

and other elements from the surrounding mountains. The arid climate rapidly evaporates water from the valley floor, concentrating these elements into new minerals such as halite (table salt), gypsum, and borax. Observe these interesting formations at the salt flats near Badwater or the Devil's Golf Course.

8 A Recipe For Badlands

Why are these hills so barren? Extreme heat is only part of the answer. The story of these "badlands" begins and ends with water. These lakebed deposits contain impermeable clay, so any rainfall quickly moves downhill. In addition, the combination of steep slopes and sporadic but intense storms increases rapid surface runoff. Nature's way of efficiently removing so much water is the formation of the numerous gullies and ravines that characterize the badlands. Unable to survive in this inhospitable environment, plants are limited to the gravel washes and banks. For the plants, these hills are indeed bad land.

9 It's All Downhill

Entering a canyon during a rare desert rainstorm can be dangerous. Besides the threat of flash floods, falling rocks can be an unexpected hazard. Rocks loosened by rainwater tumble off cliffs and steep slopes, crashing toward the narrow canyon bottom. Hikers beware!

Come rain or shine, rocks are destined to make their way to lower elevations. Water and gravity work together to move the rock, but other forces can help start the process. Regional stresses fracture the rock, and deposits of salt within the cracks may grow and expand to further break the rock apart. As large blocks of rock are broken up, water and gravity are able to transport the smaller pieces more easily.

10 Red Cathedral

Notice the change from the relatively gentle yellow slopes in the foreground to the steeper red cliffs beyond. More resistant to erosion than the soft yellow mudstone, the rocks of Red Cathedral form steep cliffs. These cliffs are composed of conglomerate similar to that exposed near the mouth of Golden Canyon, and they are also the debris of a former alluvial fan. Oxidation of iron creates the red color, like the process that forms rust. For an impressive view of Red Cathedral's fluted walls, hike another ¼ mile up the main wash, keeping to the right at forks in the drainage.

As you continue your exploration of the rugged mountains, canyons, salt flats, and other landforms of Death Valley National Park, notice the many geologic clues that are clearly exposed in this desert land. As you have seen here in Golden Canyon, processes working today have also been working in the past. These same processes will continue into the future, shaping and changing this dynamic landscape.

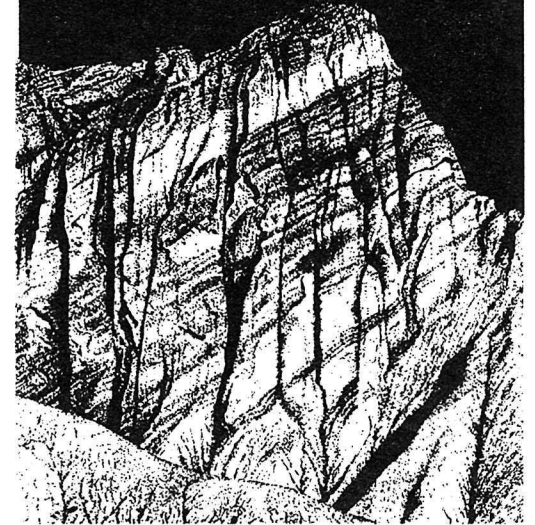
Beyond Golden Canyon

Hikers wanting to continue beyond Golden Canyon have several options. From the end of the interpretive trail (Stop 10), a marked trail leads to **Zabriskie Point**. This will be a total of 2.5 miles (4 km) one-way from the parking lot with a total elevation gain of 950 feet (290m).

Another option off this side trail is to follow **Gower Gulch** back down to the valley. Some rock scrambling is required to climb down two dry falls. A path from the mouth of Gower Gulch heads north along the base of the mountains back to the parking lot. This entire loop is 4 miles (6.4 km) round trip and gains a total of 500 feet (152m).

Golden Canyon

trail guide



Wandering through twisting narrows and colorful rock formations, this self-guided, interpretive trail leads to a spectacular view of Manly Beacon and Red Cathedral.

Distance: 2 mile (3.2 km) round trip

Elevation Gain: ... 300 feet (91m)

Difficulty: The gradual and steady uphill grade is rocky and uneven, so please walk carefully. Sturdy shoes are advised.

Warnings: On hot days, be sure to carry and drink plenty of water.

Death Valley National Park



Death Valley National Park



Golden Canyon preserves geologic stories steeped in change. Like pages in a book, it's rocks tell tales of ancient times when a lake once covered this land; they also speak of violent flash floods racing down the canyon. Golden Canyon is a fascinating showcase of the effects of water in an arid land.

1 Death Valley's Fan Club

Before you enter the canyon, look across Death Valley toward the Panamint Mountains. Great aprons of rocky debris partially bury this majestic range in its own eroded remains. Deposited by periodic floods, this blanket of sediment is actually composed of many individual, fan-shaped deposits that radiate from each mountain canyon. Geologists come from throughout the world to study these magnificent *alluvial fans*.

And you are standing on one. Flash floods emerge from the narrow mouth of Golden Canyon and suddenly spread out into the open valley below. As the torrent slows, the water rapidly dumps its mixture of silt, sand, gravel and cobbles. Imagine the size of the floods required to move the larger boulders! Although these dynamic fans shift with each flood, their basic patterns remain consistent.

2 An Abrasive Situation

The flat, dark layer in front of you is not a *natural geologic formation*. A road once entered Golden Canyon, but what has destroyed the pavement here? In February 1976, a four-day storm dropped 2.3 inches (5.7cm) of rain at Furnace Creek. On the last day of the storm, a violent downpour caused a surge of water, mud, and rock to flow through these narrows.

Such sediment-laden floods work like sandpaper, cutting away and undermining the rocky canyon walls. In narrows such as these, floodwaters are constricted and the speed increases. If you look

closely at the walls of the canyon, you will see a coating of mud that indicates the height of the water that has moved through these narrows.

Flash floods like these have been shaping the canyons of Death Valley for millions of years.

3 Former Fans

Look closely at the rock exposed in the canyon walls. Notice that the layers are composed of sediment that ranges in size from boulders to fine-grained sand and silt. Does it remind you of the debris at the canyon's mouth? Estimated to be about five million years old, these rocks tell of a former alluvial fan. Burial and cementation transformed the loose material into a solid conglomerate. Subsequent uplift and erosion have exposed these deposits.

What was the source for the material that composes these older alluvial fans? These layers of conglomerate become thinner farther to the east, suggesting they eroded from mountains to the west. Within this conglomerate is the story of a former landscape that predated Golden Canyon and the dramatic basin of Death Valley.

4 The Restless Earth

What existed before Death Valley? The rocks of Golden Canyon provide evidence of an older basin. The tilted layers surrounding you were nearly horizontal when they were initially deposited. Why do these layers tilt so steeply now? Movement along the major faults of Death Valley has created a large fold centered near the Texas Springs Campground. In the process, these basin sediments have been uplifted and tilted, and erosion now carries sediment out to a new valley floor. Tilted layers of rock are relatively common in Death Valley; tortured rocks have been fractured, faulted, and folded because of the dynamic tectonic activity that continues to shape this restless land.

5 Long Gone Lake

As you walk up Golden Canyon, you travel through an ancient, changing landscape. Look closely at the rocks exposed in the canyon walls. The conglomerate layers containing large boulders have given way to light-colored deposits of silt and clay. Such fine-grained sediment typifies debris deposited at the bottom of a calm lake. These mudstones are thought to be of similar age to the conglomerate described at Stop 3. In crossing the boundary between these different rock layers, you have walked across an alluvial fan and into a lake!

6 Ripples in Time

Imagine standing at the edge of the lake that once covered this area. Light sparkles off shimmering water, and shorebirds skitter through the shallows. Small waves gently lap at the shore, forming ripples in the loose sand. Amazing! It was so different than Death Valley today!

Examine the surfaces of the tilted rock layers in the canyon walls around you. Do you observe the undulating pattern? These ripple marks formed at the lakeshore about five million year ago. Preservation of their delicate pattern required rapid burial beneath another layer of sediment. In other places in Death Valley, fascinating fossil footprints of large mammals are exposed in such lake deposits.

7 Salt of the Earth

In this section of canyon wall, you can see deposits of white minerals. These delicate crystals grew as mineral-laden water evaporated. Please treat the crystals with care so other hikers can see them too.

Mineral deposits similar to these are currently forming on the floor of Death Valley. Water carries dissolved sodium, chlorine, sulfur, calcium, boron