The theory of plate tectonics explains so much about the world around us-mountains, great valleys, shorelines, sea beds-and yet it's hard to point to a particular rock or canyon, and say, "There! That's plate tectonics." Many Earth processes operate on time scales that are so long that we don't realize they're taking place right before our eyes. We're so small compared to Planet Earth that it's hard to get a true perspective. Let's gain a little elevation above one of North America's greatest examples of tectonic movement and see what comes into focus. Over California's San Andreas Fault, we'll be asking questions like "Can I really see evidence of plate tectonics?", "How does this fault actually move?", and "Am I likely to be directly affected by the San Andreas?"

While we're climbing, let's review some basics. Earth's rigid outer layer, called the lithosphere, is divided into seven dominant plates. When plates move around the surface of the Earth, they can interact in only one of three ways: they can converge, diverge, or they can slide past one another. During convergence, an oceanic plate usually slides under a continental plate. At divergent boundaries, plates are being pulled apart. The third interaction where plates slide past one another produces what's called a transform fault. Finally, it's tempting to think of plates as either thick continental or thin oceanic, but that's not always correct. The Pacific plate is mostly oceanic but has some continental lithosphere on its edges. Conversely, a lot of the North American plate is continental, but it also contains a large amount of oceanic lithosphere over on its eastern edge.

You gotta' understand, California is a mess. During past collisions, exotic terranes arrived here from all corners of the globe. Great volumes of magma beneath California rose toward the surface to become the Sierra Nevada. Volcanoes belched basalt that now covers many parts of the state. And then, beginning 28 million years ago, along comes the San Andreas Fault, slicing cleanly through this smörgåsbord, 750 miles south to north from the Salton Sea to Shelter Cove. The San Andreas offers a world-class illustration of two plates, North America and the Pacific, sliding past one another along a transform fault. The San Andreas Fault is a convergent plate boundary, stretches well out into the Pacific Ocean, defines part of the boundary between the Pacific and North American plates. In most of California, the San Andreas is the boundary between the Pacific and North American plates.

The first stop on our search for evidence of tectonic motion is Pinnacles National Park. The park's volcanic rocks have been eroded into elegant canyons and spires. These same rocks are also found in Antelope Valley, 195 miles to the southeast. Same age, same chemistry, same rocks. They were created as a single body 23 million years ago, but the two halves are now separated almost 200 miles by the San Andreas Fault. Pinnacles is riding aboard the Pacific Plate, moving steadily away toward the northwest.

The Calaveras Fault, a splinter of the San Andreas, lies directly beneath the town of Hollister where sidewalks buckle a little more every year. You can sit and stare, hoping to see movement on the fault, but if you blink, you'll miss it. Homeowners, though, know that their fences and foundations are being twisted maybe a quarter inch every year. In places, the presence of water can mark the trace of the San Andreas. Unlike northern parts of the state, central California tends to be dry, so any lake automatically stands out. So-called sag ponds are found where the fault has shoved up scarps that form small, enclosed basins. These otherwise unlikely lakes are found along the fault near Coalinga and in the San Benito Valley.

Now let's head for the Carrizo Plain. Not much grows here; some grass, an occasional scrub tree. The geology is stark, undeniable. This is Wallace Creek. Not surprisingly, it's dry today. When rain does fall, water flows west out of the Temblor Range. But something funny happens right here: the creek bed suddenly jogs to the northwest before resuming its westerly, downhill course. The jog marks the exact trace of the San Andreas Fault where lower Wallace Creek has been carried to the northwest. There’s an even older, lower part of the creek that’s been carried so far that it’s been cut off entirely from the upper section. In fact, creek beds all along the face of the Temblor Range show this offset, each in the same direction. If you stand on either side of the fault, the other side always moves to the right during an earthquake, so the San Andreas is called a right lateral strike-slip fault.

The San Andreas accommodates most movement of the Pacific plate as it slides past North America. Most, but not all. Did you notice the little jog in the San Andreas north of Los Angeles? The jog, called the Big Bend, acts locally to bind up movement between the two plates. Here, instead of just slipping occasionally, the two plates are squeezed together. As a result, the Transverse Ranges have been shoved thousands of feet above sea level in the last 2 to 4 million years.

How does offset occur along the San Andreas? In Hollister, we saw that a fault can slowly, inexorably creep. This is true because the fault isn’t locked, and the two edges glide past one another. But along most other portions of the San Andreas, movement is much more likely to be abrupt. Here the fault is usually locked, the respective plates continue to move, and stress builds up at the boundary. When the boundary eventually snaps, energy is instantly released as an earthquake. The Carrizo Plain experienced its last big earthquake in 1857 when the fault edges jumped 30 feet. 30 feet?

Do earthquakes matter? Of course they do. 30 million people live within a stone’s throw of the San Andreas fault. When the Loma Prieta earthquake struck San Francisco in 1989, 63 people died. But this occurred when just a small branch of the San Andreas slipped near Santa Cruz. Historically, major earthquakes have occurred along the main San Andreas fault, about every 150 years. The last time the San Andreas itself slipped beneath San Francisco was 1906, when thousands of lives were lost. A century has passed, and now millions more live in harm's way. The two plates are still moving relative to one another, almost an inch a year. Having studied the San Andreas, geologists know that the plates continue to move and that earthquakes will happen again.

What did you learn? A. Most earthquakes occur when adjacent blocks of lithosphere creep past one another as seen near Hollister, B.) are bent by continued plate motion, C.) suddenly move relative to one another. C.) Major earthquakes occur along the San Andreas fault when its two edges suddenly slip past one another.

This volcano was a single, intact cinder cone. Does it offer any clues about what sort of fault runs under this part of California's Death Valley National Park? Less than 300,000 years ago, magma rose along the southern Death Valley fault zone, where the lithosphere has already been fractured. Since then, movement along the fault split the cone and has carried the two halves apart. So, this is likely to be a strike-slip fault.