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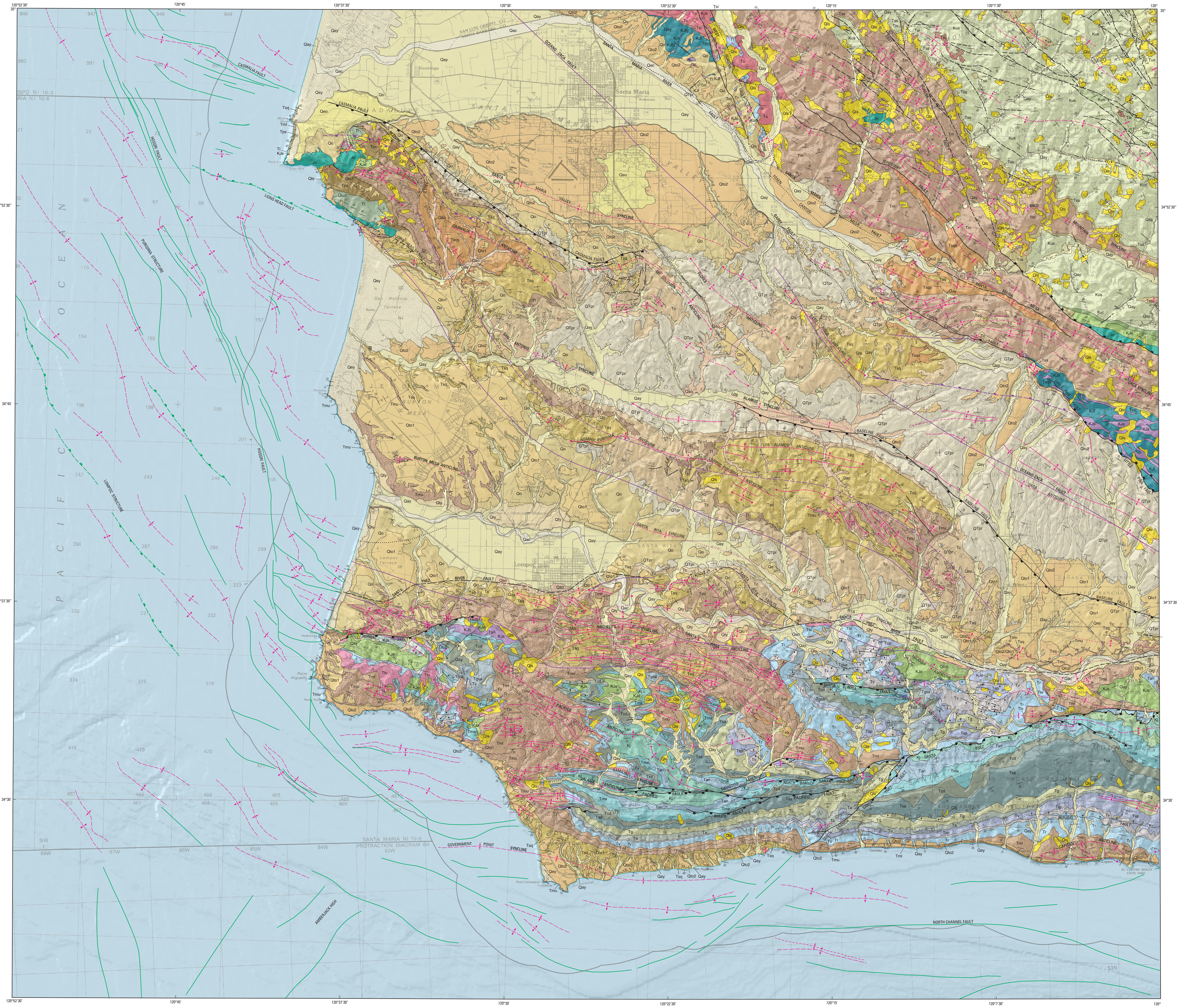
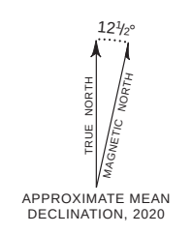
U.S. Geological Survey

**Scientific Investigations Map 3472**
**Supersedes USGS Open-File Report 95–25**
**and USGS Open-File Report 92–189**
*Pamphlet accompanies map*


120°52'30"
120°45'
120°37'30"
120°30'
120°22'30"
120°15'
120°7'30"
120°
35°
34°52'30"
34°45'
34°37'30"
34°30'
PACIFIC OCEAN
HOSGRI FAULT
CASMALIA FAULT
LIONS HEAD FAULT
PURISIMA STRUCTURE
LOMPOC STRUCTURE
AMBERJACK HIGH
OCEANO-ZACA FAULT
SANTA MARIA RIVER FAULT
SANTA MARIA VALLEY SYNCLINE
CASMALIA ANTICLINE
SAN ANTONIO SYNCLINE
MT SOLOMON ANTICLINE
LOMPOC-PURISIMA ANTICLINE
BURTON MESA ANTICLINE
SANTA RITA SYNCLINE
LOS ALAMOS SYNCLINE
LOS ALAMOS ANTICLINE
BASELINE FAULT
FOXEN CANYON FAULT
SANTA MARIA MESA FAULT
TEPUSQUET FAULT
WEST HUASNA FAULT
EAST HUASNA FAULT
GAREY FAULT
LITTLE PINE FAULT
ZACA SYNCLINE
BALD MOUNTAIN SYNCLINE
SANTA YNEZ RIVER FAULT
SANTA RITA FAULTS
SAN MIGUELITO SYNCLINE
SANTA ROSA ANTICLINE
SANTA ROSA FAULT
NOJOQUI ANTICLINE
HONDA FAULT
PACIFICO ANTICLINE
PACIFICO FAULT
JALAMA ANTICLINE
RAMAJAL SYNCLINE
BULITO FAULT
GAVIOTA SYNCLINE
NORTH BRANCH SANTA YNEZ FAULT
SOUTH BRANCH SANTA YNEZ FAULT
REFUGIO FAULT
CAPITAN ANTICLINE
GOVERNMENT POINT SYNCLINE
NORTH CHANNEL FAULT
Santa Maria
Guadalupe
Orcutt
Lompoc
Los Alamos
Point Sal
Point Arguello
Point Conception
Purisima Point
Gaviota
EL CAPITAN BEACH STATE PARK
SAN LUIS OBISPO CO
SANTA BARBARA CO
SANTA MARIA NI 10-6 PROTRACTION DIAGRAM 6A

Universal Transverse Mercator Projection, Zone 10 North American Datum 1983
Topographic base from U.S. Geological Survey 1:100,000 scale digital line graphics, Santa Maria and Point Conception 30- by 60-minute quadrangles (1981–82). Additional hydrography from U.S. Geological Survey National Hydrography Database (NHD) (2001).
Shaded-relief base from the USGS National Elevation Dataset https://ned.usgs.gov
Bathymetric contours from U.S. Geological Survey Coastal and Marine Geology Program (1991) and from California Department of Fish and Wildlife.


12½°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2020

SCALE 1:100 000
1 0 1 2 3 4 5 6 7 8 MILES
1 0 1 2 3 4 5 6 7 8 9 10 KILOMETERS
CONTOUR INTERVAL 40 METERS
BATHYMETRIC CONTOUR INTERVAL 100 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP LOCATION

Geology of the Santa Maria 30- by 60-minute quadrangle preliminarily compiled by M.E. Tennyson, W.R. Beeman, and S.B. Urban, 1992–1994; geologic mapping and major revisions and compilation of the Santa Maria and Point Conception 30- by 60-minute quadrangles by D.S. Sweetkind and S.C. Demas, 2010–2013. Geophysical data collection, compilation, and mapping by V.E. Langenheim, 2009–2013. Offshore geology by C.C. Sorlien, 2012–2013
GIS database and digital cartography by D.S. Sweetkind and S.C. Demas
Digital cartographic production and edit by J.A. Herrick and L.J. Binder
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# Geologic and Geophysical Maps of the Santa Maria and Point Conception 30′×60′ Quadrangles, California

By
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2021

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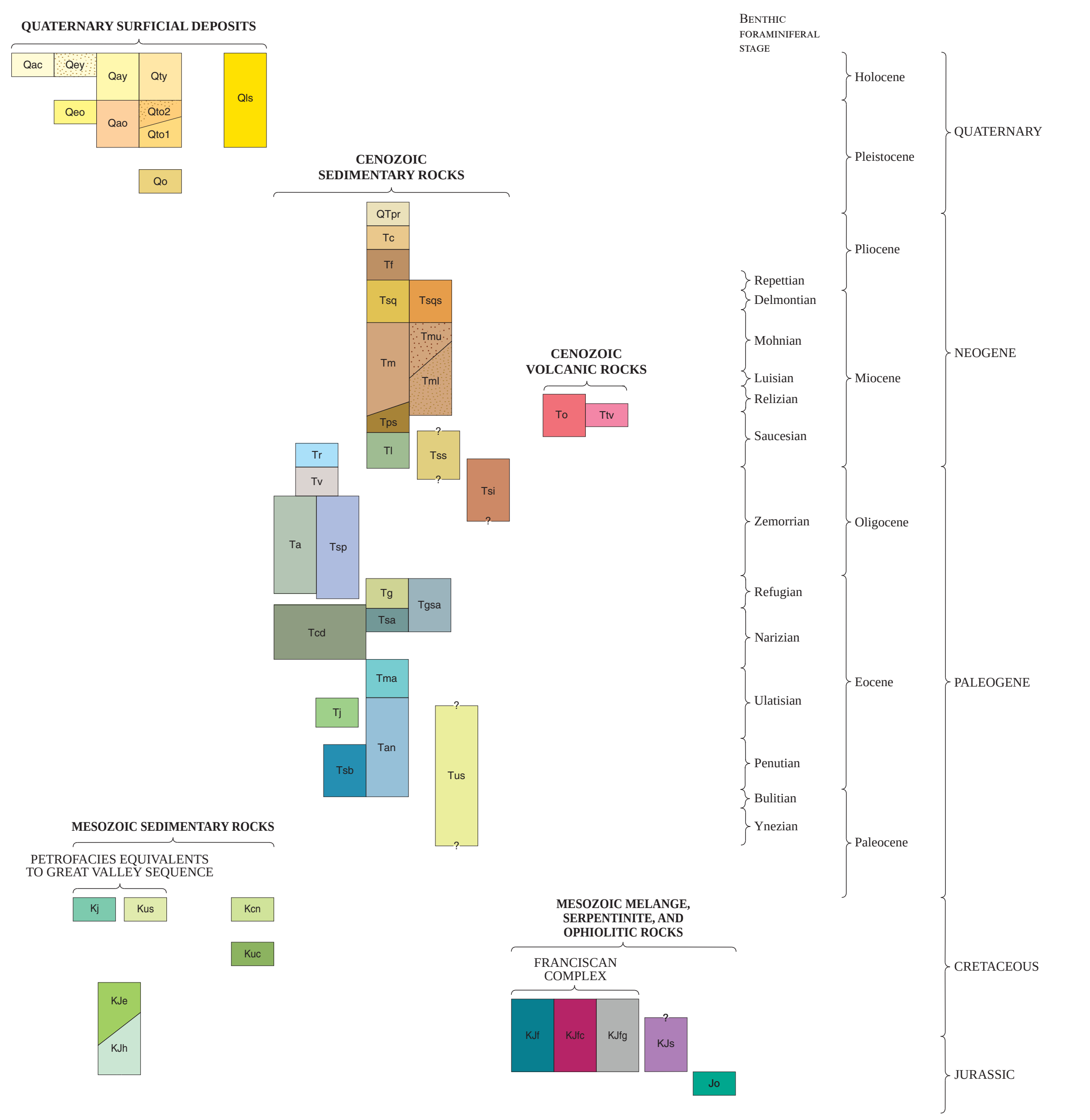
## CORRELATION OF MAP UNITS

[See Description of Map Units (in pamphlet) for precise unit ages. Due to the addition of a shaded-relief base, colors in the Description of Map Units and the Correlation of Map Units may not exactly match unit colors on the map when that layer is active]


QUATERNARY SURFICIAL DEPOSITS
Qac
Qey
Qay
Qty
Qeo
Qao
Qto2
Qto1
Qls
Qo
CENOZOIC SEDIMENTARY ROCKS
QTpr
Tc
Tf
Tsq
Tsqs
Tmu
Tm
Tml
Tps
Tl
Tss
Tsi
Tr
Tv
Ta
Tsp
Tg
Tgsa
Tcd
Tsa
Tma
Tj
Tan
Tsb
Tus
CENOZOIC VOLCANIC ROCKS
To
Ttv
MESOZOIC SEDIMENTARY ROCKS
PETROFACIES EQUIVALENTS TO GREAT VALLEY SEQUENCE
Kj
Kus
Kcn
Kuc
KJe
KJh
MESOZOIC MELANGE, SERPENTINITE, AND OPHIOLITIC ROCKS
FRANCISCAN COMPLEX
KJf
KJfc
KJfg
KJs
Jo
BENTHIC FORAMINIFERAL STAGE
Repettian
Delmontian
Mohnian
Luisian
Relizian
Saucesian
Zemorrian
Refugian
Narizian
Ulatisian
Penutian
Bulitian
Ynezian
Holocene
Pleistocene
Pliocene
Miocene
Oligocene
Eocene
Paleocene
QUATERNARY
NEOGENE
PALEOGENE
CRETACEOUS
JURASSIC
?

## LIST OF MAP UNITS

[See Description of Map Units (in pamphlet) for complete unit descriptions. Due to the addition of a shaded-relief base, colors in the Description of Map Units and the Correlation of Map Units may not exactly match unit colors on the map when that layer is active]

### QUATERNARY SURFICIAL DEPOSITS

| | |
|---|---|
| Qac | **Active alluvium (Holocene)** |
| Qey | **Beach and dune sand (Holocene)** |
| Qay | **Alluvial fan and fluvial deposits (Holocene)** |
| Qty | **Terrace deposits (Holocene)** |
| Qls | **Landslide deposits (Quaternary)** |
| Qeo | **Dune sand (Pleistocene)** |
| Qao | **Older alluvium (Pleistocene)** |
| Qto2 | **Younger terrace deposits (late Pleistocene)** |
| Qto1 | **Older terrace deposits (middle and early Pleistocene)** |
| Qo | **Orcutt Sand (late Pleistocene?)** |

### CENOZOIC SEDIMENTARY ROCKS

| | |
|---|---|
| QTpr | **Paso Robles Formation (early Pleistocene and upper Pliocene)** |
| Tc | **Careaga Sandstone (upper Pliocene)** |
| Tf | **Foxen Mudstone (upper and middle Pliocene; upper Repettian)** |
| Tsq | **Sisquoc Formation (upper Pliocene and upper Miocene; Repettian to Mohnian** |
| Tsqs | **Todos Santos Claystone Member and Tinaquaic Sandstone Member of Sisquoc Formation, undivided (lower Pliocene and upper Miocene; Repettian to Mohnian)** |
| Tm | **Monterey Formation (upper, middle, and upper lower Miocene; Mohnian to upper Saucesian)** |
| Tmu | **Informal upper member of Monterey Formation (upper and middle Miocene; Mohnian to upper Luisian)** |
| Tml | **Informal lower member of Monterey Formation (middle to lower Miocene; Mohnian to lower Saucesian)** |
| Tps | **Point Sal Formation (lower middle Miocene to upper lower Miocene; Relizian to Saucesian)** |
| Tl | **Lospe Formation (upper lower Miocene; Saucesian)** |
| Tss | **Unnamed sandstone (lower Miocene? to upper Oligocene?; Saucesian? to Zemorrian?)** |
| Tr | **Rincon Shale (lower Miocene; Saucesian)** |
| Tsi | **Simmler Formation (lower Miocene to upper Oligocene?; Saucesian to Zemorrian?)** |
| Tv | **Vaqueros Formation (upper Oligocene; Zemorrian)** |
| Ta | **Alegria Formation (Oligocene and upper Eocene; Zemorrian and Refugian)** |
| Tsp | **Sespe Formation (Oligocene to upper Eocene; Zemorrian and Refugian)** |
| Tg | **Gaviota Formation (upper Eocene; Refugian)** |
| Tgsa | **Gaviota and Sacate Formations, undivided (upper to middle Eocene; Refugian to Narizian)** |
| Tcd | **Cozy Dell Shale (upper and middle Eocene; lower Refugian to Narizian)** |
| Tsa | **Sacate Formation (upper and middle Eocene; upper Narizian)** |
| Tma | **Matilija Sandstone (middle Eocene; lower Narizian to Ulatisian)** |
| Tj | **Juncal Formation (lower to middle Eocene; Ulatisian)** |
| Tan | **Anita Shale (lower Eocene to Paleocene; Ulatisian to upper Bulitian)** |
| Tus | **Unnamed sandstone (Eocene? and (or) Paleocene?; Ulatisian? to Ynezian?)** |
| Tsb | **Sierra Blanca Limestone (lower Eocene to upper Paleocene; Penutian to upper Bulitian)** |

### CENOZOIC VOLCANIC ROCKS

| | |
|---|---|
| To | **Obispo Formation (uppermost lower Miocene; upper Saucesian to Relizian)** |
| Ttv | **Tranquillon Volcanics (uppermost lower Miocene; Saucesian and Relizian)** |

### MESOZOIC SEDIMENTARY ROCKS

**Petrofacies equivalents to Great Valley Sequence**—Divided into:

| | |
|---|---|
| Kj | **Jalama Formation (Upper Cretaceous)** |
| Kus | **Unnamed sandstone (Upper Cretaceous)** |
| KJe | **Espada Formation (Lower Cretaceous and Upper Jurassic)** |
| KJh | **Honda Formation (Lower Cretaceous and Upper Jurassic)** |
| Kcn | **Unnamed conglomerate (Upper Cretaceous)** |
| Kuc | **Unnamed conglomerate (lowermost Upper Cretaceous; Cenomanian)** |

### MESOZOIC MELANGE, SERPENTINITE, AND OPHIOLITIC ROCKS

**Franciscan Complex (Cretaceous and Jurassic)**—Divided into:

| | |
|---|---|
| KJf | **Franciscan Complex (Cretaceous and Jurassic)** |
| KJfc | **Chert blocks (Cretaceous and Jurassic)** |
| KJfg | **Graywacke blocks (Cretaceous and Jurassic)** |
| KJs | **Serpentinite (Cretaceous? and Jurassic)** |
| Jo | **Ophiolite (Upper Jurassic; Callovian)** |

## EXPLANATION FOR GEOLOGIC MAP

**Contact**

**Fault**—Long dashed where approximately located, short dashed where inferred, dotted where concealed. Question mark where identity or existence questionable. Arrows show direction of movement (left lateral and right lateral)

**Normal fault**—Ball and bar on downthrown block. Long dashed where approximately located and dotted where concealed

**Reverse fault**—Rectangles on upthrown block. Long dashed where approximately located and dotted where concealed. Question mark where identity or existence questionable

**Fault located by gravity and magnetic surveys**—Dashed where location is approximately located

**Fault located by seismic reflection survey**—Dashed where location is approximately located

**Anticline**—Long dashed where approximately located and dotted where concealed; question mark where identity or existence questionable; large arrowhead shows direction of plunge

**Syncline**—Long dashed where approximately located, short dashed where inferred, dotted where concealed; question mark where identity or existence questionable; large arrowhead shows direction of plunge

### PLANAR POINT FEATURES

⊕ **Horizontal bedding**

5 **Inclined bedding**—Showing dip angle

50 **Overturned bedding**—Showing dip angle

**Vertical bedding**

◇ C937 **Chevron sample fossil locality**

◇ U13 **USGS sample fossil locality**

### AREAL FEATURE

**Shoreline**—Showing open water

## EXPLANATION FOR GRAVITY MAP

[Units in milligal (mGal); see pamphlet for more information about data acquisition and processing]

### SOURCES OF GRAVITY DATA

▲ **Offshore 4-km grid**—derived from ship track data (Vedder and others, 1974; Beyer, 1980; McCulloch and others, 1989)

**Onshore data**

● **Data compiled by Langenheim (2014) and new data, U.S. Geological Survey**

**Data compiled by Sauer and Mariano (1990)**

■ **Defense Mapping Agency**

▲ **Rietman and Beyer (1982)**

● **Up de Graff (1984)**

### GRAVITY ANOMALIES

○ **Density boundaries automatically calculated from grid**—larger circles indicate greater than average magnitude of horizontal gravity gradient. Smaller circles indicate less than average magnitude of horizontal gravity gradient

20 **Gravity contour**—interval 2 mGal; hachures indicate gravity low; contours were compter generated based on 300-m grid

### ISOSTATIC GRAVITY FIELD

[Scale is for both 2,670 kg/m³ and 2,000 kg/m³ reduction density]

-44 -42 -40 -38 -36 -34 -32 -30 -28 -26 -24 -22 -20 -18 -16 -14 -12 -10 -8 -6 mGal

## EXPLANATION FOR MAGNETIC MAP

[Units in nanoteslas (nT); see pamphlet for more information about data acquisition and processing]

### HORIZONTAL MAGNETIC FIELD GRADIENT MAXIMUM

○ **Gradient larger than average magnetic gradient**

○ **Gradient smaller than average magnetic gradient**

### MAGNETIC ANOMALIES

0 **Magnetic contour**—Contour intervals for each dataset: shallow magnetic field data is 2 nT, medium magnetic field data is 12 nT, and total magnetic field data is 20 nT

### TOTAL MAGNETIC FIELD

-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 nT

### SHALLOW MAGNETIC FIELD

-12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18 20 22 24 26 nT

### MEDIUM MAGNETIC FIELD

-96 -84 -72 -60 -48 -36 -24 -12 0 12 24 36 48 60 72 84 96 108 120 132 nT

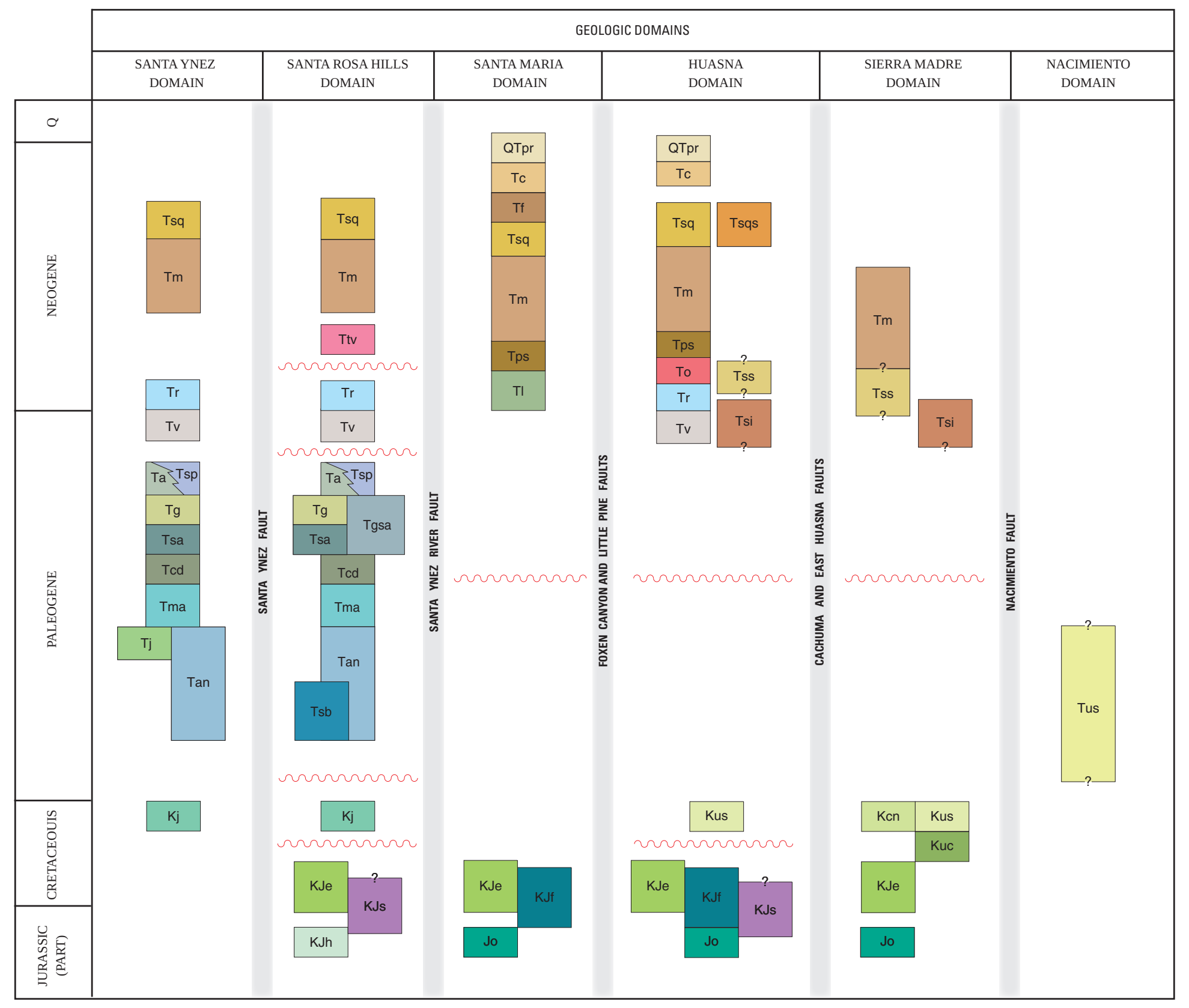
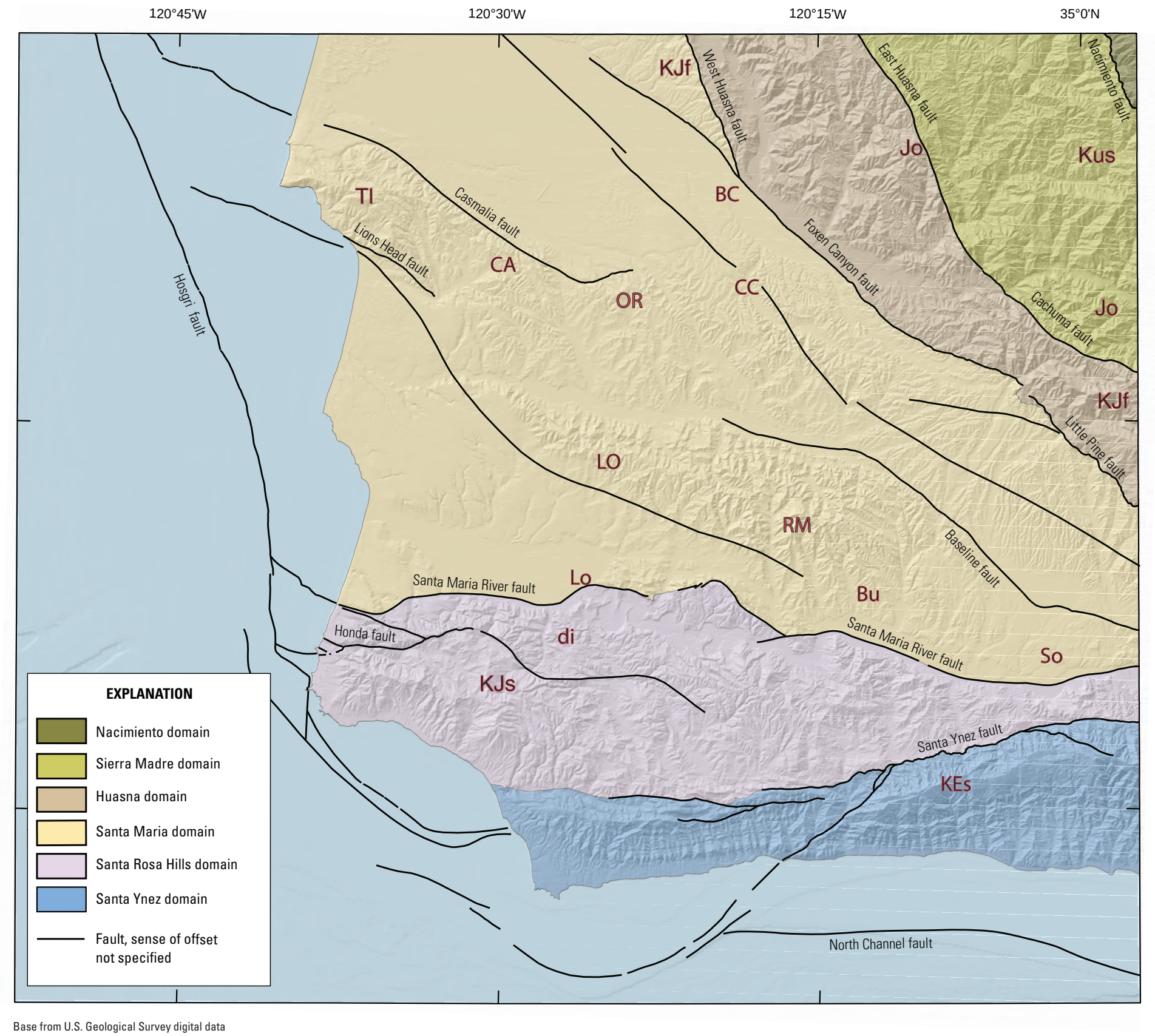
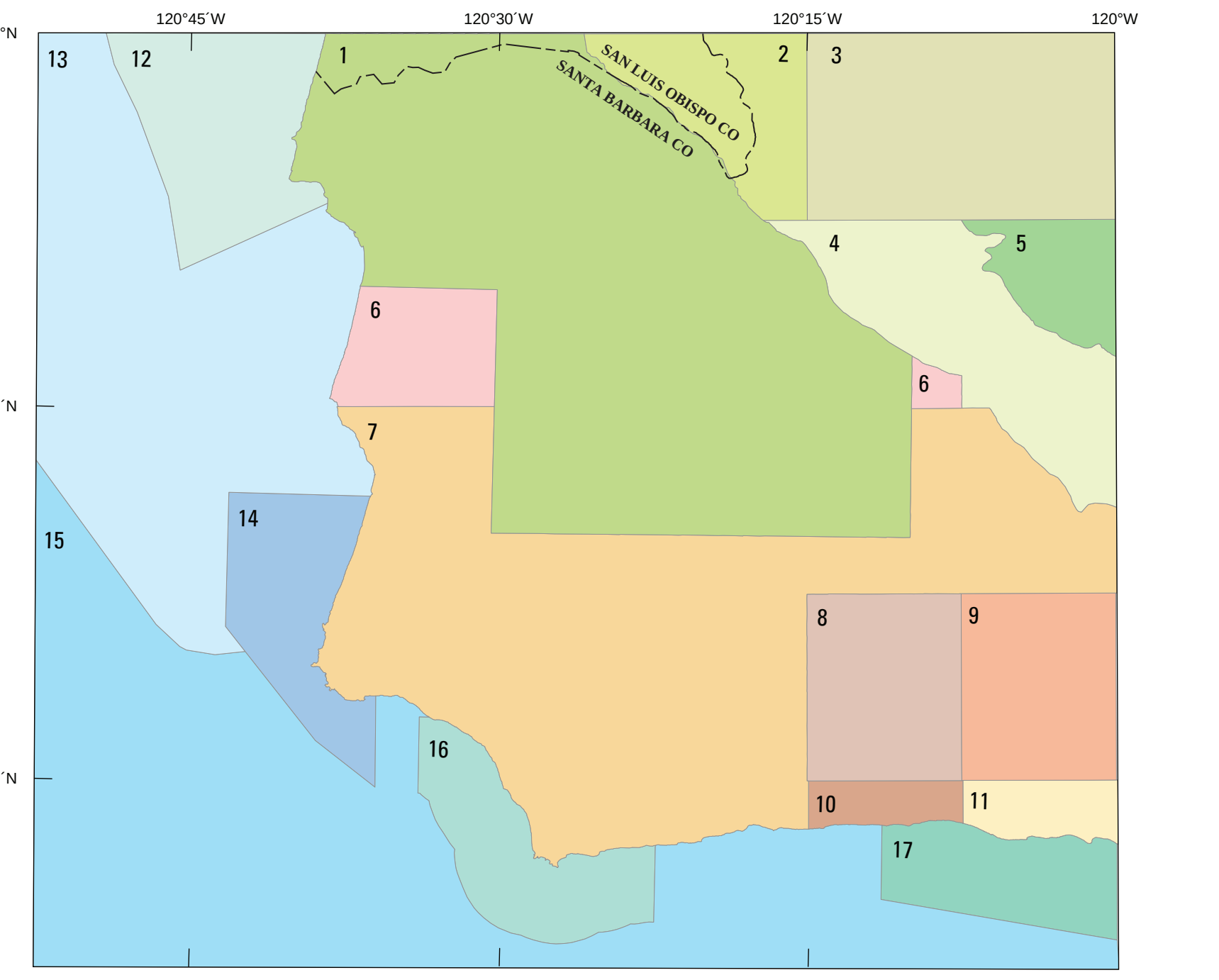

GEOLOGIC DOMAINS
SANTA YNEZ DOMAIN
SANTA ROSA HILLS DOMAIN
SANTA MARIA DOMAIN
HUASNA DOMAIN
SIERRA MADRE DOMAIN
NACIMIENTO DOMAIN
Q
NEOGENE
PALEOGENE
CRETACEOUS
JURASSIC (PART)
SANTA YNEZ FAULT
SANTA YNEZ RIVER FAULT
FOXEN CANYON AND LITTLE PINE FAULTS
CACHUMA AND EAST HUASNA FAULTS
NACIMIENTO FAULT
QTpr
Tc
Tf
Tsq
Tsqs
Tm
Ttv
Tps
Tl
To
Tr
Tv
Tss
Tsi
Ta
Tsp
Tg
Tgsa
Tsa
Tcd
Tma
Tj
Tan
Tsb
Tus
Kj
Kus
Kcn
Kuc
KJe
KJf
KJs
KJh
Jo
?

**Figure 1.** Stratigraphic correlation chart for units in individual stratigraphic domains. Location of domains and bounding structures are shown in figure 1. Wavy red lines indicate major unconformities; local unconformities are indicated by gaps between colored boxes. Quaternary surficial deposits common to most of the domains are not shown; Q for part of the Quaternary.


120°45'W
120°30'W
120°15'W
35°0'N
34°45'N
34°30'N
KJf
Jo
Kus
Tl
BC
CA
OR
CC
LO
RM
Lo
Bu
So
di
KJs
KEs
Hosgri fault
Casmalia fault
Lions Head fault
West Huasna fault
East Huasna fault
Foxen Canyon fault
Nacimiento fault
Cachuma fault
Little Pine fault
Baseline fault
Santa Maria River fault
Honda fault
Santa Ynez fault
North Channel fault
EXPLANATION
Nacimiento domain
Sierra Madre domain
Huasna domain
Santa Maria domain
Santa Rosa Hills domain
Santa Ynez domain
Fault, sense of offset not specified
0 5 10 Miles
0 5 10 KILOMETERS

Base from U.S. Geological Survey digital data
Universal Transverse Mercator projection, zone 10N
North American Datum of 1983

**Figure 2.** Index map showing location of stratigraphic domains. Selected structures are shown for reference including the labeled locations which also appear on the gravity and aeromagnetic map layouts: Bradley Canyon (BC), Buellton (Bu), possible diatomatic location (di), Santa Ynez Mountain eastern ridge (KEs), Lompoc (Lo), Lompoc oilfield (LO), and Solvang (So). There are five geologic unit labels that appear here and on those map layouts: Jo, KJf, KJs, Kus, and Tl.


120°45´W
120°30´W
120°15´W
120°W
35°N
34°45´N
34°30´N
SAN LUIS OBISPO CO
SANTA BARBARA CO
1
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16
17

**Figure 3.** Index map showing areas of previous mapping in the study area. 1, Woodring and Bramlette (1950); 2, Hall (1978); 3, Vedder and others (1991); 4, Hall (1981); 5, Frizzell and Vedder (1986); 6, modified from Jennings (1977); 7, Dibblee (1950); 8, Dibblee (1981b); 9, Dibblee (1981,c); 10, Dibblee (1981d); 11, Dibblee (1981a); 12, Johnson and Watt (2012); 13, Willingham and others (2013); 14, Sorlien and others (1999a); 15, Sorlien and others (1999b); 16, Johnson and others (2018); 17, Johnson and others (2015).

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