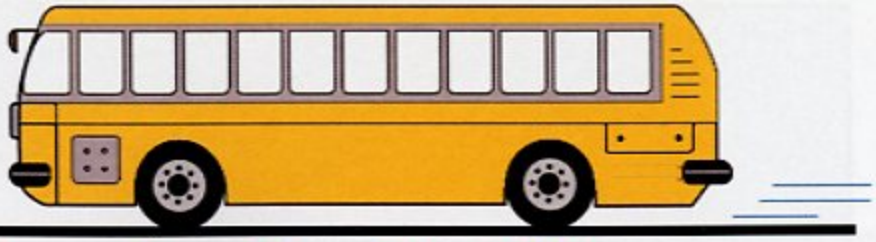
CALIFORNIA GEOLOGY

JULY/AUGUST
2000

$3.95

Teacher Feature



Looking for Faults in All the Right Places

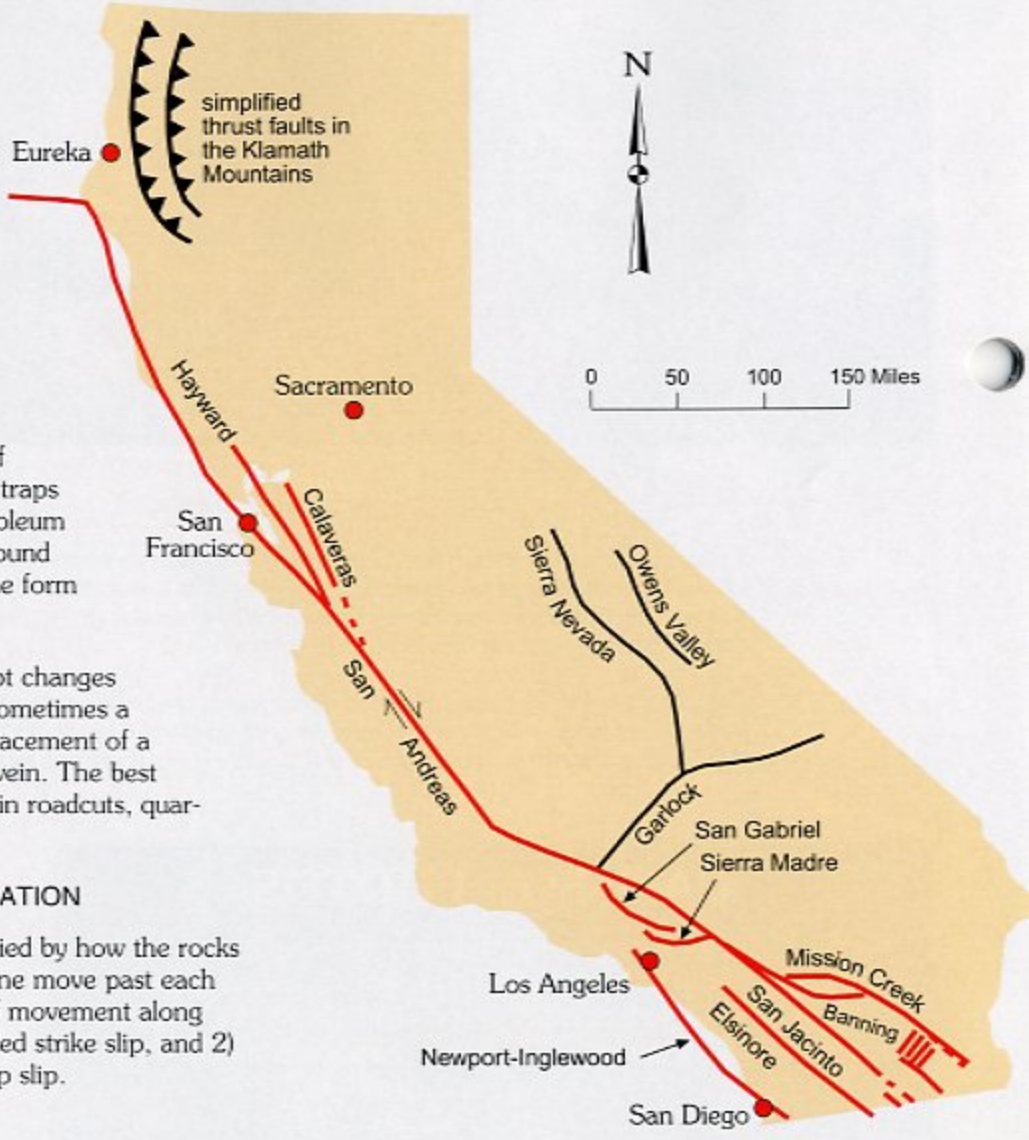
A fault is a fracture along which there is movement. Some faults are actually composed of several fractures called fault branches. Collectively the branches are a fault zone (see map).

California's diverse landscape and complex geology can be attributed to faulting. Many of the state's valleys, mountain ranges and desert areas show the effects of faulting. Faults create underground traps in which valuable reservoirs of petroleum form, and spaces in which underground waters deposit valuable metals in the form of veins and masses of ore.

Faults are distinguished by abrupt changes in rock structure or composition. Sometimes a fault can be recognized by the displacement of a particular feature such as a bed or vein. The best places to observe faults are usually in roadcuts, quarries and sea cliff exposures.

FAULT CLASSIFICATION

Faults and fault zones are classified by how the rocks on each side of the fault or fault zone move past each other. There are two main types of movement along faults: 1) a sideways movement called strike slip, and 2) an up or down movement called dip slip.

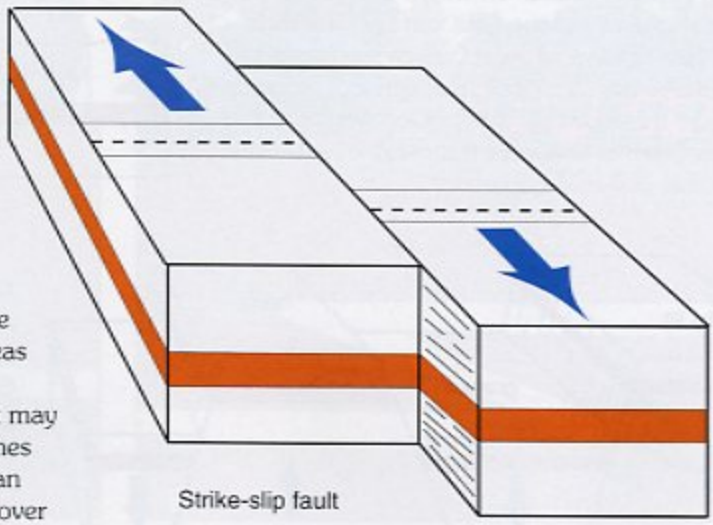


The San Andreas Fault system and its principal branches are identified by red lines. Some other faults are shown in black. *Modified from Geology of California, Norris and Webb, 1990.*

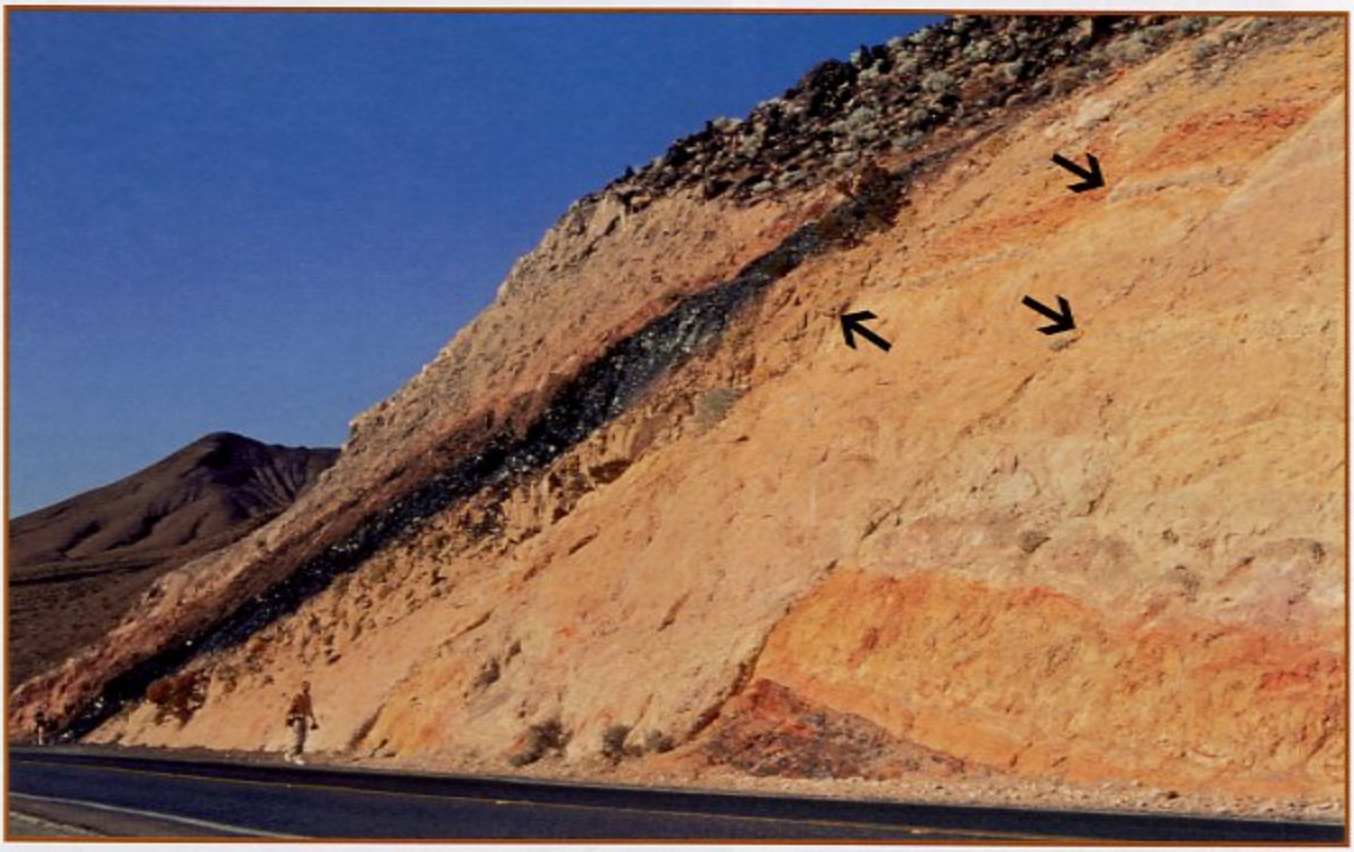
Strike-Slip Faults

The movement along a **strike-slip fault** is approximately parallel to the strike of the fault, meaning the rocks move past each other horizontally.

The San Andreas is a strike-slip fault that has displaced rocks hundreds of miles. As a result of horizontal movement along the fault, rocks of vastly different age and composition have been placed side by side. The San Andreas Fault is usually refered to as a fault zone rather than a single fault, and movement may occur along any of the many fault branches in the zone. The surface effects of the San Andreas Fault zone can be observed for over 600 miles.



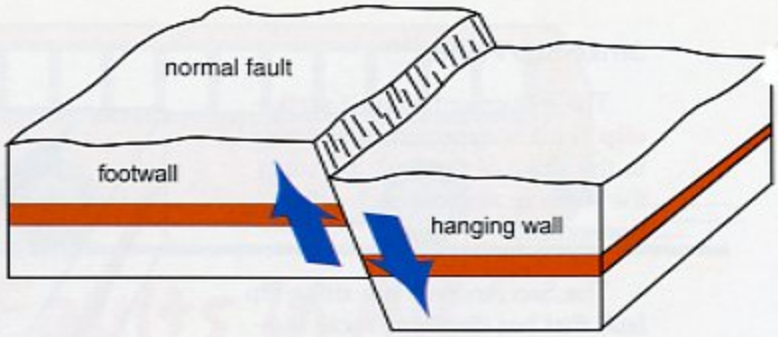
Strike-slip fault

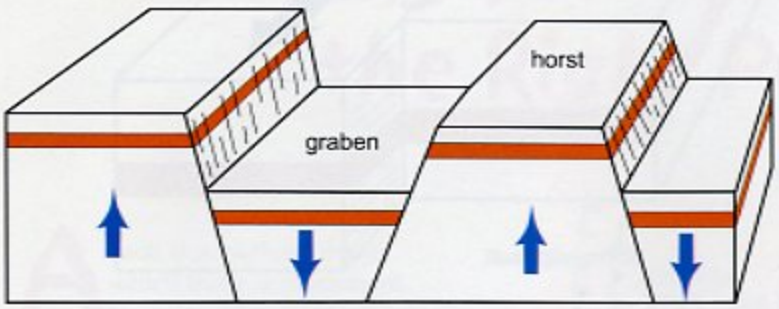


Faulting can sometimes get complicated when more than one fault is present. Multiple faults (arrows) are shown here cutting welded tuff layers (volcanic rock). The dark prominent black band on the left is volcanic glass and was probably dropped down relative to the rock on the right side. This roadcut is located near Resting Spring Pass along Highway 178 east of Shoshone, Inyo County, California. *Photo by John A. Karachewski, Walnut Creek, CA ©2000.*

Dip-Slip Faults

Dip-slip faults are faults on which the movement is parallel to the dip of the fault surface. **Normal faults*** are dip-slip faults on which the hanging wall** (the rocks above the fault surface) move down relative to the footwall** (the rocks below the fault surface). Normal faults are the result of extension (forces that pull rocks apart).

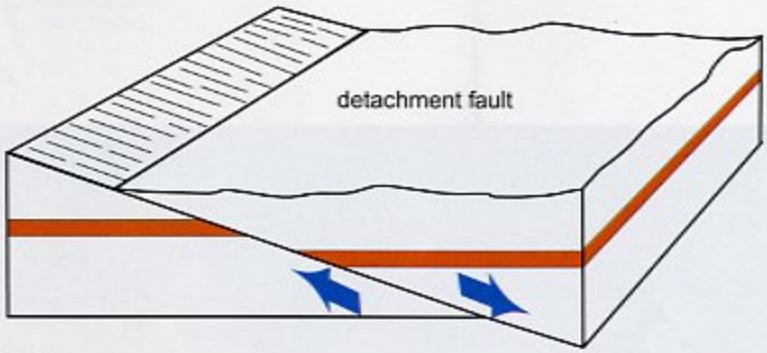


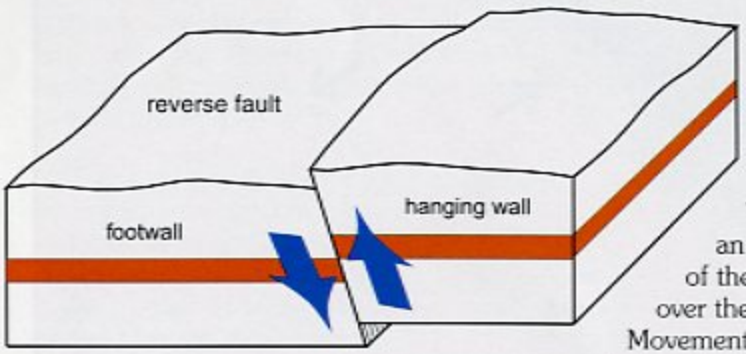


high-angle normal fault

Where the dip of a normal fault's surface is steep, it is called a **high-angle normal fault**, or simply a normal fault. The Owens Valley and the Sierra Nevada fault zones are examples of high-angle normal faults. Together, they produce a down-dropped block that forms the Owens Valley. This type of fault-bounded valley is called a **graben**. A fault-bounded ridge is called a **horst**.

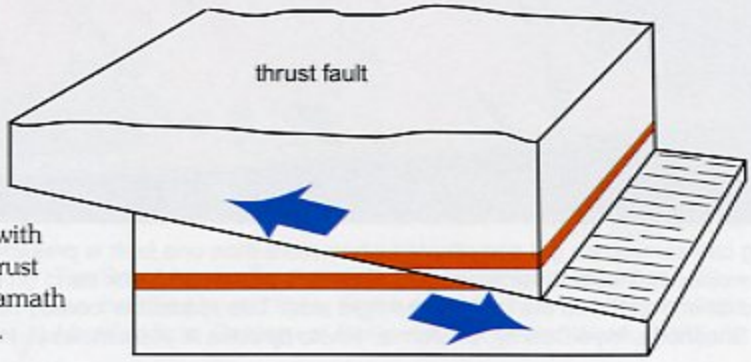
Where the dip of a normal fault's surface is very gentle or almost flat, it is referred to as a **detachment fault** or low-angle normal fault. Detachment faults are common in the desert areas of California.



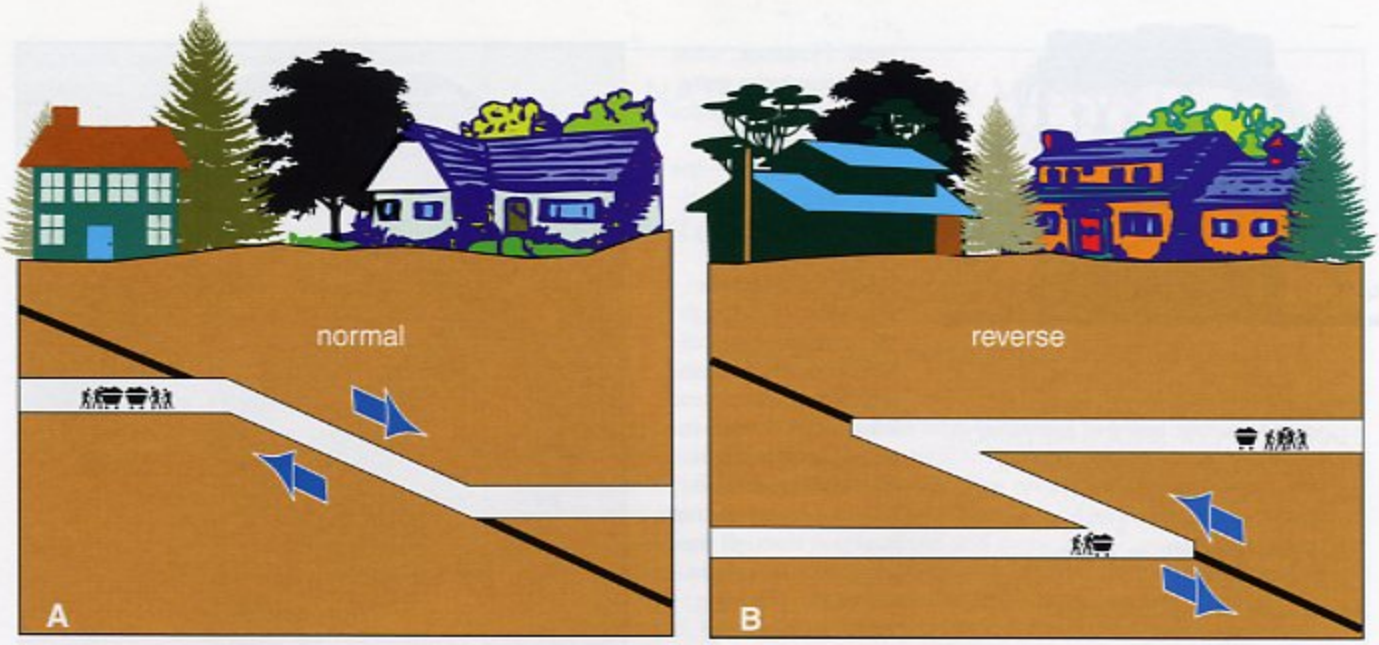


Reverse faults* are dip-slip faults in which the hanging wall moves up relative to the footwall. Reverse faults are the result of compression (forces that push rocks together).

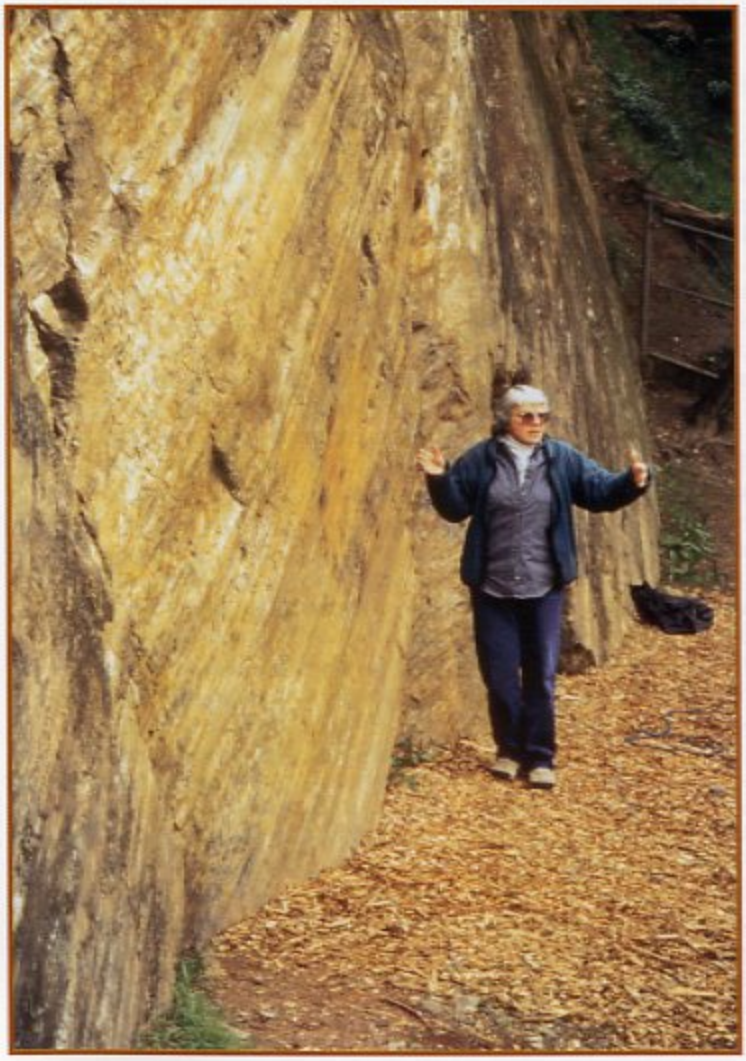
The Sierra Madre Fault zone of southern California is an example of reverse-fault movement. There the rocks of the San Gabriel Mountains are being pushed up and over the rocks of the San Fernando and San Gabriel valleys. Movement on the Sierra Madre Fault zone is part of the process that created the San Gabriel Mountains.



A **thrust fault** is a reverse fault with a gently-dipping fault surface. Thrust faults are very common in the Klamath Mountains of northern California.



Cross sections showing mine workings along a flatbed offset by normal and reverse faults.*



*The terms **normal** and **reverse** were first used by English coal miners to describe faults. When working a flat coal bed where it was dislocated by a normal fault(A), the miners continued the workings either upward or downward on the fault surface in the same, or "normal" direction. The workings in a seam dislocated by a reverse fault (B) were also continued upward or downward on the fault, but in the opposite, or "reverse" direction.

The terms **hanging wall and **footwall** are also old mining terms. These terms were originally used in inclined underground passageways to refer to the rock "hanging" overhead (the hanging wall) and the floor beneath the miners' feet (the footwall) (Ojakangas, 1991).

Doris Sloan (left), geology professor at U.C. Berkeley, explains that this steep cliff is a fault surface of a fault. Grooves or slickensides, seen as diagonal striations, have been scoured into the surface from rock grinding past each other along this surface. By measuring the direction and dip of these slickensides, geologists can tell how the rock last moved across the fault. *Photo by John Karachewski, Walnut Creek, CA ©2000.*

REFERENCE

Ojakangas, R.W., 1991, Schaum's outline of theory and problems of introductory geology: McGraw-Hill, Inc., New York, 294 p.