

APPENDIX E

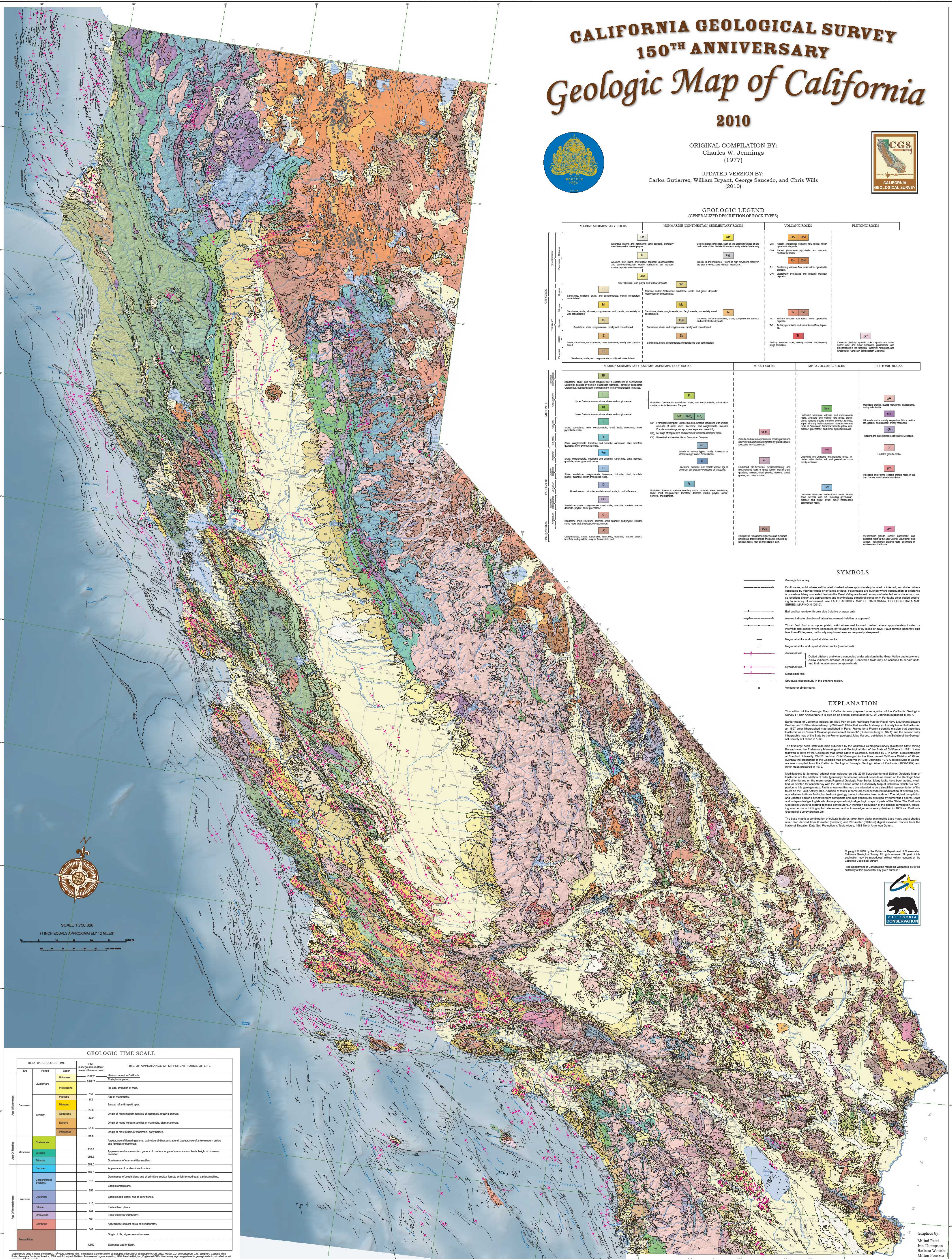
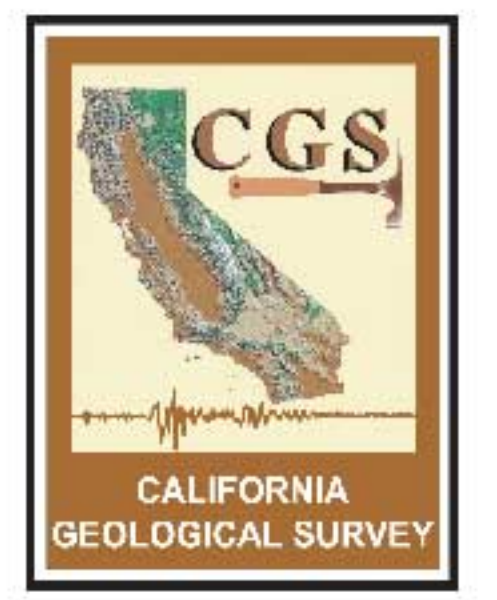
Geologic Map of California

CALIFORNIA GEOLOGICAL SURVEY 150TH ANNIVERSARY Geologic Map of California 2010



ORIGINAL COMPILATION BY:
 Charles W. Jennings
 (1977)

UPDATED VERSION BY:
 Carlos Gutierrez, George Saucedo, and Chris Wills
 (2010)



GEOLOGIC LEGEND (GENERALIZED DESCRIPTION OF ROCK TYPES)

MARINE SEDIMENTARY ROCKS	NONMARINE (CONTINENTAL) SEDIMENTARY ROCKS	VOLCANIC ROCKS	PLUTONIC ROCKS
Qs Estuarine marine and lacustrine sand deposits, generally fine to coarse or silt-clayey.	Qn Unconsolidated to weakly consolidated, mostly non-marine, but includes marine deposits near the coast.	Qv Recent (Holocene) volcanic flow rocks, minor pyroclastic deposits.	Qp Recent (Holocene) pyroclastic and volcanic mudflow deposits.
Qc Alluvium, lake, and beach sands, gravels, and silts, mostly non-marine, but includes marine deposits near the coast.	Qd Clayey silt and sand, mostly non-marine, but includes marine deposits near the coast.	Qv Clastic (volcanic) flow rocks, minor pyroclastic deposits.	Qp Clastic (volcanic) pyroclastic and volcanic mudflow deposits.
Qa Old alluvium, lake, and beach deposits.	Qm Recent (Holocene) marine sand, silt, and gravel deposits, mostly poorly consolidated.	Qv Clastic (volcanic) flow rocks, minor pyroclastic deposits.	Qp Clastic (volcanic) pyroclastic and volcanic mudflow deposits.
P Sandstone, siltstone, shale, and conglomerate, mostly non-marine, moderately to well consolidated.	Ca Recent (Holocene) marine sand, silt, and gravel deposits, mostly poorly consolidated.	Qv Clastic (volcanic) flow rocks, minor pyroclastic deposits.	Qp Clastic (volcanic) pyroclastic and volcanic mudflow deposits.
M Sandstone, shale, siltstone, conglomerate, and breccia, moderately to well consolidated.	Ca Recent (Holocene) marine sand, silt, and gravel deposits, mostly poorly consolidated.	Qv Clastic (volcanic) flow rocks, minor pyroclastic deposits.	Qp Clastic (volcanic) pyroclastic and volcanic mudflow deposits.
A Sandstone, shale, conglomerate, mostly well consolidated.	Ca Recent (Holocene) marine sand, silt, and gravel deposits, mostly poorly consolidated.	Qv Clastic (volcanic) flow rocks, minor pyroclastic deposits.	Qp Clastic (volcanic) pyroclastic and volcanic mudflow deposits.
E Shale, sandstone, conglomerate, minor limestone, mostly well consolidated.	Ca Recent (Holocene) marine sand, silt, and gravel deposits, mostly poorly consolidated.	Qv Clastic (volcanic) flow rocks, minor pyroclastic deposits.	Qp Clastic (volcanic) pyroclastic and volcanic mudflow deposits.
Es Shale, sandstone, conglomerate, minor limestone, mostly well consolidated.	Ca Recent (Holocene) marine sand, silt, and gravel deposits, mostly poorly consolidated.	Qv Clastic (volcanic) flow rocks, minor pyroclastic deposits.	Qp Clastic (volcanic) pyroclastic and volcanic mudflow deposits.
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SYMBOLS

- Geologic boundary
- Fault lines, solid where well located, dashed where approximately located or inferred, and dotted where considered by younger rocks to be lakes or bays. Fault lines are named where continuation or evidence is certain. Many unconsolidated faults are not shown. Faults shown are approximate and may indicate structural trends only. For faults color-coded according to the hierarchy of movement in the FAULT ACTIVITY MAP OF CALIFORNIA, GEOLOGIC DATA MAP SERIES, MAP NO. 6 (2010).
- Ball and bar on downthrown side (relative or apparent).
- Arrows indicate direction of lateral movement (relative or apparent).
- Thrust fault (bars on upper plate), solid where well located, dashed where approximately located or inferred, and dotted where considered by younger rocks to be lakes or bays. Fault surface generally dips less than 45 degrees, but locally may have been subsequently steepened.
- Regional strike and dip of stratified rocks.
- Regional strike and dip of stratified rocks (overturning).
- Anticline fold: Dotted offshore and where concealed under alluvium in the Great Valley and elsewhere. Arrow indicates direction of plunge. Concealed folds may be confined to certain units, and their location may be approximate.
- Synclinal fold.
- Miscellaneous fold.
- Structural discontinuity in the offshore region.
- Volcano or cinder cone.

EXPLANATION

This edition of the Geologic Map of California was prepared in recognition of the California Geological Survey's 150th Anniversary. It is built on an original compilation by C. W. Jennings published in 1977. Earlier maps of California include an 1830 Part of San Francisco Map by Royal Navy Lieutenant Edward Belcher; an 1857 hand-drawn map by William P. Blake that was the first map exclusively limited to California; an 1867 color lithographed map published in Paris, France by a French scientific mission that described California as an "ancient Mexican possession of the north" (Chouinard-Tarver, 1971); and the second color lithographed map of the State by the French geologist Jules Marcou, published in the Bulletin of the Geological Society of France in 1863.

The first large-scale geologic map published by the California Geological Survey (California State Mining Bureau) was the Preliminary Mineralogical and Geologic Map of the State of California in 1891. It was followed in 1910 by the Geologic Map of the State of California, prepared by J. P. Jenness, a geologist at Stanford University. Carl P. Jenkins, Chief Geologist for the then named California Division of Mines, supervised the production of the Geologic Map of California in 1930, covering 1077 localities. The California Geologic Survey was completed from the California Geological Survey Geologic Atlas of California (1956-1960) and other maps prepared in 1977.

Modifications to Jennings' original map included on this 2010 Supersynthesized Edition Geologic Map of California are the addition of older (generally Pleistocene) alluvial deposits as shown on the Geologic Atlas of California and on the more recent Regional Geologic Map Series. Many faults have been added, modified, or deleted for consistency with the 2010 edition of the Fault Activity Map of California, which is a companion to the geologic map. Faults shown on the map are intended to be a simplified representation of the faults on the Fault Activity Map. Addition of faults in some areas necessitated modification of bedrock geology adjacent to those faults, but bedrock geology has not otherwise been updated. The original compilation and updated editions benefited from comments and data generously provided by numerous Federal, State and independent geologists who have prepared original geologic maps of parts of the State. The California Geological Survey is grateful to these contributors. A thorough discussion of the original compilation, including source maps, bibliographic references, and acknowledgments was published in 1988 as California Geological Survey Bulletin 201.

The base map is a combination of cultural features taken from digital planimetric base maps and a shaded relief map derived from 30-meter (98-foot) and 300-meter (984-foot) digital elevation models from the National Elevation Data Set. Projection is Transverse Mercator, 1983 North American Datum.

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Graphics by:
 Milind Patel
 Jim Thompson
 Barbara Washburn
 Milton Fonseca

GEOLOGIC TIME SCALE

RELATIVE GEOLOGIC TIME	TIME OF APPEARANCE OF DIFFERENT FORMS OF LIFE
Quaternary	
Holocene	Historic record in California; Pleistocene period
Pleistocene	Ice age, extinction of man
Cenozoic	
Pliocene	Age of mammoths
Miocene	Spread of anthropoid apes
Oligocene	Origin of more modern families of mammals, grazing animals
Eocene	Origin of many modern families of mammals, giant mammals
Paleocene	Origin of most orders of mammals, early horses
Age of Fishes	
Cretaceous	Appearance of flowering plants, extinction of dinosaurs at end; appearance of a few modern orders and families of mammals
Jurassic	Appearance of some modern genera of conifers, origin of mammals and birds, height of dinosaur extinction
Triassic	Dominance of mammal-like reptiles
Permian	Appearance of modern insect orders
Carboniferous	Dominance of amphibians and of primitive tropical forests which formed coal, earliest reptiles
Devonian	Earliest amphibians
Silurian	Earliest seed plants, rise of bony fishes
Ordovician	Earliest land plants
Cambrian	Earliest bony vertebrates
Age of Mammals	
Tertiary	Appearance of most phyla of invertebrates
Cretaceous	Origin of life, algae, worm burrows
Paleozoic	Estimated age of Earth

*Approximate ages in mega-annum (Ma), 10⁶ years. Modified from International Commission on Stratigraphy, International Chronostratigraphic Chart, 2010. Walker, C.D. and Colwell, J.R., compilers. Geologic Time 2000. Geological Society of America, 2000, and C. Walker, compiler. Progress of Organic Evolution, 1966. Revised 1968. See also, C. Walker, compiler. The Geologic Time Scale, 1964. See also, C. Walker, compiler. The Geologic Time Scale, 1964. See also, C. Walker, compiler. The Geologic Time Scale, 1964. See also, C. Walker, compiler. The Geologic Time Scale, 1964.

