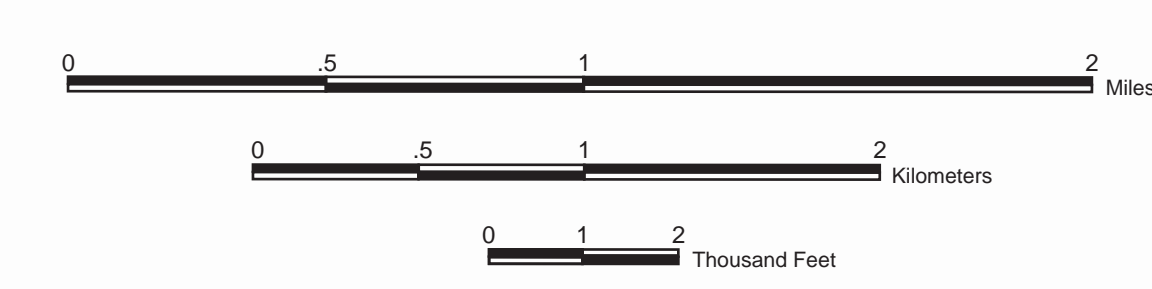
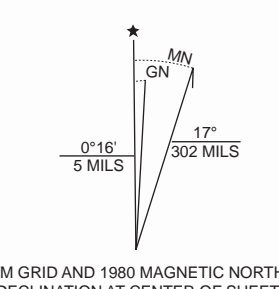


Topographic base from the U.S. Geological Survey
Kenwood 7.5-minute Quadrangle, 1980
UTM Projection, Zone 10, North American Datum 1927



Scale 1:24,000
Contour Interval 40 Feet
Dotted Lines Represent 20 Foot Contours
National Geodetic Vertical Datum of 1929

This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program, STATEMAP Award no. 06HQAG0038

Note: The digital database for this project was compiled utilizing the best, readily available photogrammetric data for horizontal control. The County of Napa provided color orthophotos and digital topographic maps covering the northeast portion of the quadrangle from a 2002 survey by Towill, Inc., at a map scale of 1:2,400. The County of Sonoma provided B&W orthophotos covering the remainder of the quadrangle from a 2000 survey by Merrick & Company at a map scale of 1:2,400. Because the location of geologic contacts are tied to these surveys, they may not precisely fit with stream lines, contours, or other features shown on the less accurate digital raster graphic of the 1:24,000-scale USGS quadrangle used as the base for this presentation.

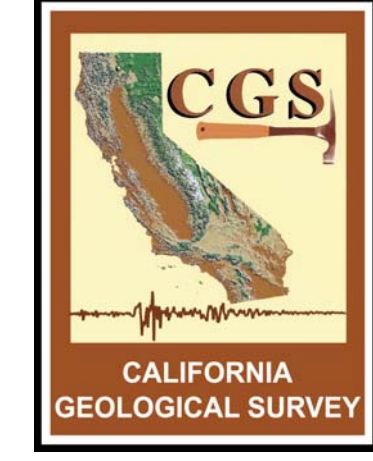
GEOLOGIC MAP OF THE KENWOOD 7.5' QUADRANGLE SONOMA AND NAPA COUNTIES, CALIFORNIA: A DIGITAL DATABASE

VERSION 1.0

By
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Digital Database
By:
Carlos I. Gutierrez¹ and Karen Toman-Sager¹
2007

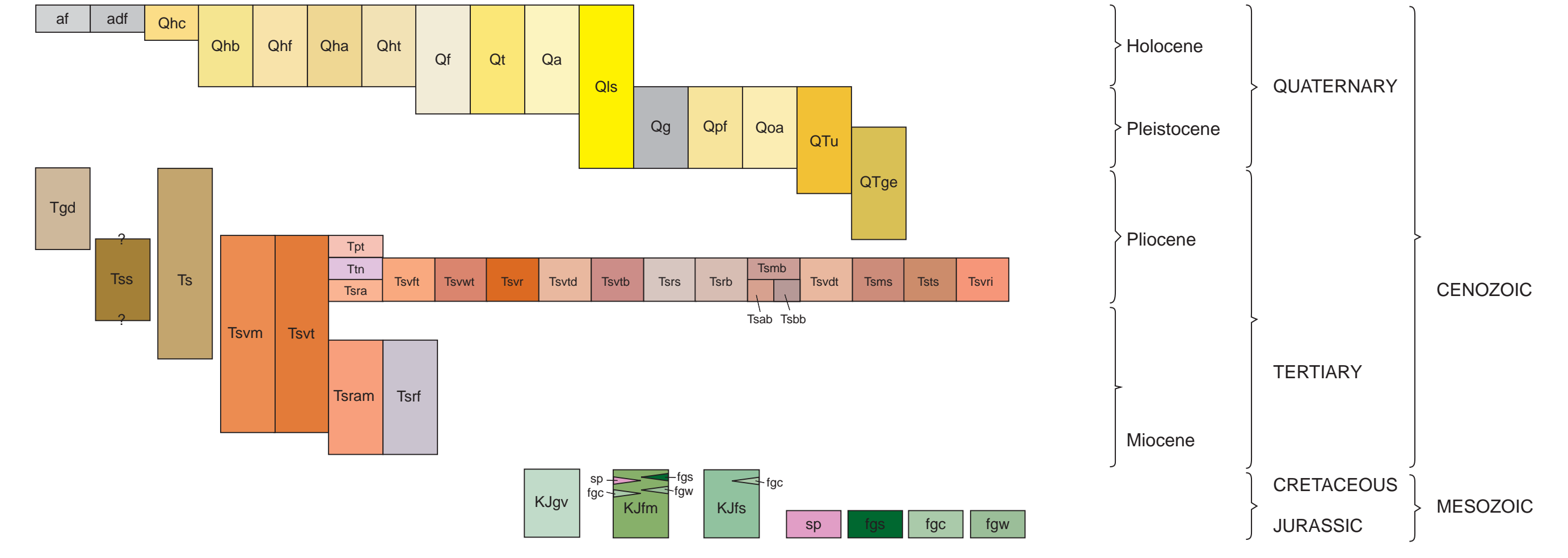
¹ California Geological Survey
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DESCRIPTION OF MAP UNITS

- af** Artificial fill (Holocene, historic) – May be engineered and/or non-engineered.
- adfl** Artificial dam fill (Holocene, historic) – Earth dams, rock-fill dams, and embankments constructed to impound water.
- Qhc** Modern stream channel deposits (Holocene <150 years) – Fluvial deposits within active, natural stream channels. Consists of loose alluvial sand, gravel, and silt.
- Qhb** Basin deposits (Holocene) – Sediment accumulated in topographic basins from slow-moving or standing water. Consists of horizontally stratified sand, silt, and clay; may be interbedded with lobes of coarser alluvial deposits.
- Qhf** Alluvial fan deposits (Holocene) – Sediment deposited by streams emanating from canyons onto alluvial valley floors. Consists of poorly to moderately sorted sand, silt, gravel, and occasionally clay.
- Qha** Alluvium, undivided (Holocene) – Alluvium deposited in fan, terrace, or basin environments which could not be readily separated for mapping. Typically consists of poorly to moderately sorted sand, silt, and gravel that form smooth geomorphic surfaces with little to no dissection.
- Qht** Stream terrace deposits (Holocene) – Moderately well-sorted and bedded sand, gravel, silt, and clay deposited along creeks.
- Ql** Alluvial fan deposits (latest Pleistocene to Holocene) – Moderately to poorly sorted deposits of sand, gravel, silt, and clay mapped on gently sloping, fan-shaped, relatively undivided alluvial surfaces.
- Ql** Stream terrace deposits (latest Pleistocene to Holocene) – Moderately to well-sorted and bedded sand, gravel, silt, and minor clay mapped on relatively flat, undivided terraces where absolute age is uncertain.
- Qa** Alluvium, undivided (latest Pleistocene to Holocene) – Sand, gravel, silt, and clay mapped in small valleys where separate fan, basin, terrace, and active stream channel units could not be delineated at the scale of mapping.
- Qg** Fluvial gravels (Pleistocene) – Boulder gravel composed of predominantly Sonoma Volcanics, although clasts of Franciscan debris do occur. Unit has distinctive reddish soil.
- Qpf** Alluvial fan deposits (Pleistocene) – Sand, gravel, silt, and clay derived predominantly from Sonoma Volcanics. Mapped on gently sloping surfaces where Pleistocene age is indicated by greater dissection. Includes some deposits with reworked tuff and obsidian pebbles, lithologically similar to Glen Ellen Formation, but with morphological expression suggestive of more localized alluvial fan origins.
- Qcs** Landslide deposits (Pleistocene to historic) – Includes deep-seated rock slides, earth flows, and debris flow deposits. Arrows indicate direction of movement; queried where existence is questionable.
- Oca** Older alluvial deposits, undivided (early to late Pleistocene) – Moderately to deeply dissected alluvial fan, stream terrace, or basin deposits. Topography often consists of gently rolling hills with little or none of the original planar alluvial surface preserved.
- QTpe** Glen Ellen Formation (Pliocene to Pleistocene) – Light-brown to yellowish-brown, interstratified gravel, sand, silt, and reworked tuff. Sediments are mostly derived from Sonoma Volcanics, though pebbles of Franciscan rock are common. Obsidian pebbles are characteristic of this unit. Tephra from the Glen Ellen Formation range from 2.5 Ma to slightly older than 2.5 Ma (Andrea Sama-Wojcik, written communications, 2003-2006).
- QTu** Unnamed fluvial deposits (Pliocene to Pleistocene) – Cobbly gravels interstratified with sand, silt, and minor clay. Previously mapped as Glen Ellen Formation (Weaver, 1949; Cardwell, 1966; Huffman and Armstrong, 1980) and/or Huichica Formation (Fox and others, 1973; Fox and others, 1985). Includes some reworked tuff and sparse obsidian pebbles, but less than typical for the type locality of the Glen Ellen Formation. Differentiated by the generally coarser composition and greater proportion of clasts derived from Franciscan basement rocks, including cobbles and occasional boulders of chert similar to that mapped along upper Santa Rosa Creek.
- Ts** Fluvial and lacustrine sediments (Pliocene to latest Miocene) – Light-gray to brownish-gray and yellowish-brown weathered, poorly indurated sandstone, mudstone, pebble gravel. Clasts are derived from Franciscan basement and Tertiary volcanic sources. Distinctive clasts of laminated, siliceous shale from the Claremont shale member of the Monterey Formation are present in some outcrops. Tephra interbedded with this unit include the Plinthe tuff (5.2 Ma), Mark West Springs tuff (<4 Ma to <4.83 Ma), Lawlor tuff (4.83 Ma), and Tuff of Napa (4.65 Ma). Earlier maps and reports (Weaver, 1949; Fox and others, 1973; Huffman and Armstrong, 1980) show these sediments as Petaluma Formation or Huichica Formation (Fox and others, 1985); however, these sediments are probably unconformable with and much younger than the Petaluma Formation in its type locality near Petaluma. This is interbedded with the Sonoma Volcanics.
- Tsa** Sedimentary deposits of uncertain age – Friable deposits of sandy gravel derived from volcanics, with interbedded tuffaceous sand, clay, and diatomite.
- Tpd** Sandstone, tuff, mudstone, and diatomite (Pliocene?) – Only limited exposures observed along Los Alamos Road. Sandstone and gravel is predominantly derived from pre-Tertiary basement. Diatomite is light brown, laminated, and fissile when weathered. Sediments underlain/interfingering(?) with tuff and andesite of Sonoma Volcanics. May correlate with the Pliocene Fluvial and Lacustrine Deposits of Humburg Creek of McLaughlin and others (2004).
- Sonoma Volcanics (Pliocene to Miocene)**
 - Tpt** Putah Tuff (Pliocene) – Pumiceous ash-flow tuff and reworked tuff dated at 3.3 Ma.
 - Th** Tuff of Napa (formerly called Healdsburg tuff) (Pliocene) – Pumiceous ash-flow tuff dated at 4.65 Ma. Commonly is a distinctive chocolate brown color with gray pumice fragments up to 2.5 cm in diameter.
 - Tsvt** Intrusive rhyolite plugs and breccias
 - Tsvf** Rhyolitic flows – Rhyolitic lava flows, with intercalated rhyolitic tuff. May be in part equivalent to Tsvb.
 - Tsvm** Mafic flows, undivided – Andesite, basaltic andesite, and basalt in massive flows and breccias, with intercalated tuff. May be in part equivalent to Tsvb or Tsvm.
 - Tsvwt** Welded tuff – Welded ash-flow tuff, with subordinate unwelded or partly welded tuff.
 - Tsvtd** Air-fall tuff – Fine-grained, interbedded air-fall and water-laid tuff and diatomaceous tuff. Light-gray to white, and brown stained locally.
 - Tsvhb** Tuff breccia – Tuff breccia with intercalated agglomerate and tuff.
 - Tsvrs** Soda rhyolite of Sugarloaf Ridge – Light-gray, fine-grained or porphyritic, with phenocrysts of sanidine and orthoclase. Frequently finely vesicular. Appears in part intrusive. Includes minor interlayered tuff and tuff-breccia.
 - Tsvfi** Ash-flow tuff and flows – Ash-flow tuff, tuff breccia, water-lain tuff and agglomerate thinly interlayered with mafic lava flows.
 - Tsvdi** Tuff and breccia – Andesitic to dacitic ash-flow tuff, tuff breccia and some water-lain tuff. Includes local deposits of agglomerate, and minor lava flows.
 - Tsvb** Rhyolite of Bennett Mountain – Massive flows and flow breccias of rhyolite and rhyodolite. Typically flow banded, with perlitic zones and some obsidian locally. Includes local deposits of silicic tuff and possible intrusions. In Annadel State Park, Ar-Ar dating of obsidian yielded an age of 4.51 to 4.54 ± 0.01 Ma (McLaughlin and others, in press).
 - Tsvmb** Mafic flows of Bennett Mountain – Andesite, basaltic andesite, and basalt in massive flows and breccias, with intercalated tuff and more siliceous deposits locally. Mapping of Annadel State Park by Higgins (1985) includes subunits Tsvb - basaltic andesite flows and flow breccias distinguished by phenocrysts of olivine and augite; and Tsva - andesite flows and flow breccias distinguished by phenocrysts of hypersthene and absence of olivine. Ar-Ar dating of flow rock in Annadel State Park yielded an age of 4.7 ± 0.03 Ma (McLaughlin and others, in press).

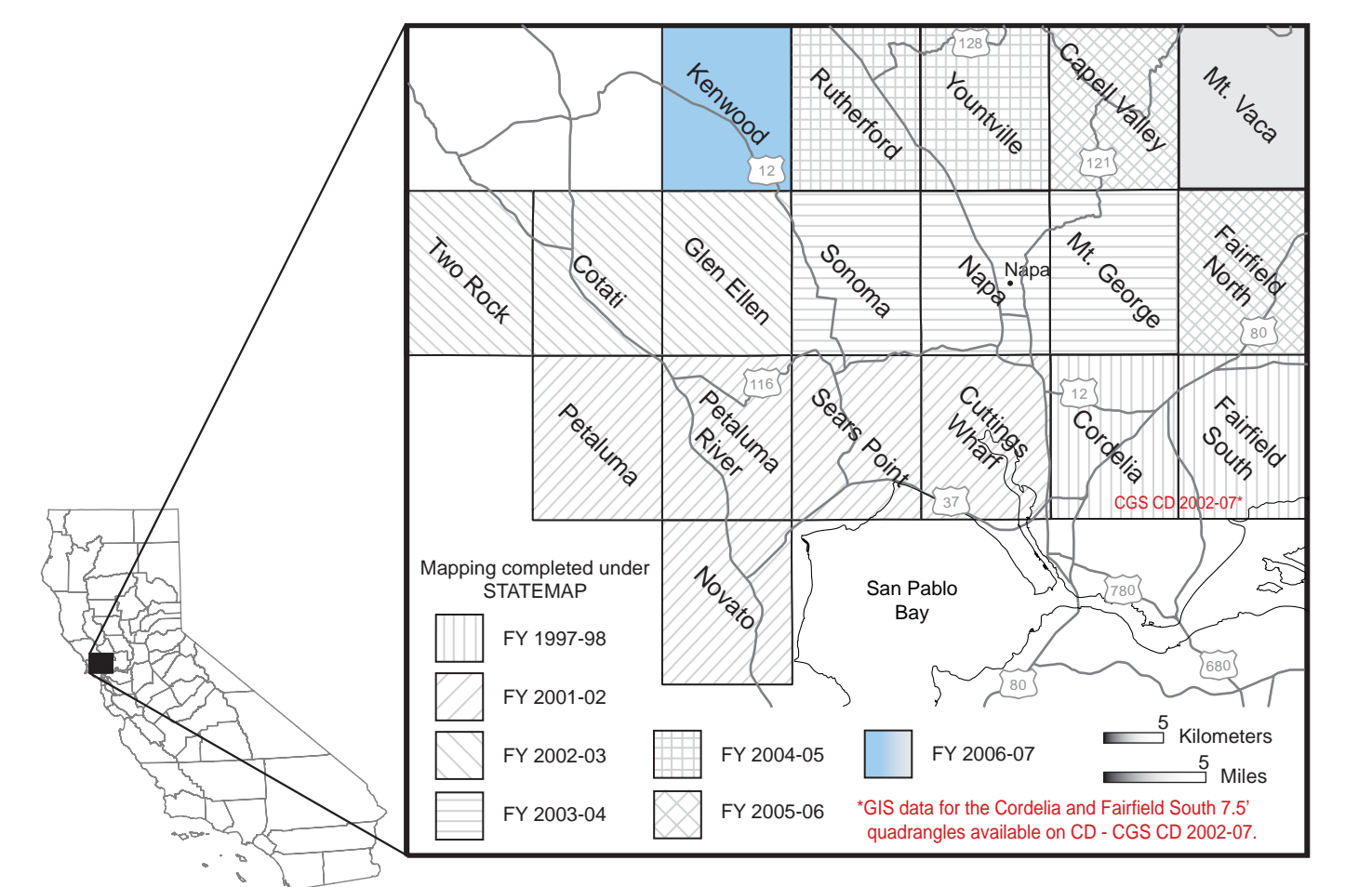
CORRELATION OF MAP UNITS



- Tsvf** Pumiceous ash-flow and minor air-fall tuff – Locally welded or partially welded. Also includes some water-lain tuff and agglomerate. Tephra collected from a quarry northwest of Los Alamos Road correlates with the Lawlor Tuff with an age of 4.83 Ma (McLaughlin and others, in press). South of Annadel State Park, tephra from near top of tuff north of Bennett Valley Road correlates with the tuff of Mark West Springs indicating ages between 4.83 and 5.02 Ma (McLaughlin and others, in press). In the same vicinity near Bennett Valley Road, K-Ar dating of tuff lower in the unit yielded an approximate age of 5.66 ± 0.33 Ma (Markinen, 1972).
- Tsvms** Mafic lava flows and intrusions of Sugarloaf Ridge (age uncertain) – Basaltic andesite and basalt erupted from vents along Sugarloaf Ridge. Includes interbeds of red- and brown-stained tuff, scoriaeous breccia, and volcanic bombs.
- Tsvts** Lithic tuff breccia – Yellowish-gray to white, massive or crudely graded ash-flow tuff and tuff breccia, with some interbeds of well-bedded water-lain tuff and agglomerate with obsidian pebbles. Lithics are predominantly flow-banded rhyolite. Lower portion of unit includes blocks of banded rhyolite exceeding several meters in diameter and vitrophere to 1 meter. Also includes thin interbedded/dip-laced blocks(?) of andesitic flow rock locally. Commonly weathers to form knobby outcrops and pinacles.
- Tsvra** Rhyolite of Adobe Canyon – Glassy gray to white rhyolite lava flows with well-developed, folded and contorted flow banding. K-Ar dated at 5.3 ± 0.2 Ma (Markinen, 1972).
- Tsvrf** Rhyolite flows – Pinkish-purple to bluish-gray, porphyritic rhyolite flows with phenocrysts of sanidine and quartz; usually with well-developed flow banding. Overlies or interbedded with Tsvrm.
- Tsvra** Rhyolite of Arrowhead Mountain(?) – Highly variable sequence of light-colored, rhyolitic flows, tuffs, breccias, and plugs. Along Trinity Road and Nunns Canyon, most exposures are severely weathered and/or silicified, including rhyolite breccias that have been largely replaced by opal and chalcedony. Also includes scattered thin mafic flows.
- KJgv** Great Valley Sequence (Early Cretaceous and Late Jurassic) – Limited exposures in Sugarloaf Ridge State Park, where it consists of gray to greenish-gray, light-brown weathered, micaceous siltstone, mudstone, and occasional sandstone. Typically broken and sheared, with little or no persistent bedding.
- KJfm** Franciscan Complex, Central Belt (Late Cretaceous to Early Jurassic)
- KJfs** Franciscan mélange – Tectonic mixture consisting largely of penetratively sheared argillite and graywacke that forms a matrix around more coherent rock masses of varying lithology that are mostly too small to map. In fact blocks and slabs within the matrix include altered mafic volcanic rock (greenstone), chert, serpentinite, coherent graywacke, and exotic metamorphic rocks. The unit is typically grass covered with little trees or brush. The surface is frequently disrupted by soil creep, shallow earthflows, and larger landslides, and has a characteristic topography produced by resistant blocks protruding from the sheared matrix.
- sp** Coherent rock masses that have been mapped separately
- fgc** Serpentinite – Variably serpentinized ultramafic rocks, including coarse basalt (pseudomorph after pyroxene) locally. Includes blocks within KJfm and larger fault-bounded bodies likely derived from the Coast Range Ophiolite.
- fgw** Greenstone – Variably altered basalt and other mafic volcanic rocks. Predominantly massive, occasionally vesicular, with pillow structure preserved at a few locations. Predominantly dark gray fresh; weathered dark brown to orange or reddish brown. Around Bald Mt., weathered a chert maroon.
- fgc** Chert and Greenstone – Greenstone is similar to fgw, but in close association with chert that could not be distinguished at map scale. Chert is typically brown, and occasionally green or yellow. Quartz veins are common. Along Santa Rosa Creek in Mt. Hood County Park, includes large sections of highly folded ribbon chert with shale interbeds.
- fgw** Graywacke and metagraywacke

MAP SYMBOLS

- Contact between map units – Solid where accurately located, dashed where approximately located, queried where uncertain, dotted where concealed.
- Fault – Solid where accurately located, dashed where approximately located, dotted where concealed, queried where uncertain. Arrow and number indicate direction and angle of dip of fault plane.
- Thrust fault – Bars on upper plate; dashed where approximately located, dotted where concealed.
- Syncline – Dashed where approximately located, dotted where concealed.
- Anticline – Dashed where approximately located, dotted where concealed.
- Strike and dip of inclined bedding.
- Strike and dip of volcanic flow.
- Landslide – Arrows indicate principal direction of movement, queried where existence is questionable.



Mapping completed under STATEMAP
 FY 1997-98
 FY 2001-02
 FY 2002-03
 FY 2003-04
 FY 2004-05
 FY 2005-06
 FY 2006-07

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