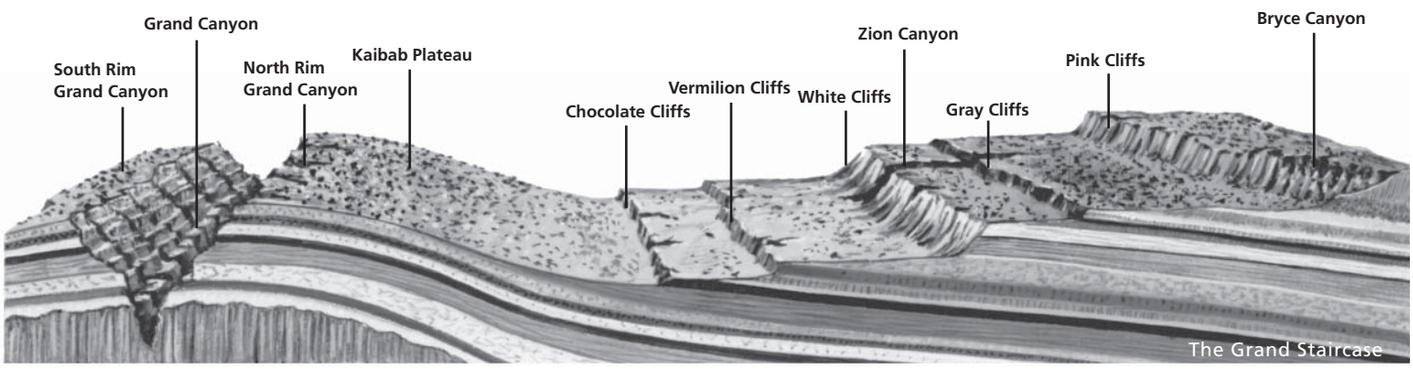
Zion

National Park Service
U.S. Department of the Interior

Zion National Park

The Geology of Zion



Zion is located along the edge of a region called the Colorado Plateau. Uplift, tilting, and erosion of rock layers formed a feature called the Grand Staircase, a series of colorful cliffs stretching between Bryce Canyon and the Grand Canyon. The bottom layer of rock at Bryce Canyon is the top layer at Zion, and the bottom layer at Zion is the top layer at the Grand Canyon.

The Geologic Story

Zion National Park is a showcase of geology. The arid climate and sparse vegetation expose bare rock and reveal the park's geologic history.

Sedimentation
Zion was a relatively flat basin near sea level 275 million years ago. As sands, gravels, and muds eroded from surrounding mountains, streams carried these materials into the basin and deposited them in layers. The sheer weight of these accumulated layers caused the basin to sink, so that the top surface always remained near sea level. As the land rose and fell and as the climate changed, the depositional environment fluctuated from shallow seas to coastal plains to a desert of massive windblown sand. This process of sedimentation continued until over 10,000 feet of material accumulated.

Lithification
Mineral-laden waters slowly filtered through the compacted sediments. Iron oxide, calcium carbonate, and silica acted as cementing agents, and with pressure from overlying layers over long periods of time, transformed the deposits into stone. Ancient seabeds became limestone; mud and clay became mudstones and shale; and river sand and sand dunes became sandstone. Each layer originated from a distinct source and so differs in thickness, mineral content, color, and eroded appearance.

The Colorado Plateau

Uplift
In an area from Zion to the Rocky Mountains, forces deep within the earth started to push the surface up. This was not chaotic uplift, but slow vertical hoisting of huge blocks of the crust. Zion's elevation rose from near sea level to as high as 10,000 feet above sea level.

Uplift is still occurring. In 1992 a magnitude 5.8 earthquake caused a landslide visible just outside the south entrance of the park.

Erosion
This uplift gave the streams greater cutting force in their descent to the sea. Zion's location on the western edge of this uplift caused the streams to tumble off the plateau, flowing rapidly down a steep gradient. These streams began eroding and cutting into the rock layers, forming deep and narrow canyons. Grain by grain the Virgin River has carried away several thousand feet of rock that once lay above the highest layers visible today.

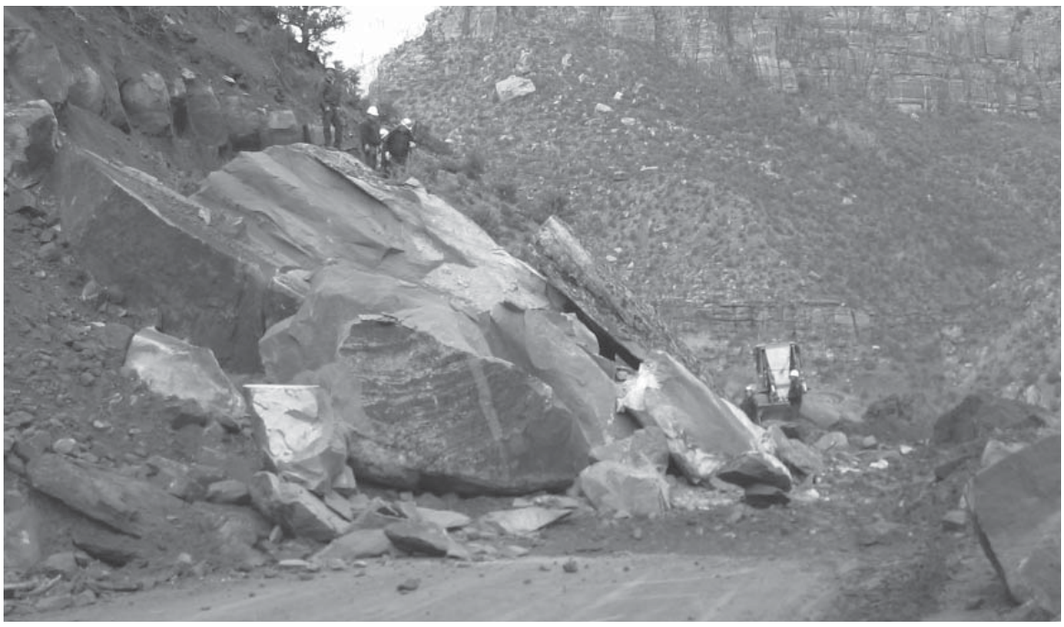
The Virgin River is still excavating. Upstream from the Temple of Sinawava, the river cuts through Navajo Sandstone, creating a slot canyon. At the Temple, the river has reached the softer Kayenta Formation below. Water erodes the shale, undermining the overlaying sandstone and causing it to collapse, widening the canyon.

Volcanic Activity
Volcanic vents, created as a result of the weakening of the Earth's crust during uplift, allowed lava flows and cinder cones to form. Cinder was piled several hundred feet high in classic cone shapes and lava flowed into valleys. Cinder cones and black basalt flows are visible west of Rockville and on Kolob Terrace.

Geology in Action

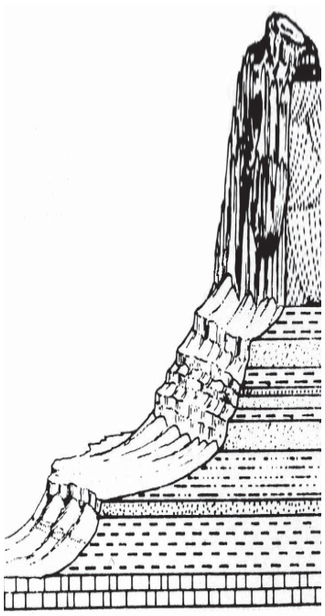
A landslide once dammed the Virgin River forming a lake. Sediments settled out of the quiet waters, covering the lake bottom. When the river breached the dam and the lake drained, it left behind a flat-bottomed valley. This change in the character of the canyon can be seen from the scenic drive south of the Zion Lodge near the Sentinel Slide. This slide was active again in 1995, damaging the road.

Flash floods occur when sudden thunderstorms dump water on exposed rock. With little soil to absorb the rain, runoff occurs quickly. These floods often occur without warning and can increase water flow by over 100 times. In 1998, a flash flood increased the volume of the Virgin River from 200 cubic feet per second to 4,500 cubic feet per second, again damaging the scenic drive at the Sentinel Slide.



Geology is not something that "happened" in the past. It is a constant force that continues to change the landscape. Earthquakes, flash floods, and rockfalls are sudden reminders that the earth is dynamic. Rock falls are common in Zion. This 700-ton rock blocked the Zion-Mt Carmel Highway on the switchbacks for two days in February, 2005.

Geologic Formations



Rock Layer	Appearance	Where To See	Deposition	Rock Type
Cinder cones and lava flows	black layers and cones	Kolob Terrace and west of Rockville	lava flows and cinder cones	basalt and cinders
Carmel	cliffs	Mt. Carmel Junction	shallow sea and coastal desert	limestone, gypsum, sandstone
Temple Cap	cliffs	top of West Temple	desert	sandstone
Navajo Sandstone	steep cliffs 1,600 to 2,200 feet thick red lower layers are colored by iron oxides	tall cliffs of Zion Canyon; highest exposures are West Temple, Checkerboard Mesa believed to be the tallest sandstone cliffs in the world	desert sand dunes covered 150,000 square miles shifting winds during deposition created cross-bedding	cross-bedded sandstone
Kayenta	rocky slopes	throughout canyon	streams	siltstone and sandstone
Moenave	slopes and ledges	lower red cliffs seen from Zion Canyon Visitor Center	streams and ponds	siltstone and sandstone
Chinle	purplish slopes	above Rockville	streams	shale, loose clay, conglomerate
Moenkopi	chocolate cliffs with white bands	rocky slopes from Virgin to Rockville	shallow sea	shale, siltstone, mudstone, others
Kaibab	cliffs	escarpment along I-15 near Kolob Canyons	shallow sea	limestone