Geologic Gems of California's State Parks

California is a veritable treasure chest of nationally acclaimed natural landmarks and much adored scenery. This geologic legacy on display in the landscape can be observed throughout California's State Park system. We selected exemplary units of the State Park system to highlight California's geologic legacy. The selected parks are dubbed "GeoGems."

◀ The rugged cliffs of **Del Norte Coast Redwoods State Park** are composed of some of the most tortured, twisted, and mobile rocks of the North American continent. The rocks are mostly buried beneath soils and covered by vigorous redwood forests, which thrive in a climate famous for summer fog and powerful winter storms. The rocks only reveal themselves in steep stream banks, along road and trail cut banks, along the precipitous coastal cliffs and offshore in the form of towering rock monuments or sea stacks. Photograph: CalTrans staff

◀ **Patrick's Point State Park** displays a snapshot of geologic processes that have shaped the face of western North America, and that continue today. The rocks exposed in the seacliffs and offshore represent dynamic interplay between the subducting oceanic tectonic plate (Gorda Plate) and the continental North American tectonic plate. The boundary between the subducting oceanic plate and the continent has been filled with an "accretionary wedge" of material literally scraped off the oceanic floor and crust, partially subducted, and then pasted to the North American continent. Photograph: Jim Falls

▲ **Humboldt Redwoods State Park** has international reknown and is classified as both a World Heritage Site and an International Biosphere Reserve. The coast redwoods (sequoia sempervirens) exist only in a narrow band that runs for 500 miles from Monterey to just over the Oregon border. Needing a warm, moist, and foggy environment, coast redwoods are confined to the coast and elevations below 3,000 feet. Redwoods are "living fossils" dating back 100 million years to the Cretaceous Period—the time of the dinosaurs. The oldest redwoods range from several hundred to as much as 2,000 years old. Old growth groves are truly monuments of the past. Prior to the Ice Ages (1.8 million years ago), the redwood forests were much more widespread but became restricted to their present range due to cooler temperatures and regional uplift of the Coast Ranges. Photograph: Bret Koehler

◀ **Sinkyone Wilderness State Park** occupies a very distinguished geologic location near the junction of three of the major plates that make up the earth's crust. These three tectonic plates (the Pacific, North American, and Gorda plates) are bounded by major faults, including the San Andreas Fault just offshore of the park and the Mendocino fracture zone and Cascadia "mega-thrust" (a subduction zone) offshore and north of the park. Photograph: Don Braun

▲ The Ten Mile Dunes complex at **MacKerricher State Park** contains a unique, relatively pristine native dune and wetland ecosystem. The effects of climate change over the past several thousand years have been recorded by sediment deposits along the coast. Recurrent periods of dune formation and sea level oscillation have been associated with the Ice Ages and more recent climatic events. These shifting sands of time produced enclosed areas of water ponding that became vegetative microclimates such as Inglenook Fen and Sandhill Lake. Photograph Copyright 2002–2009 by Kenneth and Gabrielle Adelman

◀ At **Jughandle State Natural Reserve**, some lands are preserved not only for their scenic beauty or wilderness qualities, but are also protected because they are ecologically unique, such as the pygmy forest. The sequence of terraces provides a 500,000-year-long timeline of soil and plant community development that shows the interplay of biology and geology like nowhere else. Photograph Copyright 2002–2009 by Kenneth and Gabrielle Adelman

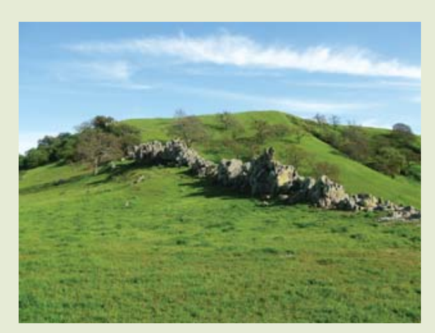
◀ Geologic oddities at **Schooner Gulch State Beach** have arisen from unusual combinations of unrelated geologic conditions. One such example is Bowling Ball Beach where concretions (odd enough in their own right), tilted outcrops of alternating hard and soft strata (not unusual), and wave erosion along the coastline (very common) combine to create a very unusual spectacle. Fortunately, the State of California values these treasures and protects them for all to see in their natural setting. Photograph: Jennifer Lotery

▲ At **Robert Louis Stevenson State Park**, unlike most of the northern California Coast Ranges, the Mayacama Mountains are largely volcanic in origin. The rocks that form Mount St. Helena and the Palisades are part of a group of rocks known as the Sonoma volcanics. The Sonoma Volcanics erupted from a number of different volcanic centers in the Napa-Sonoma region between 2.6 and 8 million years ago. Photograph: Mike Fuller

▲ At **Salt Point State Park,** how and why tafoni has formed remains a geological mystery. The beds that formed from density currents reveal undersea processes and conditions that are rarely witnessed. The exposures are a magnet for study by amateurs, students, and professional geologists. The beds lie immediately west of the San Andreas Fault and provide a key timeline and geologic marker for fault studies. Photograph: Mike Fuller

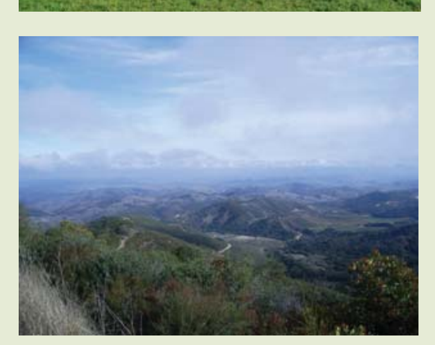
◀ The landforms and underlying geology found at **Fort Ross State Historic Park** illustrate a dynamic history of shifting tectonic plates (giant fragments of the earth's crust) and fluctuating sea level. The park is situated at the active continental margin, where the Pacific Plate and the North American Plate are moving slowly past each other along the San Andreas Fault. East of the fault, rocks of the Franciscan Complex form the core of the northern California Coast Ranges. To the west, rocks of the Point Arena terrane represent a displaced sliver of the earth's crust that has been dragged northward along the fault for millions of years. Photograph: Mike Fuller

◀ At **Mt. Tamalpais State Park**, the Franciscan Complex has perplexed geologists from around the world, and has served as an important proving ground for modern plate tectonic theories. It provides an excellent above ground laboratory of what happens in subduction zones beneath the oceanic crust and continental crust. Photograph: Mike Fuller



◀ **Mount Diablo** is a dominant topographic feature in northern California. It was established in 1851 as the initial point of the Mount Diablo Base Line and Meridian for land surveys spanning two-thirds of California and all of Nevada. The mountain's summit boasts spectacular panoramic views. Photograph: Mike Fuller

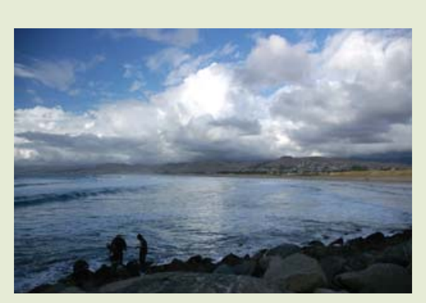
◀ **Wilder Ranch State Park** is situated in the California Coast Ranges at the continental margin, a tectonically active zone where the San Andreas Fault system forms the boundary between the Pacific Plate and North American Plate. As these two enormous pieces of the earth's crust grind slowly past one another, the lands along the plate boundary have been sheared, buckled, squeezed and deformed on a monstrous scale. Photograph: Mike Fuller



▲ Landforms and underlying geology found at **Hollister Hills State Vehicular Recreation Area** embody a dynamic history of shifting tectonic plates—giant fragments of the earth's crust. The park is situated at the active continental margin, where the Pacific Plate and the North American Plate are moving slowly past each other along the San Andreas Fault. Photograph: Steve Reynolds

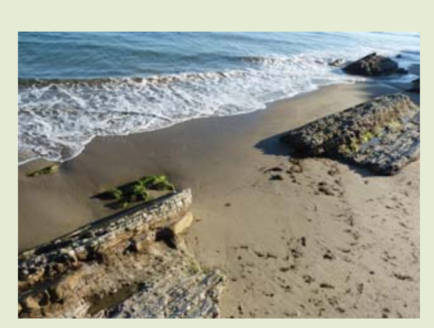
▲ **Hungry Valley State Vehicular Recreation Area** lies in the heart of a complex geologic structure known as the Ridge Basin. The highly deformed rocks within the park bear stark witness to the tremendous forces that characterize the interplay between the San Andreas and San Gabriel Faults, which bound the basin and the park. Photograph: Steve Reynolds

◀ At **Point Lobos State Natural Reserve**, the rocks offer many interesting features for inquisitive visitors to contemplate, but are of particular significance to geologists because they provide clues to decipher movements along the San Andreas Fault system and to the dynamic history that produced the California Coast Ranges. Photograph: Mike Fuller

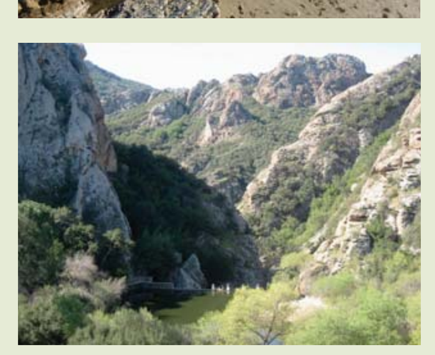


▲ **Morro Bay State Park** and **Montaña de Oro State Park** are renowned for their spectacular scenery produced over millions of years by volcanic activity, plate tectonic interactions (subduction and collision), and erosion to shape this unique landscape. Marine terraces are evidence of regional uplift. Photograph: Alan Schimierer

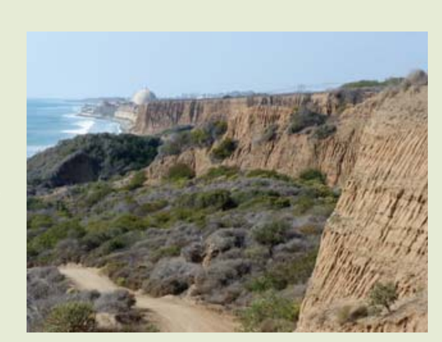
◀ The rocks that make up **Point Sal State Beach** represent one of the most intact and complete cross sections of oceanic crust visible on land. Oceanic crust comprises 60% of the earth's crust, yet we rarely have opportunities to see it and study its formation. The rocks at the park record geologic conditions that indicate submarine origin and widespread transport via plate tectonics. Oceanic crust is produced at ocean spreading centers and consumed in subduction zones. Photograph: Will Harris



◀ The coastal bluffs at **Gaviota State Park** reveal a 500 foot-thick cross-section of the geographically extensive Monterey Formation. Offshore and inland, petroleum geologists have extensively explored underground for oil reservoirs within this rock sequence and probed its depths to understand the genesis of this important oil source. The naturally cemented, bluff faces resist wave erosion and are tilted to display multiple layers like the pages of a book. The geologic layers contain some nicely preserved fossils, even the complete skeleton of a halibut-like fish. Photograph: Jennifer Lotery



◀ **Malibu Creek State Park** contains excellent exposures of the Topanga Group that cover large portions of the modern Santa Monica Mountains of the Transverse Ranges geomorphic province. The Conejo Volcanics are one of several Miocene volcanic fields along the California coast that erupted in response to a major reorientation of the tectonic plate boundary between the North American tectonic plate, the subducting Monterey microplate, and the better known Farallon Plate. The reorientation caused local areas of extension and crustal thinning. The molten rocks below the thin oceanic crust ascended through the crust along fractures to the surface and erupted as volcanic rocks. Photograph: Pam Irvine

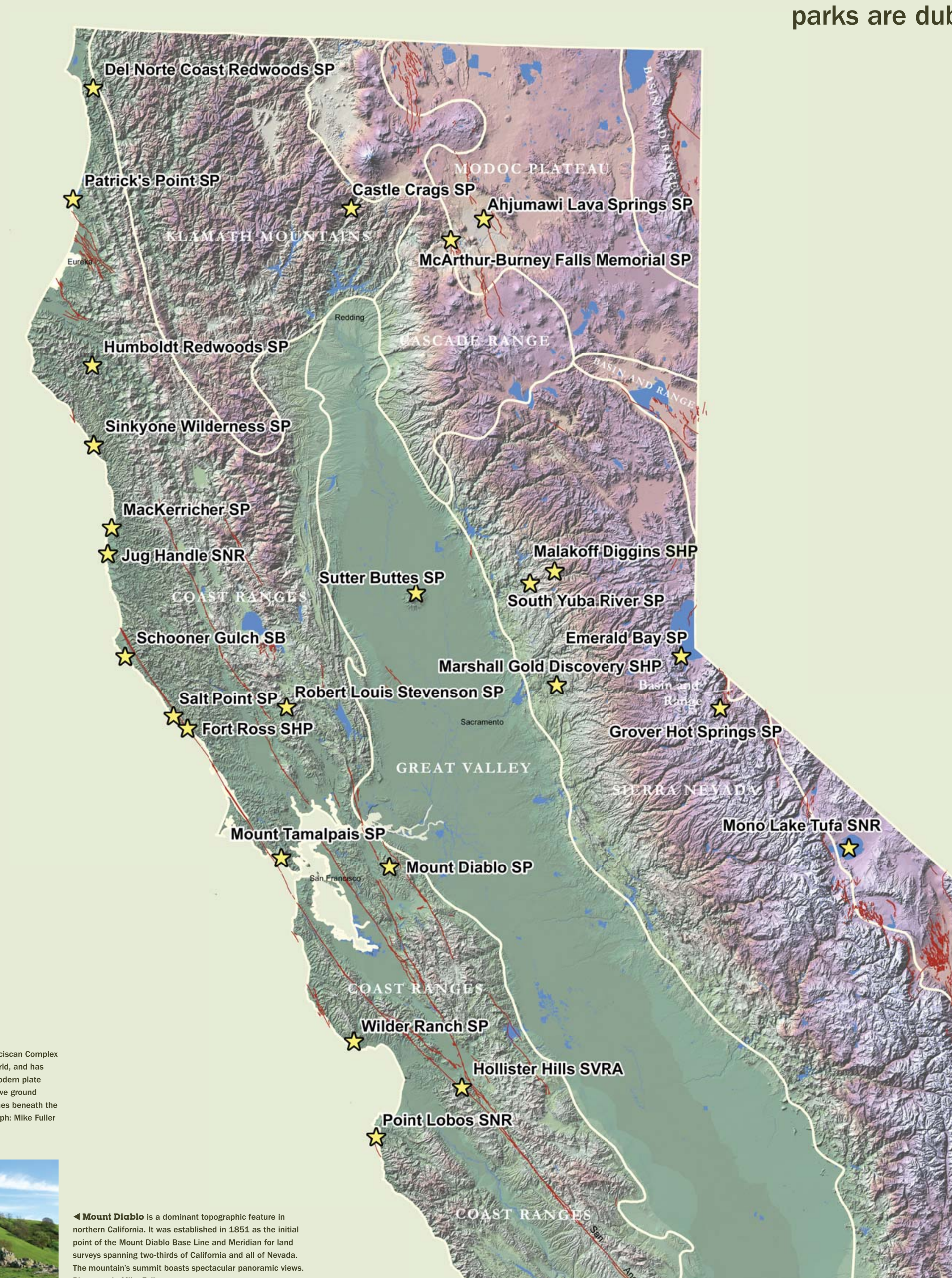


▲ **San Onofre State Beach** exemplifies the joys and challenges of living on the fragile coast. The scenic beauty derives from the panoply of geologic processes, many of which can be hazardous and difficult to manage. Landslides, massive erosion, and earthquakes are the results of a long geologic history that is readily on display within the park. Photograph: Mike Fuller

▲ **Anza-Borrego Desert State Park'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. Photograph: Mike Fuller

◀ **Torrey Pines State Natural Reserve** preserves habitat for North America's rarest and most geographically restricted type of pine tree species. Several natural processes interact to form the habitat for the pines. The reserve and beach are perfect places for visitors to see vestiges of past environments and their continuing influence on the landscape and to envision the dynamics of shoreline processes. Photo: Mike Fuller

◀ At **Cuyamaca Rancho State Park**, the rounded hills of granitic and metamorphic rock of the Peninsular Ranges are the deep roots of a much different ancient range that included volcanoes and high mountains possibly like the Andes. By examining these roots, we learn about the internal workings of other mountains. Photograph: Janis Hernandez




State Park GeoGems

SP: State Park
SB: State Beach
SHP: State Historic Park
SRA: State Recreation Area
SNR: State Natural Reserve
SVRA: State Vehicular Recreation Area

Geomorphic Provinces

Holocene Faults Active Within Last 11,000 Years

GIS Development: Mike Fuller, C.E.G., Jim Thompson

N W E S

Scale 1:1,250,000

0 15 30 60
Miles

0 37.5 75 150
Kilometers

◀ Few of California's State parks display impressive monoliths adorned like a castle with towering spires and few permit rock climbing. **Castle Crags State Park** is an exception. The scenic beauty is best enjoyed from a distant vantage point where one can see the range of surrounding landforms. The monolith and its surroundings are a microcosm of the Klamath Mountains where many such monoliths intrude and stitch together a crazy quilt of much older rocks. The surrounding rocks include the Trinity ultramafic sheet, the largest exposed body of ultramafic rock in North America. The ultramafic rock is often interpreted to represent an ancient ophiolite—a slice of the oceanic crust. Photograph: Christopher Mizeur

▲ Burney Falls at **McArthur-Burney Falls Memorial State Park** is an outstanding example of a waterfall and stream fed by large springs that are commonly associated with areas covered by recent lava flows, and also of a waterfall formed by the undercutting of horizontal rock layers. The soft white rock is diatomite. Its presence is evidence that a very large lake once filled the region and supported abundant tiny freshwater plankton called diatoms. Photograph: Michael Wopat

◀ "Ahjumawi" means "where the waters come together" in the Ajumawi language. This is a particularly appropriate description for **Ahjumawi Lava Springs State Park**, since the waters of Big Lake, Tule River, Ja She Creek, and Fall River all come together at this location. The springs at the park comprise one of the largest fresh water spring systems in the country. They discharge into Big Lake, Horr Pond, and Ja She Creek, which together form the headwaters of the East Fork of the Tule River (a major tributary to the Fall River). Photograph: Michael Wopat

◀ **Sutter Buttes State Park** contains the remains of a period of violently active volcanic eruptions between 1.35 and 1.6 million years ago. The origin of the Sutter Buttes has been hotly debated. The volcanic activity has been variously related to the Cascade Range to the North, to the Sonoma volcanics to the south and west, and to plate tectonic interactions deep below the terrestrial crust. Photograph: Mike Fuller

▲ **Emerald Bay State Park** is the California State Park system's premier glacial park—owing its spectacular scenery and dramatic alpine peaks, ridges, and crystalline lake to the scouring action of glaciers that existed at various times during the Pleistocene Epoch (11,500 to 1,800,000 years ago). Glaciers as thick as several hundred feet buried all but the highest peaks of the Sierra and tongues of ice pushed down from the Sierran crest and gouged out stream canyons, scraped off soil and weathered rock, deposited moraines and carved out lake basins. Photograph: Mike Fuller

◀ Once the **South Yuba River** watershed was the focal point of the California Gold Rush. Today, it is recognized by the California State legislature as a Wild and Scenic River with scenery of "Outstandingly Remarkable Value." This park which follows the river for 20 miles provides a very scenic geologic cross-section of a part of the State that played such prominent roles both geologically and economically in California's history. Photograph: Mike Fuller

▲ **Marshall Gold Discovery State Historic Park:** Although small amounts of gold had been found in other parts of California, it was the gold discovery at Sutter's mill that received world-wide attention in 1848. The discovery caused one of the largest mass migrations in history, bringing people to California from all over the world. Most prospectors who came did not strike it rich in the gold fields and returned home, but about ten percent stayed in California. Those who stayed contributed to California's unprecedented rapid commercial, agricultural and industrial development and statehood in 1850. Photograph: Mike Fuller

◀ At **Malakoff Diggins State Historic Park**, the ancient river gravels are important from a geologic perspective in that they provide insight into the timing of the geologic events that gave rise to the current Sierra Nevada. From the human perspective, the gold in the gravels was a source of vast wealth that drove the development of early California. Photograph: Mike Fuller

▲ **Grover Hot Springs State Park** is treasured for its beautiful alpine setting and alleged restorative and refreshing natural hot springs. For more than 100 years nature lovers have been drawn to the springs to bask in the warm mineral waters and absorb the pleasant views of the tranquil peaks surrounding the hot springs meadow. Photograph: Mike Fuller

◀ **Mono Lake Tufa State Natural Reserve** is one of the rare places in the world that contain such a unique group of geologic features. The tufa formations are notable for their unusual shapes and abundance. Extensively studied by scientists, they have aided our understanding of the climate history of this region. The extremely high salinity and alkalinity of Mono Lake has created a rare ecosystem, supporting a complex food chain of green algae, brine shrimp and alkali flies, and more than 80 species of migratory birds. Photograph: Mike Fuller

◀ The colorful badlands, cliffs and canyons of **Red Rock Canyon State Park** provide more than pretty scenery and a backdrop for movies. Hidden behind the scenes in the layers of rock is what amounts to paleontologists as a treasure trove. For almost a century, paleontologists have been combing through these layers and making important discoveries about the history of mammalian life in these parts. Photograph: Will Harris

◀ The **Providence Mountains State Recreation Area** contains the oldest rocks in the state park system and some of the most spectacular limestone caves in all of California. The caves are important to visitors for their spectacular beauty, but they also provide abundant information about the geologic and climatic history of the region. Photograph: California State Parks

◀ Major geologic forces are at play at **Ocotillo Wells State Vehicular Recreation Area** which is caught in a tug-of-war along the boundary between the North American and Pacific Plates. As the Peninsular Ranges of southern California and Baja move to the northwest with the Pacific Plate, they pull apart and tear the plate boundary along the San Jacinto Fault and the Salton Trough. Photograph: Mike Fuller

◀ **Picacho State Recreation Area** lies on the state border along the Colorado River which crosses the thirsty Sonoran Desert. The SRA characterizes the topography and geology of eastern California's Mojave Desert Geomorphic Province which overlaps the Sonoran Desert. This geologic landscape is continuous throughout southern Arizona—home of the northern Sonoran Desert. Photograph: John Mistchenko

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