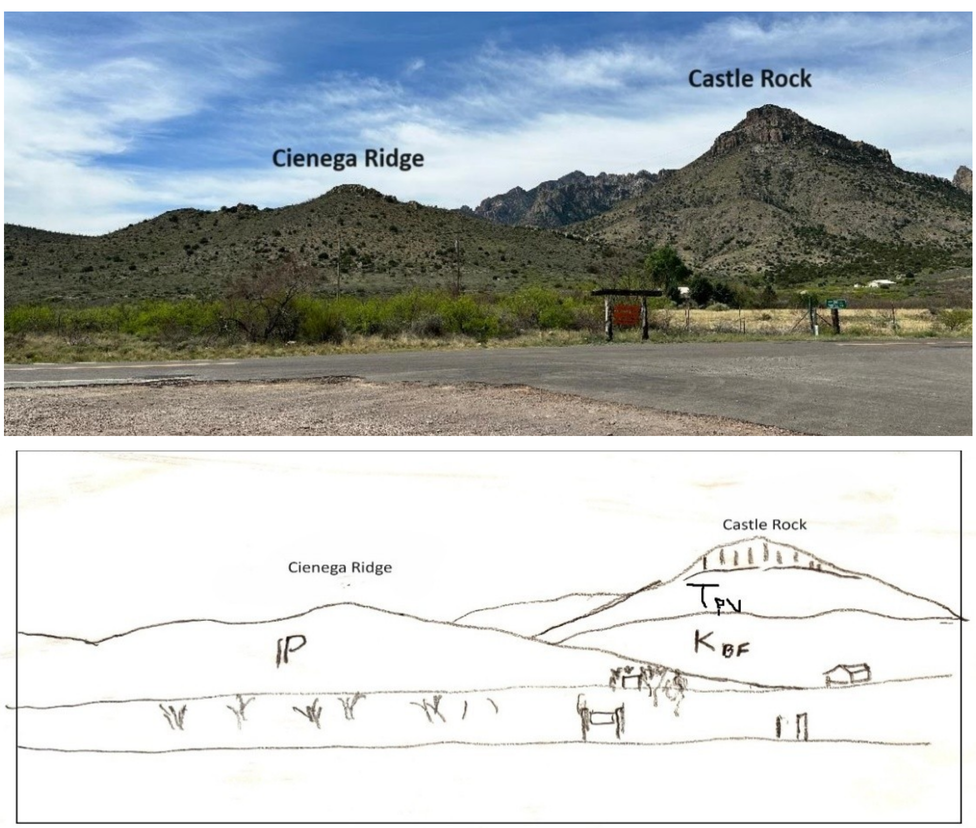


Figure 5. View south from Stop 2, showing Cienega Ridge and Castle Rock. The line sketch delineates three geological formations: Paleozoic limestones (IP), the late Jurassic/early Cretaceous Bisbee Formation (K_{BF}), and the Oligocene rhyolitic lavas (T_{PV}) from the Portal Caldera that make up Castle Rock.

The rocks in the hills of Cienega Ridge that are about a quarter mile south of us (Fig. 5) are very old, containing fossils of marine organisms from the Paleozoic Era. Some sediments date as far back as the Cambrian Period, 540 Ma; the most recent were deposited during the Permian Period, ending roughly 250 Ma.

A second, much younger set of sedimentary rocks is also visible to our south. Mesozoic Era "Bisbee Formation" sediments appear as light gray outcrops at the base of Castle Rock. The oldest of these sediments dates from the Jurassic Period and lies directly on top of the much older Permian sediments. Rocks older than 160 Ma but younger than 250 Ma are missing in our area. This 90-million-year gap is an "unconformity" – a period during which no rock was laid down, or where rocks that were laid down later eroded away.

The youngest rocks of the Bisbee Formation date from the early Cretaceous Period, approximately 100 Ma. They, in turn, are much older than the rocks that form the craggy top of Castle Rock. The rocks of Castle Rock are rhyolites that date from the Oligocene Epoch (27.6 Ma) – the same volcanic deposits that make up the tops of Portal Peak, Sulphur Peak and Darnell Peak that we saw back at Stop 1.

Turning to the northwest, Limestone Hill (Fig. 6) contains the same limestones, sandstones and shales that make up Cienega Ridge. Originally deposited horizontally, these rocks now dip steeply to the southwest.

The steep dips of the sedimentary beds can be seen clearly. The youngest sediments are on the left while farther to the right are older layers of rock. Based on an analysis by Drewes (1995), the orange line on the left marks the base of the Permian Period (around 300 Ma). The Permian rocks on the left lie on the older rocks from the Pennsylvanian (Carboniferous) Period to the right, age of around 325 Ma. We can't see the oldest Cambrian sandstones (540 Ma) from here since they are on the other side of Limestone Hill.

Figure 6. Limestone Hill as seen from southeast of Stop 2 using Google Earth. Paleozoic sediments make up Limestone Hill. The 75-degee dips of the sediment beds (orange line) are clearly visible. Orange line locates base of the Permian Period.

Completing our panorama from Stop 2, the rhyolitic flows and tuffs of Silver Peak and Mount Sceloporus (the only peak in the U.S. named for a lizard) dominate the skyline to the southwest (Fig. 7).

Figure 7. Silver Peak and Mount Sceloporus viewed southwest from Stop 2. These contain Oligocene volcanics from the Portal Caldera and overlie sediments of the Bisbee Formation.

As we continue west ¾ mile on Portal Road we will pass into the mountains and reach the town of Portal. Passing through the “Gate” into the Cave Creek Basin, Castle Rock is on our left (south), Limestone Hill is on our right (north) and Silver Peak is almost straight ahead (west-southwest), although it is hidden behind Mt Sceloporus. Let’s continue west on Portal Road another half mile to the junction with the road to Paradise. Figure 8 locates the peaks mentioned in the text.

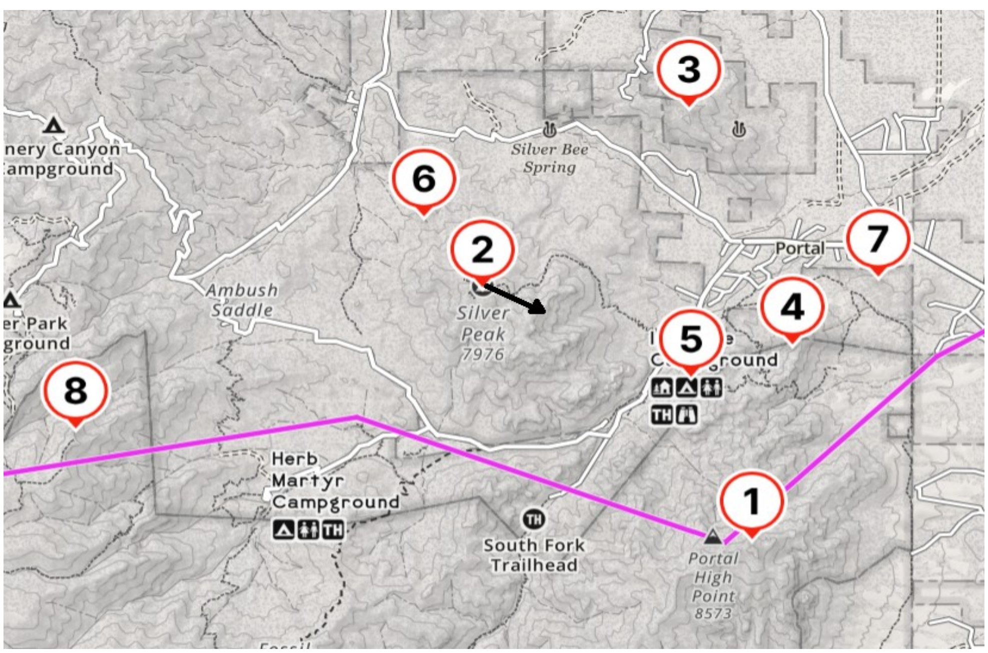


Figure 8. Peaks and Rocks mentioned in text: 1) Portal Peak, 2) Silver Peak with Mt Sceloporus to its SE (arrow), 3) Limestone Hill, 4) Castle Rock, 5) Cathedral Rock, 6)

Elephant Rock, 7) Cienega Ridge, 8) Centella Point. Purple line shows the cross section of Figure 4.

Stop Three
Junction of Portal, Paradise and Cave Creek Roads
Bisbee Formation, Orogenies and Crustal Stretching, Calderas

Park alongside the road near the junction. The Portal Road ends here. The Paradise Road continues west, then northwest to the town of Paradise. The Cave Creek Road continues southwest into the Coronado National Forest and eventually over the top of the mountains to the Sulphur Springs Valley and the Chiricahua National Monument.

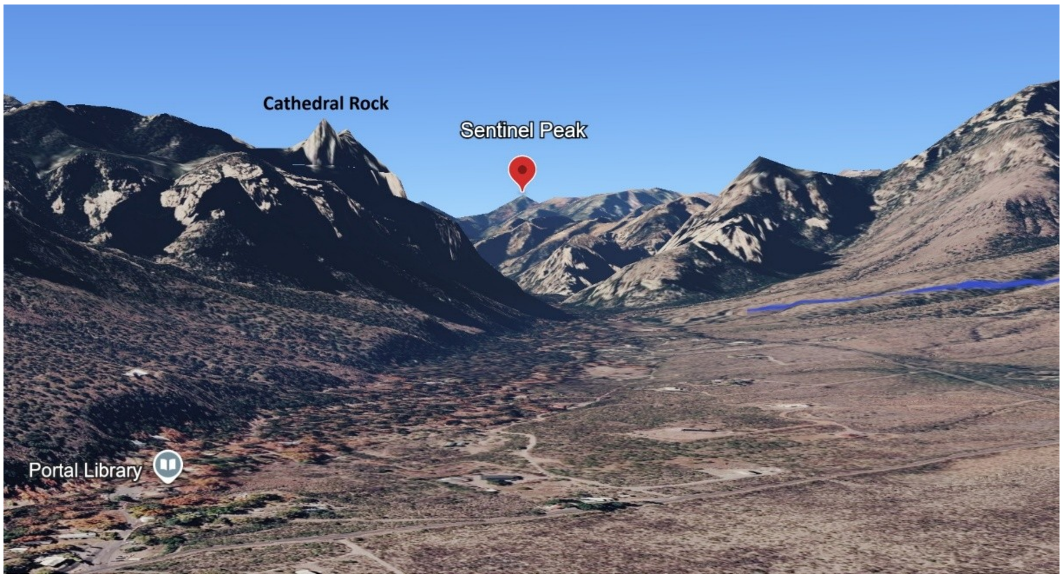


Figure 9. Panorama south and west from near Stop 3, looking up the Cave Creek drainage. Cathedral Rock is on the left and towers over the valley. Sentinel Peak is behind the rock (unnamed) that faces Cathedral Rock on the northwest side of the canyon. Sentinel Peak can be seen by moving 0.4 miles to the east along West Portal Road to the intersection of W. Portal and S. Cathedral Rock Roads. Sentinel Peak is significant in that it marks the northern rim of the Portal Caldera. Bold blue line marks the approximate location of the top of the Bisbee Formation. Photo from Google Earth.

All the peaks to the south and west that we see from here (Fig. 9) are made of rhyolitic lavas and tuffs that erupted from the Portal Caldera. In some places, they look layered, but don't be fooled, they are not sedimentary. The layers are the result of successive caldera eruptions. These peaks, along with Cathedral, Castle and Elephant Rocks, are stunning, with high cliffs that look like ramparts. Sentinel Peak, which is just barely visible from here, marks the Portal Caldera's northern edge.

The lavas and tuffs overlie the Jurassic/Cretaceous sediments and volcanics of the Bisbee Formation. Behind us are the Permian limestones of Limestone Hill. Some of the youngest rocks in the area are those eroded from Mt Sceloporus. They occur as steeply sloping, alluvial fans that lie close to the mountains. Closer to the Cave Creek flood plain are terraces that are flatter and even younger. The alluvial fans and terraces obscure the underlying rock layers.

Figure 10. Faulting and Fans. Photo from Google Earth shows the Cave Creek fault (blue) and Apache Pass Fault (red) in Portal area.

Geological faulting is evident from here. The Cave Creek Fault runs along the floor of Cave Creek Canyon and may explain the linear nature of Cave Creek and the South Fork of Cave Creek. The fault weakened the rocks and concentrated erosion in this part of the mountain range. The Cave Creek Fault drops Silver Peak and Mt Sceloporus down to the west relative to Cathedral Rock.

At right angles to the Cave Creek Fault, the Apache Pass fault zone raises Limestone Hill and drops the Bisbee Formation down to the southwest. Alluvium and terrace deposits cover the area of contact between the base of the down-dropped Bisbee Formation and the top of the older, but now more elevated Permian limestones.

This might be a place to say something about why all these diverse kinds and ages of rocks are here!

> The answers can be found in movements of the Earth's crust due to plate tectonics. The Earth has seven or eight major tectonic plates and about ten smaller plates. The plates are made of oceanic crust (thinner, hotter and primarily basalt) and continental crust (thicker, cooler and primarily granitic or granodioritic). These plates of the Earth's crust float on top of a denser layer called the "mantle." They converge, separate or slide by one another.
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> Converging plates form "subduction zones" where oceanic crust slides or "subducts" under continental crust. Converging plates made of continental crust form mountain belts (like the Himalayas and Alps). Two oceanic plates that separate will form a mid-ocean spreading center (the mid-Atlantic Ridge and the East Pacific Rise are examples). Extension or spreading within continental crust thins the crust and forms rifts (the Basin-Range area of western North America and the East African Rift are examples). Plates that slide by one another create "transform" faults such as California's San Andreas Fault or the Alpine Fault in New Zealand.
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> "Orogenies" refer to mountain building episodes associated with plate convergence. Two big orogenies have influenced the Cave Creek area. The first, which happened before any of the geological features visible from Stop 3 were formed, was the Mazatzal Orogeny during the Precambrian Eon (1.8 – 1.6 Ga). Colliding plates at that time helped to form the continent that eventually became North America. The

second was the Laramide Orogeny during the Late Cretaceous and Early Paleogene periods (75 - 55 Ma). As the Pacific Plate subducted under the North American Plate from the southwest, it caused mountain building and deformation across western North America, including southern Arizona.

The enormous compressional forces associated with the Laramide Orogeny in the Cave Creek area affected both the Bisbee Formation and the older Paleozoic sediments. This compression folded and faulted the rocks of the Bisbee Formation and, as we saw from Stop 2, it lifted, folded and tilted the Paleozoic rocks of Limestone Hill. Those Paleozoic rocks were shoved up and to the northeast along thrust (reverse) faults, creating the steep dips that we saw at Stop 2 (Fig. 6). The sediments that became Limestone Hill were originally deposited in a warm, shallow sea south of the equator, but now they are tilted as much as 75 degrees, and they are over a mile above sea level. Plate tectonics at work!

So what caused the massive volcanic eruptions that formed the Portal and Turkey Creek calderas and produced the rhyolitic lavas and tuffs that make up the Chiricahua's spectacular peaks? No surprise –the answer comes from our old friends, subducting plates.

Caldera eruptions didn't happen until the Oligocene Epoch, 30 million years after the end of mountain-building during the Laramide Orogeny. Those 30 million years are missing from the rock record, but we can assume that erosion was busy smoothing the terrain. If we had stood at this spot at the beginning of the Oligocene, we might have seen gentle hills of the eroded Bisbee Formation and Paleozoic limestones extending to the horizon.

But meanwhile, the Pacific Plate was still moving under the North American Plate. Eventually, even the "spreading center" between the Pacific Plate and the adjacent Farallon Plate subducted beneath the North American Plate. That's when things got complicated.

Heating from deep within the earth associated with the subducted spreading center created an upsurge in volcanic activity. So, if we had stood here back in the Oligocene, unbeknownst to us, massive magma chambers would have been forming beneath us. Pressure would be building up, and eventually this magma would have erupted violently to form the Portal and Turkey Creek calderas. University of Arizona professor Peter Coney (1978) referred to the process as an "ignimbrite flare-up", and the Chiricahua volcanics and calderas are prime flare-up evidence.

Eruptions and subsequent erosion from two calderas formed much of the topography you now see here: the Portal Caldera (bold orange line on Fig. 1) and the Turkey Creek Caldera (bold red line on fig. 1). Caldera eruptions are among the most violent of geologic events. Tuffs from the Portal Caldera are found as far as thirty miles northeast in the Peloncillo Mountains (McIntosh and Bryan, 2000). An estimate of the total volume of the caldera eruptions is 140 cubic kilometers. To put this in perspective, the area of the Cave Creek Basin is around 100 square kilometers, so 1,400 meters – more than 4500 feet – of caldera lavas and tuffs would have covered the entire area. Geologic mapping indicates there were many periods of volcanic activity separated by periods of quiescence and that it took tens of thousands of years to lay down the volcanic rocks you can see from here.

Another aspect of plate tectonics that has strongly influenced the geology around us is crustal stretching. As we noted earlier, spreading within continental crust can thin the crust and create rifts. Recent detailed mapping around Apache Pass in the northern Chiricahua Mountains by Chapman and others (2025) indicates that the sediments and volcanic rocks of the Bisbee Formation were deposited 155-130 Ma on much older Paleozoic sediments. This happened during the creation of the Gulf of Mexico – a rift that extended across northern Mexico into southern Arizona.

More recently, "Basin-Range" crustal extension started in southeastern Arizona about 12 Ma, as smaller plates and spreading centers moved beneath western North America. Resulting offsets on normal faults were thousands of vertical feet, forming the Basin-Range topography of today. Blocks were uplifted and valleys dropped, permitting erosion of the uplifted ranges and deposition of alluvium into the down-dropped basins. The erosion created Cave Creek Canyon, and the associated alluvial fan filled the down-dropped San Simon Valley. We saw this at Stops 1 and 2.

An excellent account of causes and formation of the caldera that deposited the tuffs in the nearby Chiricahua National Monument is available on-line (Hudson, Minor and Posthumus, 2013). Important geologic sources for locating faults and rock units are the geologic map of the Portal quadrangle (Drewes, DuBray and Pallister, 1995) and the articles by Lawton and co-workers (1995, 1999) on the Bisbee Formation in the area around the Research Station.

Let's continue along Cave Creek Road upcanyon and past the U.S. Forest Service's Visitor Information Center (staffed by volunteers, this is an excellent source of campground and trail information as well as wildlife sightings). From the VIC to the junction with the South Fork Road we will be following the valley created by the Cave Creek Fault. The Cave Creek fault zone continues up the South Fork Canyon from here, but we'll follow the main road to the right along yet another fault that drops Silver Peak down to the north and passes near the Southwestern Research Station. SWRS is a biological research station operated by the American Museum of Natural History in New York City. Turn left here onto Herb Martyr Road and then park either opposite the entrance to the Research Station, or (if it's open, March-October) in the lot inside the Research Station gate. SWRS is a good place to visit the gift shop and restrooms. After a brief stop at the SWRS, we'll continue up the Herb Martyr Road to the parking area on the left.

Stop Four
Research Station parking lot & Crystal Creek
Caves and a Caldera Rim

As we've seen, two caldera eruptions and the subsequent erosion shaped most of the topography you see from here: the Portal Caldera (27.6 Ma) to our south, and the slightly younger Turkey Creek Caldera (26.7 Ma) to our west (caldera dates are from McIntosh and Bryan, 2000). The north edge of the Portal Caldera is out of sight to the south. However, the volcanic rocks to our east and south – the ridges and peaks of Reed Mountain, Portal Peak and Silver Peak – are part of its legacy (Fig. 11). If we look the other direction, the bluffs and peaks on the western skyline are made up of rhyolitic lavas and tuffs similar to those that make up all peaks near Portal, but these are from the Turkey Creek Caldera. The prominent ridge to the west, Centella Point, marks its eastern edge. The Turkey Creek Caldera was 6 miles across!

Figure 11. View east from the Research Station parking lot towards Reed Mountain.

Deposition of volcanic rocks from the caldera eruptions on top of the sandstones, siltstones and limestones of the Bisbee Formation had some interesting consequences. For example, a number of caves in this area are known for their quartz and calcite crystal formations, possibly the result of minerals leaching from the silica-rich rhyolites on top of the limestone layers below. One example, Crystal Cave, is only about 1/2 mile west of here.

The eroded alluvium around the Research Station obscures the underlying rock, so that the boundary between the volcanics and the Bisbee Formation is difficult to see from here. It is clearer in Figure 12, taken from about 3000 feet higher and 4 miles to our west.

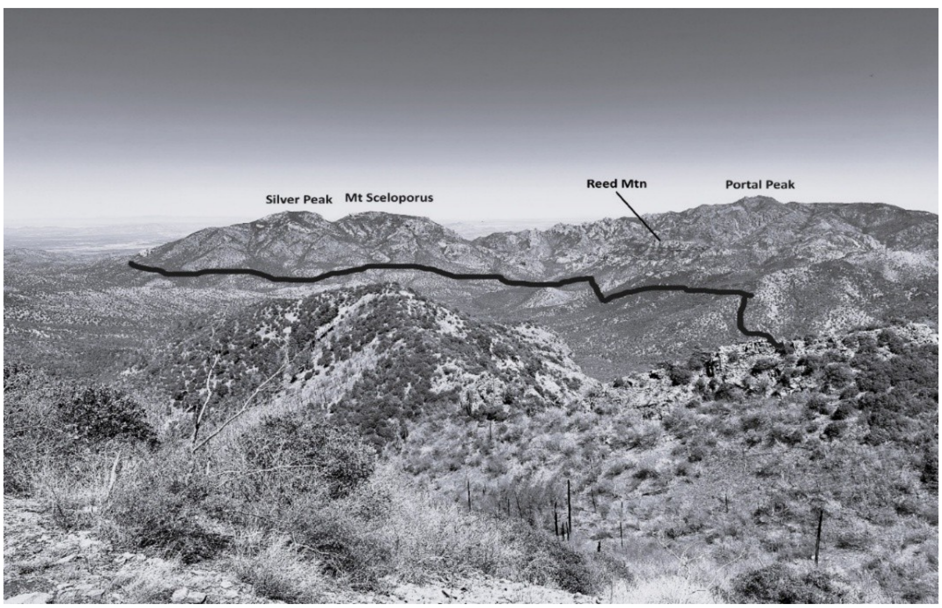

Figure 12. View east across the valley containing the Research Station. Heavy black line marks the top of the Bisbee Formation with Portal Caldera volcanics above.

Stop 4 Crystal Creek.

For a close-up view of the sediments of the Bisbee Formation, drive up the Herb Martyr Road about ½ mile to the trailhead parking for the Snowshed-Basin trail and the Crystal Cave trail. The parking lot is on the left. After parking, cross the road and walk west and a bit north up the Crystal Creek trail for about ¼ mile, to a rock ledge in the creek bed.

From here, the trail climbs steeply another quarter mile to the cave entrance (it’s locked, so no exploring). But if you stop here, the rock ledge exposes a fold in the Late Jurassic sediments. Tortuously folded sediment layers are exposed on all sides. Limestone, shale and sandstone make up this ledge (Fig. 13).

Figure 13. View to northwest of a fold in Bisbee Formation sediments exposed in Crystal Creek. Knapsack for scale.

Stop 5 Bonus Stop

One mile north of Paradise on the Turkey Creek Road
The Oldest Rocks in the Cave Creek Area

To reach Stop 5, return to the junction with the Portal Road, turn right, and retrace your steps to Stop 3. Here, turn left and take the Portal-Paradise Road for 5 miles to its termination. This road approximately follows the line of the Apache Pass fault, and Bisbee Formation rock units are prominently on display as the road curves and climbs up the valley formed by the Apache Pass Fault and Silver Creek.

At the end of the Portal-Paradise Road, you'll be at a row of mailboxes serving Paradise residents. Turn right and proceed north another 1.5 miles. This is Stop 5. Park where the road widens, just past a gated dirt driveway that cuts up the hill to the right (don't block the driveway, this is private land).

The slope to your left leads down towards the creek bed with large exposures of granodiorite. Note the large feldspar crystals and the coarse-grained, "salt and pepper" appearance. This rock (Fig. 14) is far older even than the Paleozoic sediments of Limestone Hill. It formed 1.6 billion years ago, during another collision of tectonic plates. The associated period of mountain building -- the Mazatzal Orogeny – was related to the formation of an ancient continent, known as Laurentia, that eventually became the core of what we now call North America. During the Mazatzal Orogeny, granodiorite magmas intruded into cracks in the Pinal Schist (not visible here), which is the oldest "basement" rock within the Chiricahuas.

There are no rocks in the Chiricahuas that date between these Precambrian intrusives and the rocks of Limestone Hill. In other words, there's an unconformity of over one billion years! This band of rock is missing across much of North America -- for example, in the Grand Canyon, where it was recognized in 1869 by John Wesley Powell (during his pioneering descent of the Colorado River) and named the "Great Unconformity". He was geologically astute and knew that James Hutton had previously recognized such unconformities as early as 1787 on the Isle of Arran in Scotland.

Figure 14. Precambrian granodiorite along the South Turkey Creek Road. Peter Waser photo.

Time for a picnic lunch or a visit to the Portal Café! On the drive back to Portal, remember the five important rock units in the Portal-Cave Creek area and shown on our Timeline (Fig. 2). They are:

- Precambrian schists and granodiorites north of Paradise (Stop 5)
- Paleozoic limestones, sandstones and shales of Limestone Hill and Cienega Ridge (Stops 2 and 3)
- Late Jurassic/Early Cretaceous sedimentary and volcanic rocks of the Bisbee Formation near the Research Station (Stops 3 and 4 and along the Portal-Paradise Road)
- Rhyolitic tuffs and lavas from the Oligocene caldera eruptions (Stops 1,2,3,4)
- Alluvium filling the San Simon Valley and Cave Creek resulting from faulting and subsequent erosion related to Basin-Range extension (Stops 1,2,3)

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