SEISMO TECTONICS OF STRIKE-SLIP PLATE BOUNDARIES

Non-Ridge Transform/Transcurrent Faults
San Andreas strike-slip boundary between Pacific and North American plates.

Right-lateral strike-slip fault. Formally a transform fault connecting spreading ridge in Gulf of California to ridge transform fault of Mendocino fault.
The San Andreas does not have uniform frictional sliding properties. Stick-slip in north and south, but stable sliding (creeping) in the middle.

The creeping section has many small events, but no record of large events.

Last large event in north was 1906, in south was 1857.
Strike-slip faults tend to have irregularities that produce steps, jogs, and associated along-strike features.
Salton Sea is depression in a right-stepping jump in the fault between the Imperial fault and San Andreas. This is likely hard for earthquake to rupture through, so is southern limit of big ruptures on San Andreas.
Transpression in the big bend leads to slip partitioning with thrust on shallow dipping faults on southern side of the San Gabriel Mountains and vertical strike-slip on the San Andreas.
TRIPLE JUNCTIONS EVOLVE & MIGRATE WITH TIME:
Pacific-North America - Farallon (Juan de Fuca) evolution caused formation of San Andreas and opening of Gulf of California
TRIPLE JUNCTIONS EVOLVE & MIGRATE WITH TIME

Kula-Farallon-Pacific TJ migrates
Kula plate vanishes
Farallon breaks up into Juan de Fuca, Rivera, and Cocos
Cocos-Nazca spreading center forms

Atwater website
Early Workers  
Dickinson and Snyder (1979)  
Severinghaus and Atwater (1990)

Fig 1 - The three hypotheses concerning the interaction between the East Pacific Rise and North America. From Severinghaus and Atwater (1990).
FORMATION OF TRANSVERSE RANGES

The diagram illustrates the formation of transverse ranges along the boundary between the Juan de Fuca Plate and the North American Plate. At 20 Ma, the Pacific Plate is shown moving towards the North American Plate, with the San Andreas Fault (SAF) and other geological features indicated. The map provides a visual representation of the plate tectonic activity in this region.
There are a lot of seismic stations operating in California, most are operated by the USGS, Caltech, Berkeley and CDMG.

With so many stations, we have extensive catalogs of small earthquakes.
Events prior to 1906 lack seismic recordings, but are well documented from shaking reports and surface offsets.

1872 is Owen’s valley Normal faulting.

1952 is Kern County Earthquake on Garlock Fault

1868 is on Hayward fault
Seismicity near the San Andreas fault is shallow, almost all events are at depths less than 15 km.
The northern end of the San Andreas is the Cape Mendocino triple junction with Mendocino transform fault, Gorda plate subduction zone, and San Andreas Fault.

The seismicity is low on the SAF. High inland in the crust above the slabless window.
The Bay Area is distinctive in splaying of the San Andreas into the Calaveras and Hayward faults and the northward extension along the Rodgers Creek Fault.
The creeping section has lots of small events and ends just north of Parkfield, which has had repeated magnitude 6.0 size events since 1857. The SAF is very quiet to the south, along the rupture zone of the 1857 event.
With extensive seismic stations, can determine focal mechanisms for all events down to very small magnitude of ~2.0.
Earthquake Shaking Potential for California
Spring, 2003

This map shows the relative intensity of ground shaking and damage in California from anticipated future earthquakes. Although the greatest hazard is in the San Francisco Bay area, other parts of the state, especially the north and south, are at risk.

Important messages about earthquakes for Californians to remember:

- Earthquakes have produced over 860,000 deaths in California since 1871. The next large earthquake may produce even greater losses, especially if it affects a major urban area.

- A large earthquake in or near a major urban center in California could cause the economy of the entire state and much of the nation to collapse.

- Effective disaster planning by state and local agencies, and by public utilities, can significantly reduce loss and speed recovery.

- Building codes substantially reduce the costs of damage from earthquakes, but the codes are intended only to prevent widespread loss of life by keeping the building from collapsing, not to protect the building from damage.

- If an earthquake occurred in or near Los Angeles or San Francisco, there would have been much higher casualties. The earthquake in Japan killed 2,500 people, and Turkey had over 10,000 deaths.

- After a large earthquake, residents and businesses may be isolated from basic services, fire, and emergency support for a period ranging from several hours to a few days. Citizens should be prepared to survive on their own, and to take others, until outside help arrives.

- Most of the shaking from the most recent major earthquake will be available within minutes on the Internet. The area will also receive damage to the most damaged regions and will help the public identify the areas most seriously affected.

- Efforts to reduce the losses from earthquakes have been proven effective. California's enhanced building codes, strengthened highway structures, higher standards for schools and hospitals, police and fire stations, infrastructure, well prepared emergency management and response agencies, and reduced deaths, injuries, and damage are results of the disaster prevention efforts of California's Earthquake Service.

Level of Earthquake Hazard

- High risk: Major urban areas, such as San Francisco, Los Angeles, and Orange County.

- Moderate risk: Cities and towns, such as Santa Cruz, San Jose, and Sacramento.

- Low risk: Rural areas, such as the Sierra Nevada and the Central Valley.

- Distance from hazards: Farther from faults and away from towns.

Map credits: (Left) USGS, (Right) California Earthquake Data Center. 2003. (Map) California Department of Transportation. (Service) California Department of Forestry and Fire Protection.