ROCKS FOR SHOTS

How knowing a little geology makes you a better landscape photographer

TEXT AND PHOTOGRAPHY BY JAMES KAY

I can still recall the first time I laid eyes on the red rock country around Moab, Utah. Having spent the first 18 years of my life in the rolling green hills of New Jersey, it was like stepping out of a spaceship onto the surface of Mars. Nothing could have prepared me for this other-worldly landscape of soaring cliffs, deep canyons and sparkling snowcapped peaks. As alien as the land seemed, or perhaps just for that reason, I was compelled to learn more about how this remarkable assemblage of rocks came to be. My bookshelves soon overflowed with geology books on the region, and as my knowledge increased, I discovered that I could use this information to locate beautiful subjects to photograph, just like geologists know where to look for gold based on their knowledge of the terrain.

A Brief History Of The Colorado Plateau

Before I explain how I did this, allow me to provide an overview of the geologic history of this remarkable region. Known to most of us as the red rock and canyonlands country, the Colorado Plateau contains all the famous rivers, canyons, mesas and buttes of the Amer-

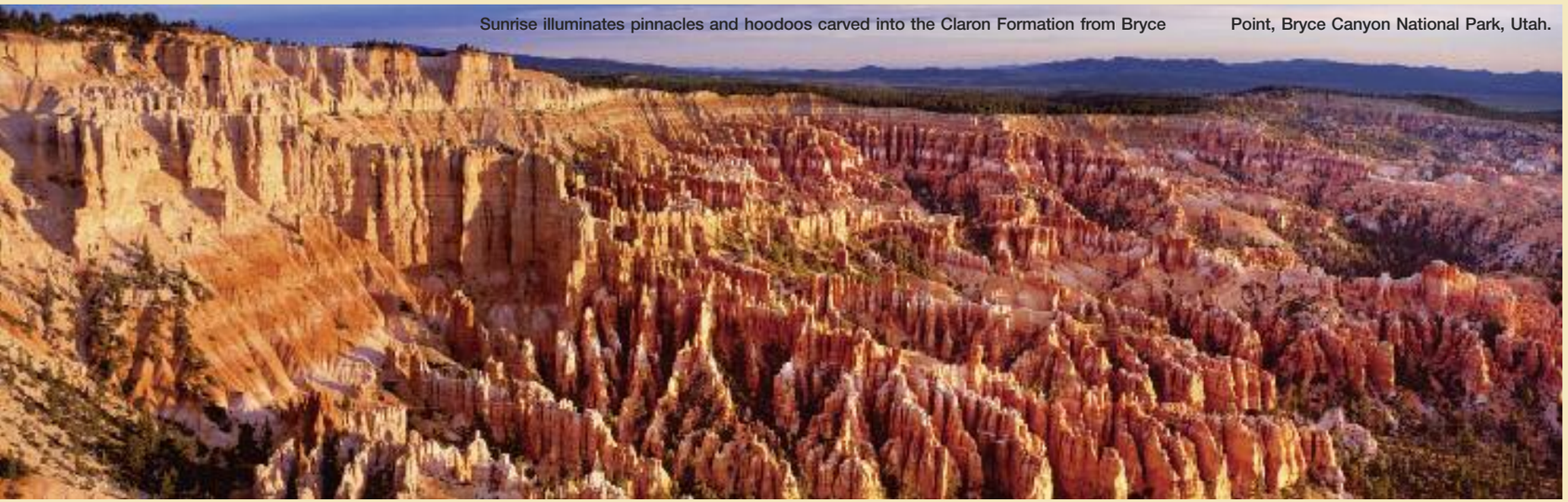
ABOVE: Water-sculpted Navajo Sandstone in Antelope Canyon, Navajo Nation, Arizona.

RIGHT: The Left Fork of North Creek flows over a ledge of maroon-colored Kayenta Formation in Zion National Park, Utah.

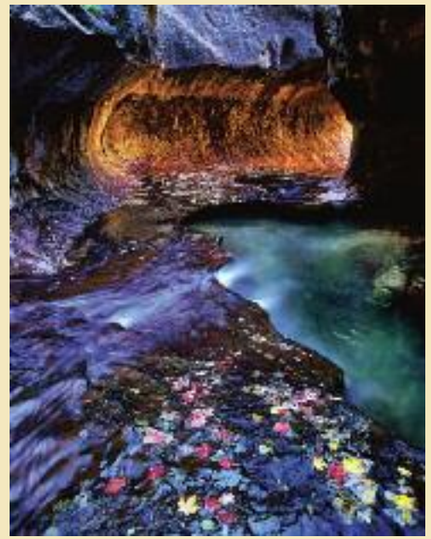
ican Southwest, from the depths of the Grand Canyon to the windswept heights of those snowcapped peaks above Moab. This major geologic province measures 130,000 square miles in extent and covers four Western states. To outline the region, trace a rough line from the Uinta Mountains in northeastern Utah down to Las Vegas, then southeast through Sedona, Ariz., to Albuquerque, N.M., and then north through western Colorado back to your starting point.

No other place on earth comes close to matching the overwhelming display of bizarre landforms exposed here. What confluence of geological events in the distant past created this remarkable landscape? To sum it up in a nutshell, this crumpled, dissected, convoluted country owes its looks today to the fact that it spent most of the last 500 million years either slightly above or slightly below sea level as a mostly featureless

Evening light illuminates hoodoos of Entrada Sandstone in Goblin Valley State Park, Utah.



Sunrise illuminates pinnacles and hoodoos carved into the Claron Formation from Bryce Point, Bryce Canyon National Park, Utah.



Left Fork North Creek carves through a layer of the Kayenta Formation to form a tunnel known as The Subway in Zion National Park, Utah.

flat surface. As sea levels fluctuated due to periodic Ice Ages or enormous ocean-floor basalt flows, or as the land itself rose or fell due to tectonic forces, ocean water would invade across the low, flat landscape and retreat again when sea levels dropped. When the sea flooded the land, thick layers of limestone were deposited on the ocean floor, and fine-grained sediments, supplied by large rivers, rained down into the depths. When the seas retreated, these same sediment-laden rivers swept across the land surface and deposited enormous quantities of sand and mud on their extensive flood plains. When changing climate dried up the rivers, these sandy sediments would blow across the region to create vast dune fields reminiscent of today's Sahara only to be inundated again by shallow seas. This never-ending ebb and flow between wet, dry, riverine and oceanic environments eventually laid down a layer cake of river floodplain, tidal mudflat, shallow water and eolian (wind-blown sand dune) deposits, which have now been uplifted and exposed for us to photograph. Talk about luck!

As we look into the details, the story gets even more interesting. Remember those rolling green hills of New Jersey where I grew up? It may seem difficult to believe, but the Appalachian Mountains actually played a key role in the formation of the rock layers across the Plateau. Travel back in time 300 million years when the Appalachians were of Himalayan proportion, located near the equator and perhaps the highest and most extensive mountain range the planet has ever seen. This enormous range extended from what's now northeastern Canada down through Texas and central Mexico. The lands of today's American West were a vast floodplain to the northwest of these mountains where huge rivers transported and deposited prodigious quantities of sediments during their journey to the sea. As these sediments were laid down over the next 100 million years, the landscape varied between lush dinosaur-infested Jurassic swamps and vast sand dune fields. The largest of these dune fields produced the famous Navajo Sandstone we see today. Remarkably enough, when we look at the most familiar layers of Navajo, Kayenta, Wingate, Chinle and Moenkopi now exposed all across southern Utah, we're seeing the eroded remains of the Appalachian Mountains. At this same time, a comparatively miniscule range called the Ancestral Rockies rose in what's now Colorado and contributed its sediments to the mix as well (these mountains were worn flat by the time today's Rockies rose and have no relation to them).

Beginning about 225 million years ago (mya), another lofty range began to rise to the west and south of the Plateau region in what's now Nevada and Arizona. These mountains likely resembled the Andes in scale and were shoved up into the sky by the collision of the Farallon Plate with the western edge of North America. This collision started when North America began to separate from Europe as the supercontinent of Pangaea split apart to form the Atlantic Ocean. For the next 200 million years, rivers draining these mountains deposited thousands of feet of additional sediments across the Plateau region. Like the Andes today, these mountains also contained large stratovolcanoes that periodically sent clouds of volcanic ash east on the prevailing winds. These ash deposits provided the vivid colors we see today in the Chinle Formation of Arizona's Painted Desert and the Morrison Formation in southern Utah.

Beginning about 70 mya, geological events were set in motion that created the Rocky Mountains we know today. Known as the Laramide orogeny, this mountain-building episode began when the Farallon Plate, which for most of its tenure had slammed into the West coast and subducted at a steep 45° angle into the Earth's mantle, began to subduct at a much shallower angle, sliding beneath the North American continent all the way to the present location of Denver, Colorado, before diving into the mantle. This "flat-slab" subduction pushed up the entire Rocky Mountain chain, from Canada to New Mexico. As part of this same process, many of the Plateau's most recognizable landforms—the monoclines (uplifts) of the Waterpocket Fold, the San Rafael Swell and the Grand Canyon's Kaibab Plateau—were also

Colorful outcrops of the Brushy Basin Member of the Morrison Formation near Hanksville, Utah.

shoved into the sky. In addition to the creation of individual mountain ranges and monoclines during this period, the entire interior West, from the Sierra Nevada Mountains to western Kansas, was uplifted thousands of feet.

By the end of the Laramide orogeny about 40 mya, the Colorado Plateau region was surrounded by mountains— the Rockies to the east and those old Andean-style mountains to the west and south. It was a high-elevation basin with no outlet to the sea. Rivers drained into this basin from the surrounding highlands to create inland lakes much larger than today's landlocked Great Salt Lake. Rivers draining into one of these lakes deposited the colorful Claron Formation of Bryce Canyon National Park. As one of the youngest layers now exposed on the Plateau, the Claron forms the top layer in the "Grand Staircase" of rock strata that steps south from the 9,000-foot rim of Bryce to the bottom of the Grand Canyon where the Colorado River laps at the 1.7-billion-year-old Vishnu Schist.

The final step in the formation of the landscape we see today involved the evolution of the Colorado River. Geologists now seem to be coalescing around the idea that the uplift caused by the Laramide orogeny, followed by the collapse of the Basin and Range Province to the south and west around 20 mya, first allowed the ancestral Colorado River to begin nibbling away at the southwestern edge of the Plateau. The full length of the Colorado River as we know it today, from its headwaters in the Rockies to its delta in the Sea of Cortez, formed as recently as 6 million years ago, and allowed, for the first time, rivers and streams to begin carving down into the thick sandstone layers of southern Utah and Arizona to create all the deep canyons we recognize today. Much of this canyon-carving occurred during the various Ice Ages of the last 2.5 million years as enormous glaciers formed and melted in the Rocky Mountains. One can only imagine the prodigious volume of water carried by the Colorado and Green Rivers as thousands of cubic miles of ice melted at their headwaters. This period of erosion removed an estimated 6,000 vertical feet of rock from the Plateau's surface, all of which was carried away as sediment by the Colorado River and dumped into the Sea of Cortez. If you do the math, this amounts to about 130,000 cubic miles of material!

Field Guide Suggestions

As part of my workshops in southern Utah, I always include a brief discussion of the geologic history of the place we're photographing and, as a reference, I carry a copy of *Ancient Landscapes of the Colorado Plateau* by Ron Blakey and Wayne Ranney, with its beautiful full-color diagrams. In addition to this book, I also recommend *The Geology of the Parks, Monuments, and Wildlands of Southern Utah* by Robert Fillmore.

How To Use Geology For Your Photography

Now that I've provided the background, I'll explain how I use this information as a tool in my photography. I first put this knowledge to work about 20 years ago in my search for beautiful, narrow slot canyons. I noticed how the most photogenic ones were always carved into sandstones that had been deposited as windblown sand dunes; the Navajo Sandstone of Antelope Canyon is a classic example. These very uniform eolian sandstone layers allow streams to slice straight down into them with very little canyon widening. It should come as no surprise, then, that the most spectacular narrow canyons on the Plateau are found in the Navajo and Wingate Sandstones, both of which are eolian deposits. If you know how to identify these layers and know where they occur across the Plateau, it's a simple matter to find these beautiful canyons. I've used this technique to locate countless photogenic slots in the Escalante Canyons, the Waterpocket Fold and the San Rafael Reef, all of which contain extensive outcrops of both the Navajo and Wingate Sandstones.

It should also come as no surprise that Zion National Park, where Navajo Sandstone attains its maximum exposed thickness of 2,300 feet, has the deepest, narrow canyons on the Plateau. As thick as this Navajo layer is, several major streams in Zion have sliced all the way down through it to encounter the river-deposited Kayenta Formation below. As soon as the streams hit this Kayenta layer, the canyons begin to grow wider because the Kayenta crumbles away and causes the overlying solid blocks of Navajo to collapse into the canyons, thus widening them. This is precisely why Zion Canyon grows progressively narrower as you drive up canyon. The next time you park your car at the end of the road, look at the canyon walls at river level, and you'll see the Kayenta layer just starting to show.

Knowing how to identify this Kayenta layer has played a critical role in my photography. I soon discovered that wherever this layer is exposed along the floors of canyons with small streams, the water flowing across its surface produces beautiful sculpted pools and waterfalls such as in "The Subway" in Zion or the sensuous stream-carved formations along Coyote Gulch in the Escalante Canyons. If you explore canyons floored with Navajo Sandstone and follow the streams to the locations where they eventually cut all the way through the Navajo into the Kayenta—voilà—waterfalls! The Escalante region is replete with canyons like this.

Once you learn the basic geology of this remarkable landscape, not only will you come to appreciate the region more, but your photography will benefit as well. **OP**

*You can see more of **James Kay**'s photographs and sign up for his workshops at www.jameskay.com.*