Anza-Borrego Desert State Park

National Natural Landmark 1974

Photo: MIke Fuller

Canyon Cutting

The mountain fronts along the western side of Anza-Borrego Desert State Park consist of a sequence of parallel canyons and arroyos. Some canyons are visually dramatic and easy to see: Henderson, Borrego-Palm, and Hellhole. Each owes its existence to catastrophic and episodic erosion by running water, which removes rock debris from high ground and deposits it along valley margins and in low desert flood basins. Few canyons sustain a year-round stream. Most remain dry, draining occasional snow melt from high, forested ridges.

Feature(s):

Erosion, canyons, and alluvial fans

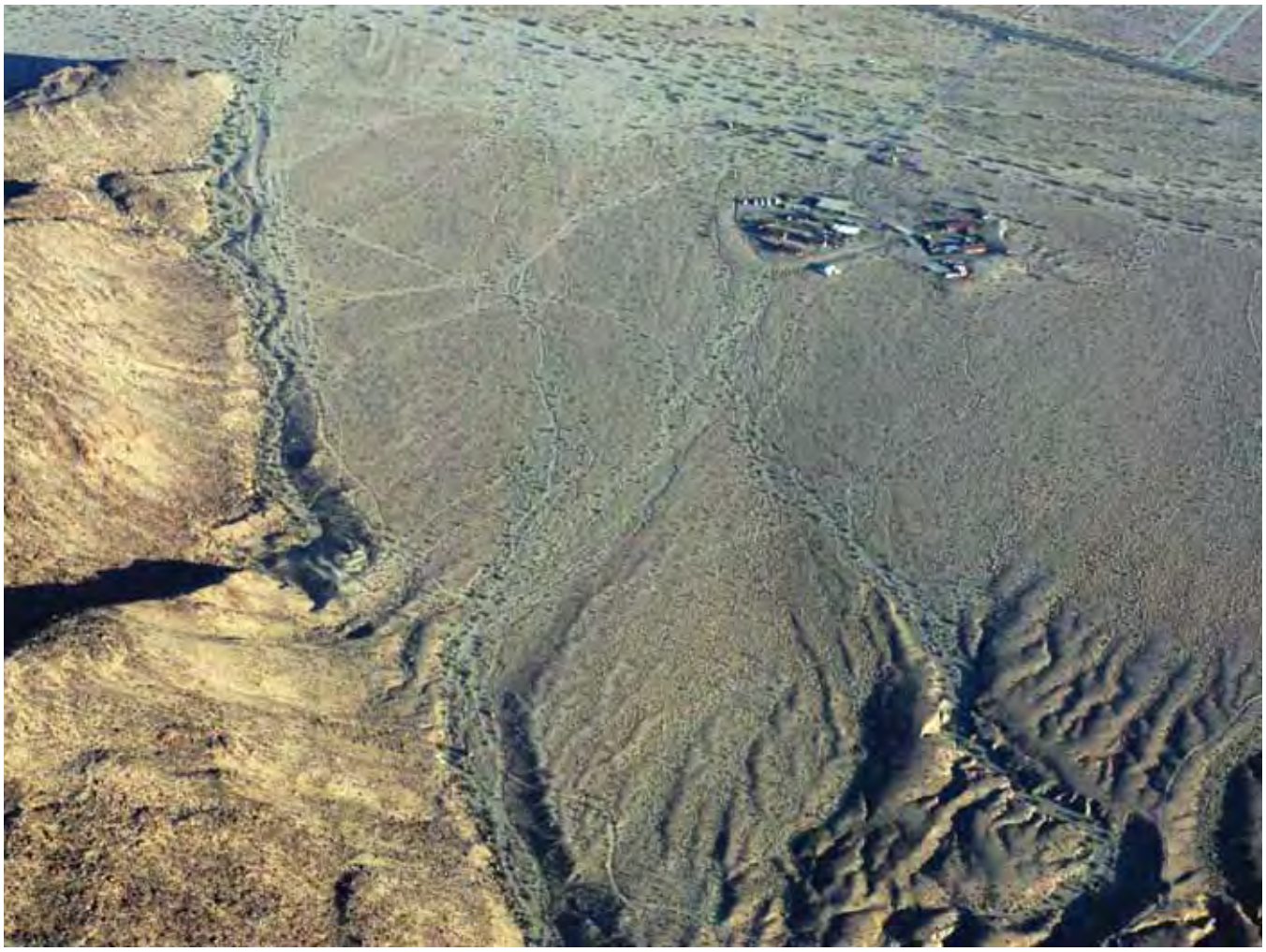
Borrego-Palm Canyon is tucked between the monolithic walls of Indianhead and San Ysidro Peak. A trail allows easy access to sheltered palm groves, cascading waterfalls, a gurgling brook, and whorls of polished crystalline rock.

Why it's important: Anza-Borrego's rugged landscape formed largely by the forces of erosion attacking the uplifted mountains. The higher the mountains rise, the more vigorously they are attacked by rain, snow, ice, and wind, as they yield to the constant pull of gravity. Weathering and erosion slowly wear down peaks and cliffs to produce huge volumes of sediment.

The sediment moves through canyons and washes, onto expansive alluvial fans at the base of the mountain slopes, mouths of canyons, and onto basin floors. Often this occurs in large pulses carried by dangerous flash floods.

The placid brook in Borrego-Palm Canyon may seem incapable of carving through several thousand feet of rock; however, when occasional rains strike, they can inundate the desert canyons in flash floods. Such sudden and heavy rainstorms occurred on September 10, 1976 during Hurricane Kathleen, between August 16 and 17, 1977 during Hurricane Doreen, and between February 27 and March 1, 1990 during a major winter storm.

The most recent flash flood event occurred on the afternoon of September 10, 2004. Runoff soon funneled down every crack and crevice, purging side canyons of debris and rubble in rills, then rivulets, building and gathering momentum as sediment-choked torrents. The narrow canyon acted as a sluice for the rushing water. The flash flood waters flooded half the campground and employee residences, and littered the desert floor with mud, debris, boulders, and palm trunks as far east as the de Anza country club and golf course. Neighborhoods surrounded by the park were submerged in a blanket of gooey mud over two feet thick. The waters carried huge boulders out onto the alluvial fan, followed by cobbles, then pebbles, sand, silt, and mud farther from the canyon mouth. The smaller the fragment, the farther it was carried out onto the alluvial fan or into the basin.



Alluvial Fans

Alluvial fans form where steep, confined mountain streams flow out (debouch) onto a valley floor. They consist of sand, gravel, and boulders deposited during myriad flood events. These flood flows are thick with debris eroded from the mountains and canyons. The debris largely consists of mud, rocks, and vegetation. Depositional patterns are characterized by a distributary system of channels that convey flood waters and sediment onto the fan surface.

Major fans occur at the mouths of Coyote, Henderson, Borrego-Palm, and Hellhole Canyons along the western edge of Borrego Valley. These delta-shaped outwash plains radiate from an apex where the stream channel emerges from the canyon. The coarsest and thickest deposits occur near the mouth and include a variety of boulders and cobbles. Gravelly sands, sand, silt, and clay occur immediately down-gradient, representing sheet flood deposits more distant from the canyon mouth. If fine-grained sediments reach the basin floor, they contribute to playa deposits of mud and silt. Good examples of this can be seen in Borrego Sink and Clark Dry Lake.

On unconfined alluvial fan surfaces, drainages become choked with alluvium and begin to level out. Streams will eventually breach their own levees to seek steeper gradients with less resistance. Shifting from side to side, they eventually re-distribute their sediments like a windshield wiper, back and forth. Flash flood waters tend to maintain fan symmetry over time, building up the alluvial fan.

Fans expand with repeated outpourings of debris, spreading so extensively that they may coalesce laterally along a mountain front. Such a merger is called a "bajada." Connecting older mountain canyons to desert floor, bajadas are temporary storage for sediments en route to the basins. Youthful mountain canyons are short and steep, and have isolated alluvial fan cones growing along their western bases. The lower ends of the fan cones interfinger with finer-grained playa sediments collected in the actively subsiding basin of Clark Dry Lake or interfinger with sand deposits emanating from Rockhouse Canyon. Uplift has been so recent that erosion has had little time to modify the face of the mountain fronts.

In the southern area of the state park, faults that parallel mountain ranges have elevated the older fans, rejuvenating their channel gradients. Streams entrench into these earlier deposits, and build up a staircase of new alluvial cones basinward. Such features occur along the Tierra Blanca Mountains north and south of the small town of Canebrake along the Tierra Blanca Mountains Frontal Fault, and on the northern side of San Felipe Creek west of Tamarisk Grove along the San Felipe Fault.

Final Thoughts

Flood by flood, deposition is the last chapter of the erosion cycle. Sediments transported downstream eventually collect in low-lying desert basins without external drainages—Borrego Sink, Clark Dry Lake, or the Salton Basin. These comparatively young structural depressions are filled with thousands of feet of interbedded silt and clay playa deposits.

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