CALIFORNIA GEOLOGICAL SURVEY 150TH ANNIVERSARY

Geologic Map of California

2010

ORIGINAL COMPILATION BY:
Charles W. Jennings
(1977)

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

CALIFORNIA GEOLOGICAL SURVEY

GEOLOGIC LEGEND

(GENERALIZED DESCRIPTION OF ROCK TYPES)

MARINE SEDIMENTARY ROCKS

CENOZOIC — QUATERNARY — Pleistocene - Holocene

Qs — Extensive marine and nonmarine sand deposits, generally near the coast or desert playas.

Q — Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated. Mostly nonmarine, but includes marine deposits near the coast.

Qoa — Older alluvium, lake, playa, and terrace deposits

CENOZOIC — TERTIARY — Pliocene

P — Sandstone, siltstone, shale, and conglomerate; mostly moderately consolidated.

CENOZOIC — TERTIARY — Miocene

Ml — Sandstone, shale, siltstone, conglomerate, and breccia; moderately to well consolidated.

CENOZOIC — TERTIARY — Oligocene

Os — Sandstone, shale, conglomerate; mostly well consolidated.

CENOZOIC — TERTIARY — Eocene

E — Shale, sandstone, conglomerate, minor limestone; mostly well consolidated.

CENOZOIC — TERTIARY — Paleocene

Ep — Sandstone, shale, and conglomerate; mostly well consolidated.

NONMARINE (CONTINENTAL) SEDIMENTARY ROCKS

Qls — Selected large landslides, such as the Blackhawk Slide on the north side of San Gabriel Mountains; early to late Quaternary.

Qg — Glacial till and moraines. Found at high elevations mostly in the Sierra Nevada and Klamath Mountains.

QPc — Pliocene and/or Pleistocene sandstone, shale, and gravel deposits; mostly loosely consolidated.

Mc — Sandstone, shale, conglomerate, and fanglomerate; moderately to well consolidated.

Tc — Undivided Tertiary sandstone, shale, conglomerate, breccia, and ancient lake deposits.

Ouc — Sandstone, shale, and conglomerate; mostly well consolidated.

Ec — Sandstone, shale, conglomerate; moderately to well consolidated.

VOLCANIC ROCKS

Qrv — Recent (Holocene) volcanic flow rocks; minor pyroclastic deposits.

Qrv^p — Recent (Holocene) pyroclastic and volcanic mudflow deposits.

Qv — Quaternary volcanic flow rocks; minor pyroclastic deposits.

Qv^p — Quaternary pyroclastic and volcanic mudflow deposits.

Tv — Tertiary volcanic flow rocks; minor pyroclastic deposits.

Tv^p — Tertiary pyroclastic and volcanic mudflow deposits.

Ti — Tertiary intrusive rocks; mostly shallow (hypabyssal) plugs and dikes.

PLUTONIC ROCKS

gr^c — Cenozoic (Tertiary) granitic rocks - quartz monzonite, quartz latite, and minor monzonite, granodiorite, and granite; found in the Kingston, Panamint, Amargosa, and Greenwater Ranges in southeastern California.

MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS

MESOZOIC — TERTIARY - CRETACEOUS

TK — Sandstone, shale, and minor conglomerate in coastal belt of northwestern California; included by some in Franciscan Complex. Previously considered Cretaceous, but now known to contain early Tertiary microfossils in places.

MESOZOIC — CRETACEOUS

Ku — Upper Cretaceous sandstone, shale, and conglomerate.

Kl — Lower Cretaceous sandstone, shale, and conglomerate.

K — Undivided Cretaceous sandstone, shale, and conglomerate; minor nonmarine rocks in Peninsular Ranges.

KJf — Franciscan Complex: Cretaceous and Jurassic sandstone with smaller amounts of shale, chert, limestone, and conglomerate. Includes Franciscan melange, except where separated - see KJf_m.

KJf_m — Melange of fragmented and sheared Franciscan Complex rocks.

KJf_s — Blueschist and semi-schist of Franciscan Complex.

MESOZOIC — JURASSIC

J — Shale, sandstone, minor conglomerate, chert, slate, limestone; minor pyroclastic rocks

sch — Schists of various types; mostly Paleozoic or Mesozoic age; some Precambrian.

ls — Limestone, dolomite, and marble whose age is uncertain but probably Paleozoic or Mesozoic.

MESOZOIC — TRIASSIC

Ts — Shale, conglomerate, limestone and dolomite, sandstone, slate, hornfels, quartzite; minor pyroclastic rocks.

PALEOZOIC — PERMIAN

Pm — Shale, conglomerate, limestone and dolomite, sandstone, slate, hornfels, quartzite; minor pyroclastic rocks.

PALEOZOIC — CARBONIFEROUS

C — Shale, sandstone, conglomerate, limestone, dolomite, chert, hornfels, marble, quartzite; in part pyroclastic rocks.

PALEOZOIC — DEVONIAN

D — Limestone and dolomite, sandstone and shale; in part tuffaceous.

Ps — Undivided Paleozoic metasedimentary rocks. Includes slate, sandstone, shale, chert, conglomerate, limestone, dolomite, marble, phyllite, schist, hornfels, and quartzite.

PALEOZOIC — SILURIAN - ORDOVICIAN

SO — Sandstone, shale, conglomerate, chert, slate, quartzite, hornfels, marble, dolomite, phyllite; some greenstone.

PRECAMBRIAN — CAMBRIAN

є — Sandstone, shale, limestone, dolomite, chert, quartzite, and phyllite; includes some rocks that are possibly Precambrian.

p€ — Conglomerate, shale, sandstone, limestone, dolomite, marble, gneiss, hornfels, and quartzite; may be Paleozoic in part.

MIXED ROCKS

gr-m — Granitic and metamorphic rocks, mostly gneiss and other metamorphic rocks injected by granitic rocks. Mesozoic to Precambrian.

m — Undivided pre-Cenozoic metasedimentary and metavolcanic rocks of great variety. Mostly slate, quartzite, hornfels, chert, phyllite, mylonite, schist, gneiss, and minor marble.

p€c — Complex of Precambrian igneous and metamorphic rocks. Mostly gneiss and schist intruded by igneous rocks; may be Mesozoic in part.

METAVOLCANIC ROCKS

Mzv — Undivided Mesozoic volcanic and metavolcanic rocks. Andesite and rhyolite flow rocks, greenstone, volcanic breccia and other pyroclastic rocks; in part strongly metamorphosed. Includes volcanic rocks of Franciscan Complex: basaltic pillow lava, diabase, greenstone, and minor pyroclastic rocks.

pzv — Undivided pre-Cenozoic metavolcanic rocks. Includes latite, dacite, tuff, and greenstone; commonly schistose.

Pzv — Undivided Paleozoic metavolcanic rocks. Mostly flows, breccia, and tuff, including greenstone, diabase and pillow lavas; minor interbedded sedimentary rocks.

PLUTONIC ROCKS

gr^m — Mesozoic granite, quartz monzonite, granodiorite, and quartz diorite.

um — Ultramafic rocks, mostly serpentine. Minor peridotite, gabbro, and diabase; chiefly Mesozoic.

gb — Gabbro and dark dioritic rocks; chiefly Mesozoic.

gr — Undated granitic rocks.

gr^p — Paleozoic and Permo-Triassic granitic rocks in the San Gabriel and Klamath Mountains.

gr^pc — Precambrian granite, syenite, anorthosite, and gabbroic rocks in the San Gabriel Mountains; also various Precambrian plutonic rocks elsewhere in southeastern California.

SYMBOLS

Geologic boundary

Fault traces, solid where well located; dashed where approximately located or inferred; and dotted where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Many concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trends only. For faults color-coded according to recency of movement, see 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 (barbs on upper plate), solid where well located; dashed where approximately located or inferred; and dotted where concealed by younger rocks or by 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 (overturned).

Anticlinal fold.

Synclinal 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.

Monoclinal 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 1839 Port of San Francisco Map by Royal Navy Lieutenant Edward Belcher; an 1853 hand-tinted 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" (Guillemin-Tarayre, 1871); and the second color lithographic map of the State by the French geologist Jules Marcou, published in the Bulletin of the Geological Society of France in 1883.

The first large-scale statewide map published by the California Geological Survey (California State Mining Bureau) was the Preliminary Mineralogical and Geological Map of the State of California in 1891. It was followed in 1916 by the Geological Map of the State of California, prepared by J. P. Smith, a paleontologist at Stanford University. Olaf P. Jenkins, Chief Geologist for the then named California Division of Mines, oversaw the production of the Geologic Map of California in 1938. Jennings' 1977 Geologic Map of California was compiled from the California Geological Survey's Geologic Atlas of California (1958-1969) and other maps prepared in 1972.

Modifications to Jennings' original map included on this 2010 Sesquicentennial 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 this geologic map. Faults shown on this 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 acknowledgements was published in 1985 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 90-meter (onshore) and 200-meter (offshore) digital elevation models from the National Elevation Data Set. Projection is Teale Albers, 1983 North American Datum.

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CALIFORNIA CONSERVATION

SCALE 1:750,000

(1 INCH EQUALS APPROXIMATELY 12 MILES)

10 0 10 20 30 40 50 MILES

10 0 10 20 30 40 50 KILOMETERS

GEOLOGIC TIME SCALE

RELATIVE GEOLOGIC TIME: Era	Period	Epoch	TIME in mega-annum (Ma)* unless otherwise noted	TIME OF APPEARANCE OF DIFFERENT FORMS OF LIFE
Age Of Mammals	Cenozoic — Quaternary	Holocene	200 yr	Historic record in California
			0.0117	Post-glacial period.
		Pleistocene	2.6	Ice age, evolution of man.
	Cenozoic — Tertiary	Pliocene	5.3	Age of mammoths.
		Miocene	23.0	Spread of anthropoid apes.
		Oligocene	33.9	Origin of more modern families of mammals, grazing animals.
		Eocene	55.8	Origin of many modern families of mammals, giant mammals.
		Paleocene	65.5	Origin of most orders of mammals, early horses.
Age Of Reptiles	Mesozoic	Cretaceous	145.5	Appearance of flowering plants; extinction of dinosaurs at end; appearance of a few modern orders and families of mammals.
		Jurassic	201.6	Appearance of some modern genera of conifers; origin of mammals and birds; height of dinosaur evolution.
		Triassic	251.0	Dominance of mammal-like reptiles.
Age Of Invertebrates	Paleozoic	Permian	299.0	Appearance of modern insect orders.
		Carboniferous Systems	318	Dominance of amphibians and of primitive tropical forests which formed coal; earliest reptiles.
			359	Earliest amphibians.
		Devonian	416	Earliest seed plants; rise of bony fishes.
		Silurian	444	Earliest land plants.
		Ordovician	488	Earliest known vertebrates.
		Cambrian	542	Appearance of most phyla of invertebrates.
	Precambrian		4,500	Origin of life; algae, worm burrows. Estimated age of Earth.

*Approximate ages in mega-annum (Ma), 10^6 years. Modified from: International Commission on Stratigraphy, International Stratigraphic Chart, 2009; Walker, J.D. and Geissman, J.W., compilers, Geologic Time Scale, Geological Society of America, 2009; and G. Ledyard Stebbins, Processes of organic evolution, 1966, Prentice-Hall, Inc., Englewood Cliffs, New Jersey. Age designations for geologic units do not reflect recent changes in this time scale.

Graphics by:
Milind Patel
Jim Thompson
Barbara Wanish
Milton Fonseca