USGS
science for a changing world

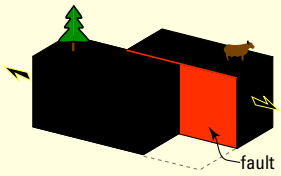
Does slow and steady really win the race? A story of the Hayward fault's unique behavior

What is going on here???

Rose Street curb, Hayward

A fault is where two blocks of Earth's crust meet and slide past one another.

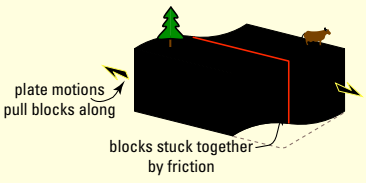
The Hayward fault runs along the base of the East Bay Hills. It is one of many major faults that slice up the Bay Area.

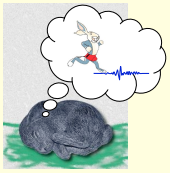


The curb is offset by motion of the Hayward fault

Most faults move *only* during earthquakes, staying locked together for decades between earthquakes.

Friction causes the blocks to get stuck together. Meanwhile, plate motions try to pull the blocks along. Stress builds up until, eventually, the blocks lurch forward in an earthquake.



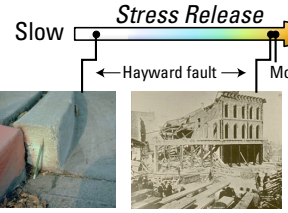


Most faults remain stuck for decades.

There have been *no* large earthquakes on the Hayward fault in the past 137 years, but curbs show evidence of motion. The Hayward fault can move without large earthquakes.

Steady Creep

Sudden Earthquakes



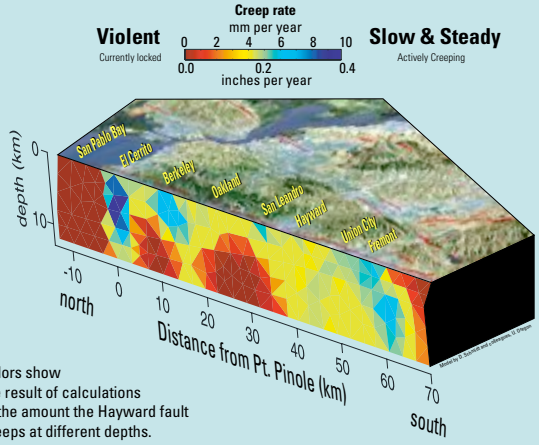
Present-day Creep

1868 Earthquake

Fault motion can be slow and steady, or come in sudden jerks.

We call the slow and steady motion "***creep***." Like earthquakes, creep releases the stress built up by plate tectonics, but it does so slowly and without violent shaking. Which do you prefer?

Most faults only slip only in violent earthquakes, but the Hayward fault seems to do both. We don't yet understand what causes some faults to creep. It could be the type of rocks on either side of the fault, or may be related to water trapped in the fault zone.



Colors show the result of calculations of the amount the Hayward fault creeps at different depths.

Is the Hayward fault creeping fast enough to release all the strain (so that we won't have any earthquakes)?

No. The fault creeps in some patches but is stuck in others. With careful measurements, scientists can locate the stuck spots.

Red patches in the picture to the left are stuck. In the next large earthquake, they will release more energy than blue patches that are creeping along. The entire region will experience strong shaking, but areas closest to the energy release will shake even more.

While scientists cannot use this information to predict *when* an earthquake will occur, these measurements can determine the amount of energy that will be released and *where* shaking will be strongest.

The Hayward fault creeps in some spots, but is stuck in others.