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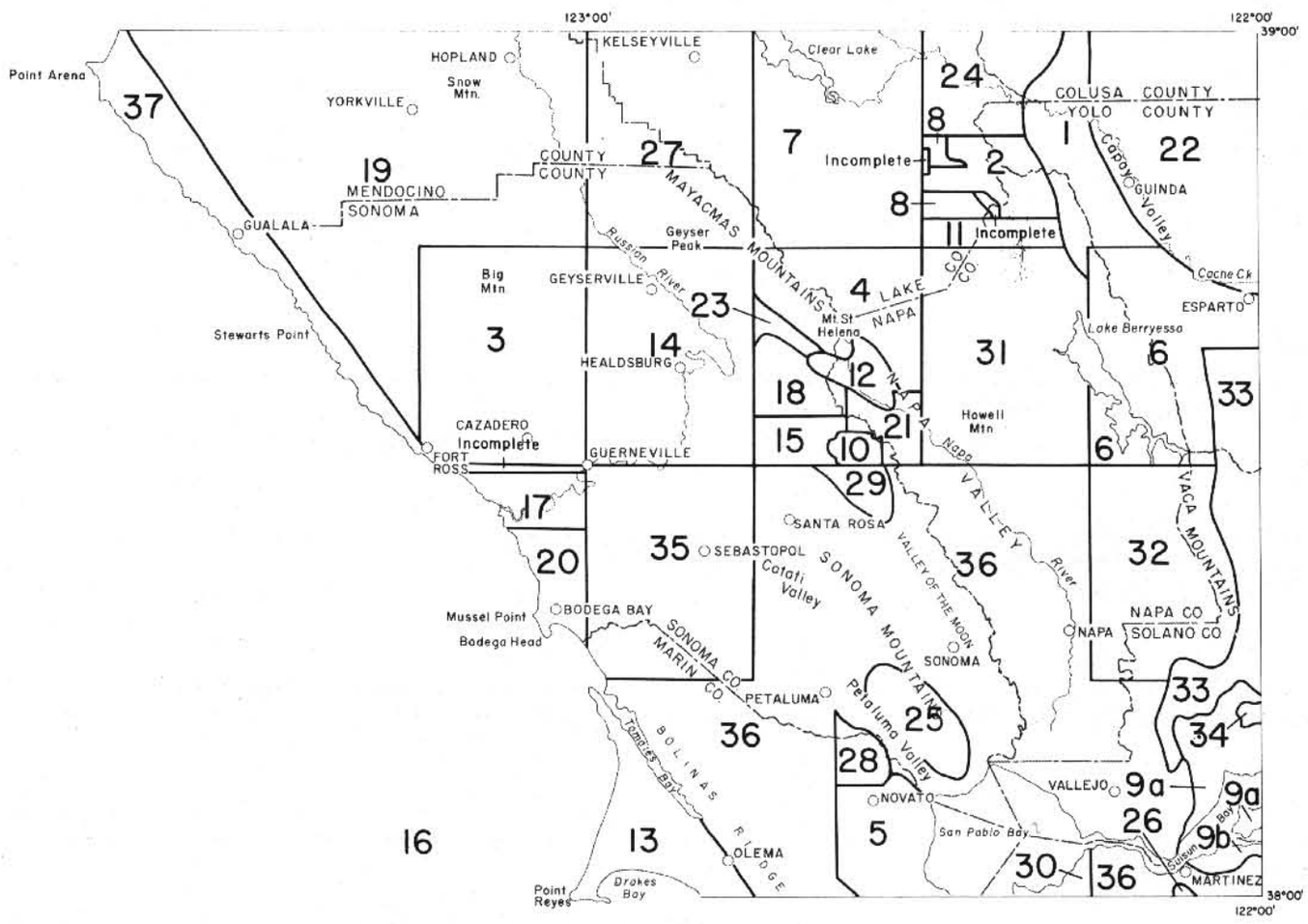
EXPLANATORY DATA

SANTA ROSA SHEET
GEOLOGIC MAP OF CALIFORNIA
OLAF P. JENKINS EDITION

Compiled by James B. Koenig 1963

(Third Printing, 1976)

INDEX TO GEOLOGIC MAPPING
USED IN THE COMPILATION OF THE SANTA ROSA SHEET



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For a complete list of published geologic maps of this area see Division of Mines and Geology Special Reports 52 and 52-A.

STRATIGRAPHIC NOMENCLATURE—SANTA ROSA SHEET

AGE	STATE MAP SYMBOL	STATE MAP UNIT State Map Units listed here are not necessarily in stratigraphic sequence; the sequence used has been standardized for all sheets of the Geologic Map of California	STRATIGRAPHIC UNITS AND CHARACTERISTIC LITHOLOGIES (The formally named formations grouped within an individual State Map Unit are listed in stratigraphic sequence from youngest to oldest.)
CENOZOIC / QUATERNARY / Recent	Qs	**RECENT DUNE SAND**	Dune sand and associated beach deposits.
	Qal	**RECENT ALLUVIUM**	Stream and valley alluvium. Artificial fill. Mud flats and salt marsh deposits bordering San Pablo Bay.
	Qsc	**RECENT RIVER AND MAJOR STREAM CHANNEL DEPOSITS IN THE GREAT VALLEY**	River silts and sands (deposits along channels and natural levees of major streams).
	Qf	**RECENT ALLUVIAL FAN DEPOSITS IN THE GREAT VALLEY**	Alluvial-fan deposits (Pleistocene and Recent).
	Qb	**RECENT BASIN DEPOSITS IN THE GREAT VALLEY**	Sediments deposited during flood stages of major streams in areas between natural levees and alluvial fans. Sacramento-San Joaquin River delta mud, loam, muck and peat.
		RECENT VOLCANIC ROCKS:	
	Qrv	**UNDIFFERENTIATED**	Andesite and basalt.[1]
	Qrv^r	**RHYOLITIC**	Olivine dacite.[1]
	Qrv^b	**BASALTIC**	Basalt.[1]
	Qrv^p	**PYROCLASTIC**	Basaltic lapilli and other ejecta, forming cinder cone south of Clear Lake.[1]
QUATERNARY / Pleistocene	Qt	**QUATERNARY NONMARINE TERRACE DEPOSITS**	River and stream terrace sands, silts and gravels. In Big Valley, near Kelseyville, these deposits form a thin veneer over diatomaceous silts and gravels of the Cache Formation. Includes older alluvium on west side of Sonoma Valley.
	Qm	**PLEISTOCENE MARINE DEPOSITS AND MARINE TERRACE DEPOSITS**	Millerton Formation—*fossiliferous sands, clays and gravels* (on Tomales Bay and near Carquinez). Marine and nonmarine deposits on wave-cut terraces along coast.
	Qc	**PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	Red Bluff Formation—*poorly-sorted reddish-brown sands and gravels, and minor clay beds* (may include post-Red Bluff stream terrace gravels). Montezuma Formation—*gravels, sands and clays*. Huichica Formation—*clay and silt, and gravelly and sandy clay, with reworked pumice and tuff near base*. Unnamed silts, clays, sands, gravels, and minor peat deposits (in part called Older Alluvium in alluviated valleys).
		PLEISTOCENE VOLCANIC ROCKS:	
	Qpv^r	**RHYOLITIC**	Rhyolite flows and tuffs of Cobb Mountain.[1] Rhyodacite.[1] Silicic dacite.[1] Obsidian (in part Recent).[1]
	Qpv^a	**ANDESITIC**	Andesite.[1]
	Qpv^b	**BASALTIC**	Basalt and olivine basalt, largely quartz-bearing (basal flows intercalated with the Cache Formation; may be in part Pliocene).[1]
	Qpv^p	**PYROCLASTIC**	Rhyolitic tuff of the Cache Formation, stratigraphically below quartz-bearing basalts (Qpv^b).
	QP	**PLIOCENE-PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	Cache Formation—*silts, gravels, and clays, with beds of tuffaceous sand, marl, limestone, and diatomite*. Glen Ellen Formation—*poorly sorted silts, gravelly clays, and sands and gravels, with basal reworked tuff beds*. (Includes Older Alluvium of Travis, 1952, and upper part of the Sonoma Group of Gealey, 1950. Lower section of the Glen Ellen Formation is interbedded with the Merced Formation and with the Sonoma Group.) Unnamed silts, sandy clays, sands, and gravels bordering Lake Berryessa, and near Hopland. Unnamed conglomerates, siltstones, and lenses of limestone and coal, along Little Sulphur Creek (includes lagoonal or marine lenses).
	✳	**QUATERNARY AND/OR PLIOCENE CINDER CONES**	Quaternary cinder cone south of Clear Lake.
CENOZOIC / TERTIARY / Pliocene	Pc	**UNDIVIDED PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Alluvial and lacustrine sand, silt, gravel, diatomite, and gravelly clay, largely tuffaceous. (Considered to be part of the Sonoma Group: see Pv, Pv^p).
	Puc	**UPPER PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Tehama Formation—*fluviatile and lucustrine (?) silt, clay, silty sand with sand and gravel lenses, and basal beds of reworked tuff*. (May locally include correlatives of the Red Bluff Formation.)
	Pu	**UPPER PLIOCENE MARINE SEDIMENTARY ROCKS**	Merced Formation—*fossiliferous marine sandstone, siltstone, silty clay, with interbedded gravels and with basal tuff beds* (grades into nonmarine beds eastward along Petaluma and Santa Rosa Valleys, where it interfingers with rocks of the Sonoma Group; age ranges from middle Pliocene to early Pleistocene). Ohlson Ranch Formation—*marine sandstone, siltstone, and conglomerate, and fluviatile or lacustrine conglomerate* (middle to late(?) Pliocene age).
	Pmlc	**MIDDLE AND/OR LOWER PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Wolfskill Formation—*sandstone, conglomerate and andesitic tuff* (in vicinity of Port Chicago). Petaluma Formation—*sandstone, conglomerate and clay shales of fluviatile, lacustrine and estuarine origin* (Petaluma Valley area). Orinda Formation—*conglomerate, sandstones, clays, ostracodal limestone* (west of Pinole). (These three formations may be in part contemporaneous—Weaver, 1949.)
	Pml	**MIDDLE AND/OR LOWER PLIOCENE MARINE SEDIMENTARY ROCKS**	Siltstone, diatomaceous siltstone, sandstone, and claystone (on Pt. Reyes; early Pliocene age).
		PLIOCENE VOLCANIC ROCKS:	
	Pv	**UNDIFFERENTIATED**	Sonoma Group[2]—*andesite, basalt and rhyolite flows, tuffs and breccias, agglomerates, minor pumice and obsidian, with associated water-laid sediments of volcanic origin*. (Probably of middle and late Pliocene age. Interfingers in part with the Merced Formation and with the Glen Ellen Formation: see Pu and QP.)
	Pv^r	**RHYOLITIC**	Rhyolite of the Sonoma Group,[2] including the St. Helena Rhyolite—*rhyolitic flows and tuffs, perlite, pumice and obsidian, with interbedded agglomerate, sands, clays, and gravels*.
	Pv^a	**ANDESITIC**	Andesite flows, tuffs, breccias, and agglomerates of the Sonoma Group.[2]
	Pv^b	**BASALTIC**	Basalt flows and breccias of the Sonoma Group.[2]
	Pv^p	**PYROCLASTIC**	Tuffs, tuff breccias, agglomerates, water-laid sands, gravels, diatomaceous clays and silts, minor pumice and perlite, and interbedded flows of the Sonoma Group.[2] Nomlaki Tuff Member of the Tehama Formation—*pumiceous dacitic tuff* (along the border of Sacramento Valley). Lawlor Tuff—*andesitic tuffs and gravels* (in Los Medanos Hills; early to middle Pliocene). Pinole Tuff—*andesitic tuff and interbedded sand, gravel and clay* (in vicinity of Pinole; early to middle Pliocene).
TERTIARY / Miocene	Mu	**UPPER MIOCENE MARINE SEDIMENTARY ROCKS**	San Pablo Group—*marine sandstones, tuffs and shales* consisting of: Neroly Sandstone—*fine- to coarse-grained sandstone, with thin shale beds*; Cierbo Sandstone—*sandstone, white tuff, and gray tuffaceous shale*; Briones Sandstone—*quartz sandstone and local conglomerate lenses*, and Hercules Shale Member of Briones Sandstone—*siliceous and bituminous shale*.
	Mm	**MIDDLE MIOCENE MARINE SEDIMENTARY ROCKS**	Monterey Group—*six alternating shale and sandstone units:* Rodeo Shale—*siliceous and chalky shale*; Hambre Sandstone—*brown-gray sandstone and minor sandy shale*; Tice Shale—*chalky bituminous shale*; Oursan Sandstone—*sandstone and tuffaceous sandstone*; Claremont Shale—*shale with minor grit lenses*; Sobrante Sandstone—*fine- to coarse-grained sandstone*. "Monterey Shale"—*siliceous shales, glauconitic sandstone, and bedded chert* (on Pt. Reyes).[3]
	Ml	**LOWER MIOCENE MARINE SEDIMENTARY ROCKS**	Point Arena Beds—*foraminiferal clay shales, bituminous sandstone, cherty shale* (may be in part of middle Miocene age). Gallaway Beds—*sandy shales, mudstones and sandstones* (on Pt. Arena; may be in part Oligocene).[4] Sandstone, mudstone, shale, and minor volcanic rock of early Miocene age, near Fort Ross.[5]
Oligocene	Φ	**OLIGOCENE MARINE SEDIMENTARY ROCKS**	San Ramon Formation—*silty shale, and interbedded sandstone and conglomerate*. (Considered by many paleontologists to be earliest Miocene, rather than Oligocene.)

STRATIGRAPHIC NOMENCLATURE—Continued

AGE	STATE MAP SYMBOL	STATE MAP UNIT State Map Units listed here are not necessarily in stratigraphic sequence; the sequence used has been standardized for all sheets of the Geologic Map of California	STRATIGRAPHIC UNITS AND CHARACTERISTIC LITHOLOGIES (The formally named formations grouped within an individual State Map Unit are listed in stratigraphic sequence from youngest to oldest.)
CENOZOIC / TERTIARY / Eocene	E	**EOCENE MARINE SEDIMENTARY ROCKS**	Markley Formation—*sandstone, sandy shale and clay shale* (includes Jameson Shale Member); Nortonville Shale—*clay shales and siltstones;* Domengine Formation—*clay shales and massive sandstone* (includes "Ione-type" quartzitic sandstone of Tolman, 1943); Capay Formation—*clay shales and siltstones, basal conglomerate.* Unnamed sandstones and shales in Conn Valley, in Potrero Hills, and in vicinity of Vacaville. Sandstone, mudstone, and conglomerate of middle and late Eocene age north of Fort Ross, and of probable Late Cretaceous to Oligocene(?) age east of Point Arena.[5]
CENOZOIC / TERTIARY / Paleocene	Ep	**PALEOCENE MARINE SEDIMENTARY ROCKS**	Martinez Formation—*micaceous sandstone, gray foraminiferal shale, glauconitic sandstone* (includes "Lower Meganos(?)" shale; and sandstone of Tolman, 1943, in the Potrero Hills). Vine Hill Sandstone—*massive, glauconitic sandstone* (same as lower part of "Martinez Formation"). Unnamed massive conglomerate and siltstone on Pt. Reyes.[3] Sandstone, conglomerate, and mudstone of Paleocene and possibly Late Cretaceous age, north of Fort Ross.[5]
CENOZOIC / TERTIARY / Undivided	Tc	**TERTIARY NONMARINE SEDIMENTARY ROCKS**	Unnamed siltstone, claystone, sandstone, and minor conglomerate of fluviatile, lacustrine and partially-marine origin, in the English Hills area. Includes detritus from Putnam Peak Basalt; age estimated to be Oligocene(?) to Pliocene(?)—Thomasson, Olmsted and LeRoux, 1960.
		TERTIARY INTRUSIVE (HYPABYSSAL) ROCKS:	
	Ti^b	**BASALTIC**	Hornblendite and "Solano" diabase of Weaver, 1949, on Sulphur Springs Mountain (pre-middle Eocene; probably Mesozoic).
	Ti^r	**RHYOLITIC**	Rhyolitic plugs, northeast of Santa Rosa.
	Ti^a	**ANDESITIC**	Sulphur Springs Mountain Andesite—*altered reddish-buff, shallow-intrusive andesite* (post-Knoxville and pre-middle Eocene).
		TERTIARY VOLCANIC ROCKS:	
	Tv^b	**BASALTIC**	Putnam Peak Basalt—*dense, black, vesicular basalt* (age estimated to be Oligocene(?) to Pliocene(?)—Thomasson, Olmsted and LeRoux, 1960). Skooner Gulch Basalt—*flow breccia and amygdaloidal basalt* (also called Iversen Basalt by Weaver, 1944; Eocene to Miocene in age). Unnamed black spilite at Black Point.[6]
	Tv^p	**PYROCLASTIC**	Vent breccia, west of Petaluma (post-Franciscan and pre-Merced, Johnson, 1943).
MESOZOIC / CRETACEOUS	K	**UNDIVIDED CRETACEOUS MARINE SEDIMENTARY ROCKS**	Unnamed graywacke sandstones, shales, conglomerates, and mildly metamorphosed equivalents, in the coastal belt east of the San Andreas Fault zone. (Now considered by E. H. Bailey, oral communication, 1963, to be equivalent to the upper part of the Franciscan Formation.)
MESOZOIC / CRETACEOUS	Ku	**UPPER CRETACEOUS MARINE SEDIMENTARY ROCKS**	Gualala Group, of Weaver—*sandstone, conglomerate, and shale* (restricted herein to those beds of known Late Cretaceous age). "Chico Formation"—*massive to thin-bedded sandstones and shales and minor conglomerate.* Forbes, Guinda, Funks, Sites, Yolo and Venado Formations—*green, gray, tan, and black shales, massive to thin-bedded buff and gray sandstones and siltstones, and conglomerate lenses.* Unnamed sandstones, shales and conglomerates in the Vaca Mountains, including "Salt Creek Conglomerate." Novato Conglomerate—*massive cobble and pebble conglomerate* (possibly of Early Cretaceous age). Unnamed arkosic sandstone, quartzitic sandstone, and thin-bedded shales, in vicinity of Novato. Includes rocks of probable Early Cretaceous age in hills west of Oakville.
MESOZOIC / CRETACEOUS	Kl	**LOWER CRETACEOUS MARINE SEDIMENTARY ROCKS**	Rocks of the Shasta Series, including the "Horsetown" and "Paskenta" Formations—*shales, siltstones, sandstones, conglomerates, and local detrital serpentine.* Unnamed massive conglomerates and minor shales north and west of Healdsburg and in vicinity of Cazadero and Jenner. (Areas shown as Kl(?) may include rocks of Late Cretaceous or Jurassic age.)
MESOZOIC / CRETACEOUS	KJf	**FRANCISCAN FORMATION**	Franciscan Formation—*graywacke, shale, conglomerate, chert, minor lenses of limestone, and glaucophane schists and related metamorphic rocks.* Locally may include basalt, greenstone and diabase, or peridotite and dunite bodies, largely serpentinized. (May include rocks of the Knoxville Formation locally.) Areas shown as KJf glaucophane schist or KJf schist are major zones of glaucophane schist and related metamorphic rocks of the Franciscan Formation.
MESOZOIC / CRETACEOUS	KJfv	**FRANCISCAN VOLCANIC AND METAVOLCANIC ROCKS**	Greenstone, basalt, and diabase of the Franciscan Formation.
MESOZOIC / CRETACEOUS	grt	**TONALITE (QUARTZ DIORITE) AND DIORITE**	"Bodega Diorite"—*quartz diorite, granodiorite and diorite* (Pt. Reyes, Tomales Point, and Bodega Head).
MESOZOIC / UNDIVIDED JURASSIC	bi	**MESOZOIC BASIC INTRUSIVE ROCKS**	Gabbro and diorite (closely associated with serpentine, and with diabase intrusive bodies of the Franciscan Formation).
MESOZOIC / UNDIVIDED JURASSIC	ub	**MESOZOIC ULTRABASIC INTRUSIVE ROCKS**	Serpentine, peridotite, dunite, and pyroxenite, and minor amounts of silica-carbonate rock derived from alteration of serpentine.
MESOZOIC / UNDIVIDED JURASSIC	Jk	**KNOXVILLE FORMATION**	Knoxville Formation—*shale, siltstone, sandstone, and conglomerate, with local limestone lenses; detrital serpentine in Knoxville area.* Rocks of the Knoxville Formation largely are recognized on the presence of the fossil pelecypod *Buchia piochii.* (Areas shown as Jk(?) may include rocks of the Franciscan Formation, or other rocks of Early Cretaceous age.)
MESOZOIC / UNDIVIDED JURASSIC	m ls	**PRE-CRETACEOUS METAMORPHIC ROCKS, UNDIFFERENTIATED, ls = LIMESTONE AND/OR DOLOMITE**	Quartzite and mica schist (considered to be "Sur Series" by Weaver, 1949). Crystalline limestone (considered to be "Sur Series" by Weaver, 1949).

NOTES

1. Part of the Clear Lake Volcanic Series of Brice, 1953.
2. Also called Sonoma Volcanics. Described by V. C. Osmont, 1904, Calif. Univ. Pub., Dep't. Geol. Bull., v. 4, pp. 39-87, as consisting of Mark West Andesite, Sonoma Tuff, and St. Helena Rhyolite. These are no longer considered mappable units, except for the St. Helena Rhyolite in the southern part of Napa Valley and along the east side of Sonoma Valley (Kunkel and Upson, 1960, p. 24).
3. Includes part of the Laird Sandstone of Weaver, 1949.
4. This unit was named Gallaway Beds by C. E. Weaver, 1943, Calif. Div. Mines Bull. 118, pp. 628-632. However, in 1944, Weaver, Univ. Washington Pubs. Geol., V. 6, p. 4, renamed this the Gallaway Formation, and designated the lower 350 feet of coarse-grained sandstone as the Skooner Gulch Formation of Oligocene(?) age.
5. Considered by Weaver, 1943, to be part of the Gualala Group of Late Cretaceous age, but separated herein on the basis of mapping by Carl Wentworth, Stanford University, Ph.D. thesis in preparation, 1963.
6. Underlies Paleocene rocks formerly assigned to the Gualala Group, and is possibly of Cretaceous age.

View southeast along the San Andreas Fault Zone, which separates rocks of the Franciscan Formation (mainland, left) from the quartz diorite pluton exposed on Bodega Head (right center) and Tomales Point (top of photo, center). The San Andreas Fault Zone, here approximately two miles wide, extends for over 650 miles across California. The 1906 San Francisco earthquake caused displacement of the land surface in the fault zone, with a maximum of about 20 feet of lateral displacement recorded near Olema. Physical features caused by repeated fault movement during the geologic past include the steep escarpment at the juncture of Bodega Head with the sand beach tying it to the mainland; and the trench-like form of Tomales Bay (top of photo, center).

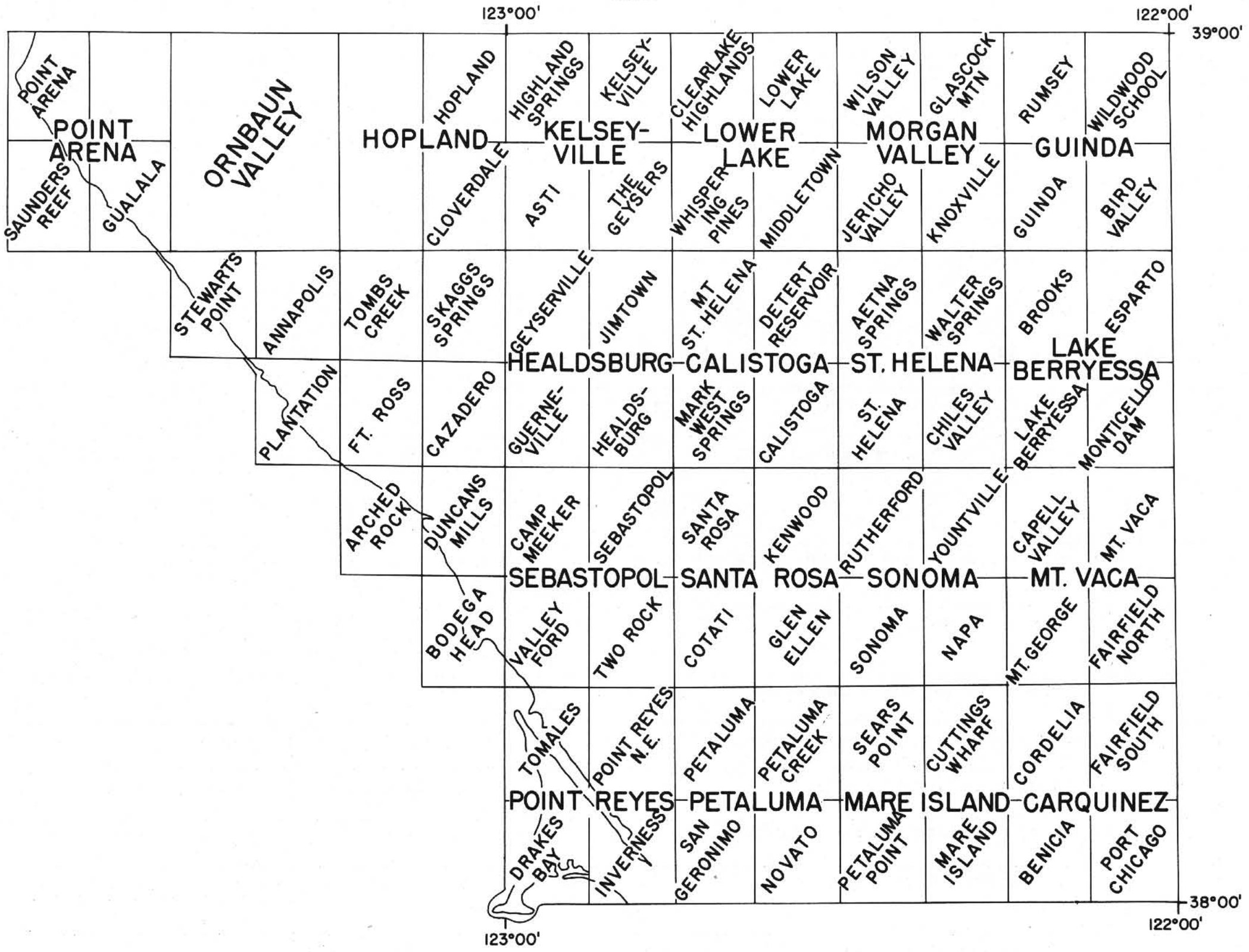
Photo by Aero Photographers, Sausalito, 1959

TOPOGRAPHIC QUADRANGLES

WITHIN THE SANTA ROSA SHEET

AVAILABLE FROM THE U.S. GEOLOGICAL SURVEY

1963



View northwest across Clear Lake (Santa Rosa and Ukiah map sheets). The lake, it is believed, was formed by a lava flow damming pre-existing stream valleys. Mt. Konocti (upper left), composed of Pleistocene dacite and andesite, rises nearly 3000 feet above the lake. Beyond Mt. Konocti is alluvium-filled Big Valley. The hills west of Big Valley and along the north shore of Clear Lake are principally composed of rocks of the Franciscan Formation. Borax Lake (dark patch, right center) was the first commercial source of borax in California. Beyond Borax Lake lies Sulphur Bank Point, famous for mercury and sulphur production. The plain in the foreground is formed by sediments of the Cache Formation, capped by basalt, dacite, and obsidian, and bordered by alluvium. Volcanic activity in this area probably continued into Recent time. *Photo by Aero Photographers, Sausalito, 1959*

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