CALIFORNIA GEOLOGICAL SURVEY 150TH ANNIVERSARY

Fault Activity Map of California

2010

COMPILATION AND INTERPRETATION BY:
Charles W. Jennings and William A. Bryant

WITH ASSISTANCE FROM:
George Saucedo

INTRODUCTION

This edition of the Fault Activity Map of California was prepared in recognition of the California Geological Survey's 150th anniversary. This map is a revision of the 1994 FAULT ACTIVITY MAP OF CALIFORNIA AND ADJACENT AREAS. The location and complexity of most faults showing evidence of displacement during Quaternary time have been digitally compiled from original-scale source maps used for the 1975 and 1994 maps, as well as more recent mapping when warranted. This map is not intended to replace or supersede the Official Maps of Earthquake Fault Zones - the location of fault traces shown should not be substituted for site-specific fault-rupture investigations required by the Alquist-Priolo Earthquake Fault Zoning Act.

The base map is a combination of cultural features taken from digital planimetric base maps and a shaded relief map derived from 90-meter (onshore) and 200-meter (offshore) digital elevation models from the National Elevation Data Set. Projection is Teale Albers, 1983 North American Datum.

Bulletin 201, "An Explanatory Text to Accompany the Fault and Geologic Maps of California," published separately, contains detailed source index maps and references to all the published and unpublished reports and information used in compiling the 1975 FAULT MAP OF CALIFORNIA. Appendices accompanying this 2010 map contain the additional information that has been incorporated in this new map.

Users of this map should be aware that active faults and earthquakes are the subject of continuing research and that refinement of the interpretations given here are sure to come within a few years. Therefore, this map should be considered a provisional inventory of faults in California. An updated digital database of Quaternary faults (Digital Database of Quaternary Faults from the Fault Activity Map of California, Version 3.0) will be available from the California Geological Survey by the end of 2010. A detailed summary of selected Quaternary faults can be found at the National Quaternary Fault and Fold Database website (http://earthquake.usgs.gov/hazards/qfaults/).

Geologic Time Scale		Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Holocene	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
	Late Quaternary				Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		11,700			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary (Pleistocene)	700,000			Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary		1,600,000*			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
		4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.

A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break.

Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

SCALE 1:750,000

(1 INCH EQUALS APPROXIMATELY 12 MILES)

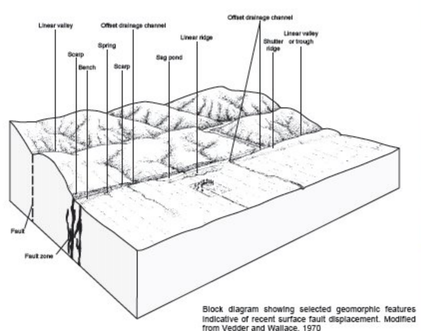
RECENCY OF FAULTING

Data from a large body of literature, published and unpublished, regarding faulting in California have been synthesized on this map. The purpose of this fault map is to depict what is known about the recency of displacement along these faults. Future studies may find additional faults, require relocation of faults, or in some cases, change the age classification as shown here.

The age classifications are determined by examining geologic evidence to determine the youngest faulted unit and the oldest unfaulted unit along each fault or fault section. If Quaternary displacement is indicated, the fault is classified into one of three categories within Quaternary time (Holocene, late Quaternary, or Quaternary undifferentiated). Faults with reported surface rupture during historic time are further classified as historically active. Faults having evidence indicating no displacement in Quaternary time are classified as pre-Quaternary. If a fault has insufficient evidence to allow classification, it is grouped with the pre-Quaternary faults.

The reliability of the age classifications on this map is dependent upon several factors. First, important fault-related geomorphic features may have been destroyed by natural or human activities. Second, geologists may differ in their interpretations of certain faults after examining incomplete geologic evidence for recency of faulting. Third, the ages of the rock units used to classify the faults may not be known accurately. Fourth, some of the data used to classify faults on this map were based on studies not directed to the determination of recency of fault displacement.

This is a small scale, regional map, and should be used only as a first approximation of potential hazard due to faulting. A detailed geologic investigation should be the core of any site-specific study for planning or development purposes.



Block diagram showing selected geomorphic features indicative of recent surface fault displacement. Modified from Vedder and Wallace, 1970

CAUTION
This fault map and accompanying text are for use as a guide only and should not be used to replace site-specific evaluations.

Graphics by:
Milind Patel
Ellen Sander
Jim Thompson
Barbara Wanish
Milton Fonseca