U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

In cooperation with
CALIFORNIA DIVISION OF MINES AND GEOLOGY

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OPEN-FILE REPORT 99-162
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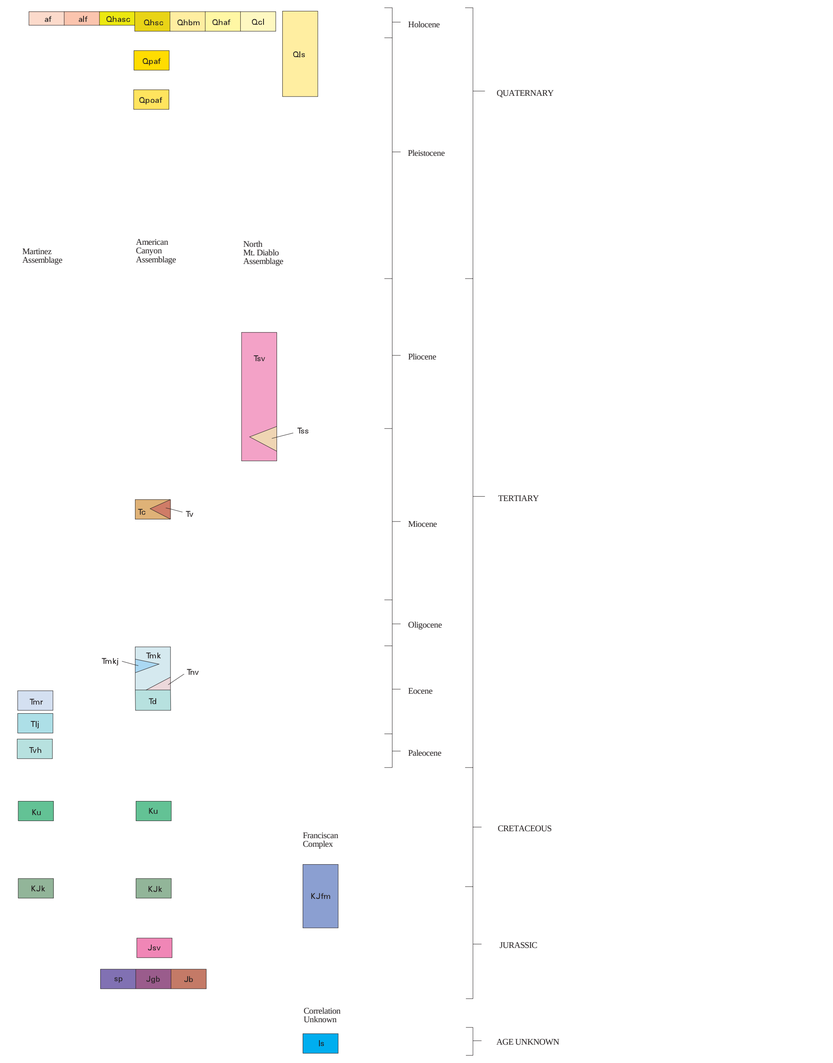
CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

af — **Artificial fill (Historic)** —Loose to very well consolidated gravel, sand, silt, clay, rock fragments, organic matter, and man-made debris in various combinations. Thickness is variable and may exceed 30 m in places. Some is compacted and quite firm, but fill made before 1965 is nearly everywhere not compacted and consists simply of dumped materials.

alf — **Artificial levee fill (Historic)** —Man-made deposit of various materials and ages, forming artificial levees as much as 6.5 m high. Some are compacted and quite firm, but fills made before 1965 are almost everywhere not compacted and consist simply of dumped materials. The distribution of levee fill conforms to levees shown on the most recent U.S. Geological Survey 7.5-minute quadrangle maps.

Qhasc — **Artificial stream channels (Historic)** —Modified stream channels, in most places where streams have been straightened and realigned.

Qhsc — **Stream channel deposits (Holocene)** —Poorly to well-sorted sand, silt, silty sand, and sandy gravel with minor cobbles. Cobbles are more common in the mountainous valleys. Many stream channels are presently lined with concrete or rip rap. Engineering works, such as diversion dams, drop structures, energy dissipaters and percolation ponds, also modify the original channel. Many stream channels have been straightened, and these are labeled Qhasc. This straightening is especially prevalent in the lower reaches of streams entering the estuary. The mapped distribution of stream channel deposits is controlled by the depiction of major creeks on the most recent U.S. Geological Survey 7.5-minute quadrangles. Only those deposits related to major creeks are mapped. In some places these deposits are under shallow water for some or all of the year, as a result of reservoir release and annual variation in rainfall.

Qhbm — **Bay mud (Holocene)** —Water-saturated estuarine mud, predominantly gray, green and blue clay and silty clay underlying marshlands and tidal mud flats of Suisun Bay. The upper surface is covered with cordgrass (*Spartina* sp.) and pickleweed (*Salicornia* sp.). The mud also contains a few lenses of well-sorted, fine sand and silt, a few shelly layers (oysters), and peat. The mud interfingers with and grades into fine-grained deposits at the distal edge of Holocene fans, and was deposited during the post-Wisconsin rise in sea-level, about 12 ka to present (Imbrie and others, 1984).

Qhaf — **Alluvial fan and fluvial deposits (Holocene)** —Alluvial fan deposits are brown or tan, medium dense to dense, gravely sand or sandy gravel that generally grades upward to sandy or silty clay. Near the distal fan edges, the fluvial deposits are typically brown, never reddish, medium dense sand that fines upward to sandy or silty clay

Qcl — **Colluvium (Holocene)** —Loose to firm, friable, unsorted sand, silt, clay, gravel, rock debris, and organic material in varying proportions.

Qls — **Landslide deposits (Pleistocene and/or Holocene)** —Poorly sorted clay, silt, sand, and gravel. Only large landslides have been mapped. For a more complete map of landslide deposits, see Nilsen and others (1979) and Ellen and Wieczorek (1988).

Qpaf — **Alluvial fan and fluvial deposits (Pleistocene)** —Brown, dense, gravely and clayey sand or clayey gravel that fines upward to sandy clay. These deposits display variable sorting and are located along most stream channels in the county. All Qpaf deposits can be related to modern stream courses. They are distinguished from younger alluvial fans and fluvial deposits by higher topographic position, greater degree of dissection, and stronger soil profile development. They are less permeable than Holocene deposits, and locally contain fresh water mollusks and extinct late Pleistocene vertebrate fossils. They are overlain by Holocene deposits on lower parts of the alluvial plain, and incised by channels that are partly filled with Holocene alluvium on higher parts of the alluvial plain. Maximum thickness is unknown but is at least 50 m.

Qpoaf — **Older alluvial fan deposits (Pleistocene)** —Brown, dense, gravely and clayey sand or clayey gravel that fines upward to sandy clay. These deposits range from poorly to well sorted. All Qpoaf deposits can be related to modern stream courses. They are distinguished from younger alluvial fans and fluvial deposits by higher topographic position, greater degree of dissection, and stronger soil profile development. They are less permeable than younger deposits, and locally contain freshwater mollusks and extinct Pleistocene vertebrate fossils.

Tsv — **Sonoma Volcanics, undivided (Pliocene and Miocene?)** —Silicic, intermediate, and minor mafic volcanic rocks, including white rhyolite tuff and vesicular plagioclase–porphyry andesite. Tuffaceous rocks on strike immediately southeast of the mapped area have been correlated with the 3.96 ±0.16 (K/Ar age) Ma Lawlor Tuff (Sarna-Wojcicki, 1976). Andesite sampled near the tuff has yielded a K/Ar age of 3.37 ±0.23 Ma (Fox and others, 1985). North of the mapped area, andesite has yielded K/Ar ages of 4.2 ±0.41 Ma (Fox and others, 1985) and 5.36 ± 0.16 Ma (Sarna-Wojcicki, 1976). West of the mapped area, andesite and basalt as old as 8 Ma (Fox and others, 1985) and 12 Ma (Blake and others, 1974) have been included in the Sonoma Volcanics, but because those rocks are seperated from the mapped area by strike-slip faults with possible large offset, the relationship of the older volcanics to the Sonoma Volcanics in the mapped area is unknown. In the mapped area, this formation includes, mapped locally:

Tss — **Volcanic mudstone, sandstone, and conglomerate** —Poorly to well consolidated volcanic mudstone (lahar), and volcanoclastic sandstone and conglomerate. Sandstone is cross-bedded in places. Conglomerate clasts are well-rounded to angular.

Tc — **Cierbo Sandstone (Miocene)** —Orange-weathering, white, clean, quartz-biotite and quartz-lithic sandstone. Locally contains pebble conglomerate with clasts of vari-colored chert, andesite, rhyolite, and quartz. Also contains, locally, mollusk shell hash in clean, hard, white quartz-lithic sandstone.

Tv — **Unnamed volcanics (Miocene?)** —Black basalt. Outcrops only in one hill north of Napa Junction, in the westernmost part of the Cordelia quadrangle. Possible Miocene age is based on similarity of rock to other Miocene volcanics in the San Francisco Bay area and on association with the Cierbo Sandstone.

Tmk — **Markley Formation (Eocene)** —Mainly buff weathering, white to light-gray, quartz-mica sandstone. Characterized in many places by including small to large plates of white mica (up to several mm). In places, the sandstone includes carbonized plant debris and other carbonaceous material. This unit also includes white or brown weathering, brown or dark-gray, foraminifer–and diatom-bearing mudstone and sandy mudstone. In the mapped area, this formation also includes, mapped locally:

Tmkj — **Jameson Mudstone member** —Laminated and siliceous, foraminifer– and diatom-bearing brown mudstone with slabby parting.

Tmv — **Nortonville Shale (Eocene)** —Gray-weathering, brown shale. Also contains thin beds of fine-grained, dark-gray, quartz-lithic–glauconitic sandstone. This unit pinches out in the area north of American Canyon.

Td — **Domingene Sandstone (Eocene)** —Gray-weathering, white, clean, quartz, quartz-lithic, and quartz-biotite sandstone, locally cross-bedded. In one outcrop, north of American Canyon, the sandstone contains abundant invertebrate fossils (shells). Also in the area north of American Canyon, this unit contains near the base a prominent, ridge-forming, boulder to pebble conglomerate containing clasts of serpentinite, gabbro, pyroxenite, crinoidal limestone, black argillite, and diorite.

Tmr — **Muir Sandstone of Weaver (1953) (Eocene)** —Massive, yellow–weathering, arkosic sandstone. Also includes claystone and thin sandstone in the lower part.

Tlj — **Las Juntas Shale of Weaver (1953) (Paleocene and Eocene)** — Gray shale with minor siltstone. This unit does not crop out in the mapped area, but does crop out between the Muir Sandstone and Vine Hill Sandstone across the Carquinez Strait in Martinez, and is presumed to be present but covered in the same stratigraphic position in Benicia.

Tvh — **Vine Hill Sandstone of Weaver (1953) (Paleocene)** —Glauconitic sandstone and shale.

Ku — **Great Valley Sequence:**
Undivided sandstone and shale (Early and Late Cretaceous) — Interbedded carbonaceous-biotite wacke, white-mica–carbonaceous sandstone, greenish-gray mudstone and shale, laminated fine-grained sandstone and gray shale, carbonaceous siltstone, black shale, and fine-grained mica wacke. Locally includes hard, laminated, clean, white, quartz-lithic-biotite sandstone and fossil-hash gritstone. This unit contains foraminifers of both Albian and Campanian age in the mapped area.

KJk — **Knoxville Formation (Early Cretaceous and Late Jurassic)** — Gray shale with concretions. Locally contains pebbly gritstone with green shale chips and probable glauconite. This unit is differentiated from Ku by the presence of the fossil *Buchia*, including both *Buchia piochii* and *Buchia pacifica*, and by the absence of thick beds of sandstone.

Jsv — **Silicic volcanic rocks (Late Jurassic)** —Orange-weathering, white, altered silicic (quartz keratophyre) and intermediate (keratophyre) volcanic rocks. Locally contains red jasper, rhyolite, and rhyolite tuff.

Coast Range Ophiolite (Jurassic):

Jb — **Basalt** —Black basalt and pillow basalt, locally amygduloidal.

Jgb — **Gabbro** —Locally also contains plagioclase-porphyry diabase, pyroxenite, and serpentinite.

sp — **Serpentinite** —Locally also contains pyroxenite and silica-carbonate rock.

KJfm — **Franciscan Complex (Cretaceous and Jurassic)** —In the mapped area composed of:
Franciscan melange —Sheared gray argillite matrix containing very large (more than 10 meters across) to very small (less than 1 meter across) blocks of hard, gray, meta-graywacke, altered basalt (greenstone), metachert, and red, ribbon chert. In one block the depositional contact between ribbon chert and greenstone has been preserved.

Is — **Algal limestone (age unknown)** —In the mapped area, this unit only crops out as a small fault bounded sliver associated with silica–carbonate rock (altered serpentinite) about 1.5 km south of Jameson Canyon.

MAP SYMBOLS

Contact—Depositional or intrusive contact, dashed where approximately located, dotted where concealed

Fault—Dashed where approximately located, small dashes where inferred, dotted where concealed, queried where location is uncertain.

Reverse or thrust fault—Dotted where concealed

Anticline—Shows fold axis, dotted where concealed

Syncline

Strike and dip of bedding

Overturned bedding
Approximate bedding
Vertical bedding

Strike and dip of foliation

Vertical foliation

U.S. Department of the Interior
United States Geological Survey

Plot derived from
Open-File Report 99-162

Base derived from U.S. Geological Survey Cordelia (1980) and Benicia (1980) 1:24,000 topographic quadrangles, using Digital Raster Graphics.

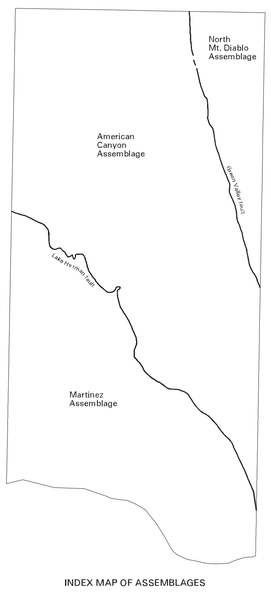
Stateplane projection, California coordinate system, zone 3

This map is a plot derived from data contained in the digital database Open-File Report 99-162, "Geology of the Cordelia and the northern part of the Benicia 7.5 minute quadrangles, California: A digital map database." PostScript and PDF images of this map are included in the Open-File Report, but the Open-File Report does not contain a paper copy of this map. The Open-File Report consists of the digital data and a pamphlet explaining the database and indicating how to obtain the data from which this map was prepared as well as PDF and PostScript images of both the map and a geologic explanation text. The pamphlet also explains how those without computers can obtain a plot of these images from a private vendor.

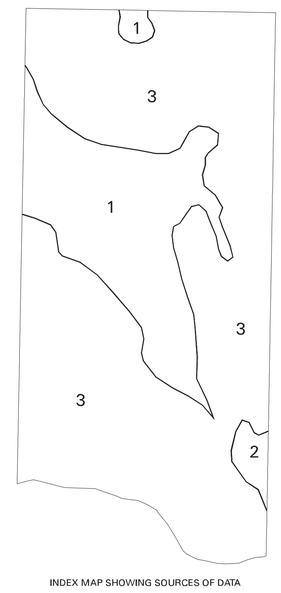
This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.
This database, identified as "Geology of the Cordelia and the northern part of the Benicia 7.5 minute quadrangles, California: A digital map database," has been approved for release and publication by the Director of the USGS. Although this database has been subjected to rigorous review and is substantially complete, the USGS reserves the right to revise the data pursuant to further analysis and review. Furthermore,it is released on condition that neither the USGS nor the United States Government may be held liable for any damages resulting from its authorized or unauthorized use.

SCALE 1:24000

1 MILE
1 KILOMETER
1 THOUSAND FEET



INDEX MAP OF ASSEMBLAGES



Quaternary deposits are modified from Helley and Graymer (1997), and Sowers and others (1998).

1. New mapping by the authors, 1997-1998
2. Modified from Helley and Graymer (1997).
3. Modified from unpublished mapping of Sonneman and Switzer (EXXON, 1961-1962), unpublished mapping of Dibblee (U.S. Geological Survey, 1978), and Dibblee (1980). See also Sims and others (1973).

INDEX MAP SHOWING SOURCES OF DATA