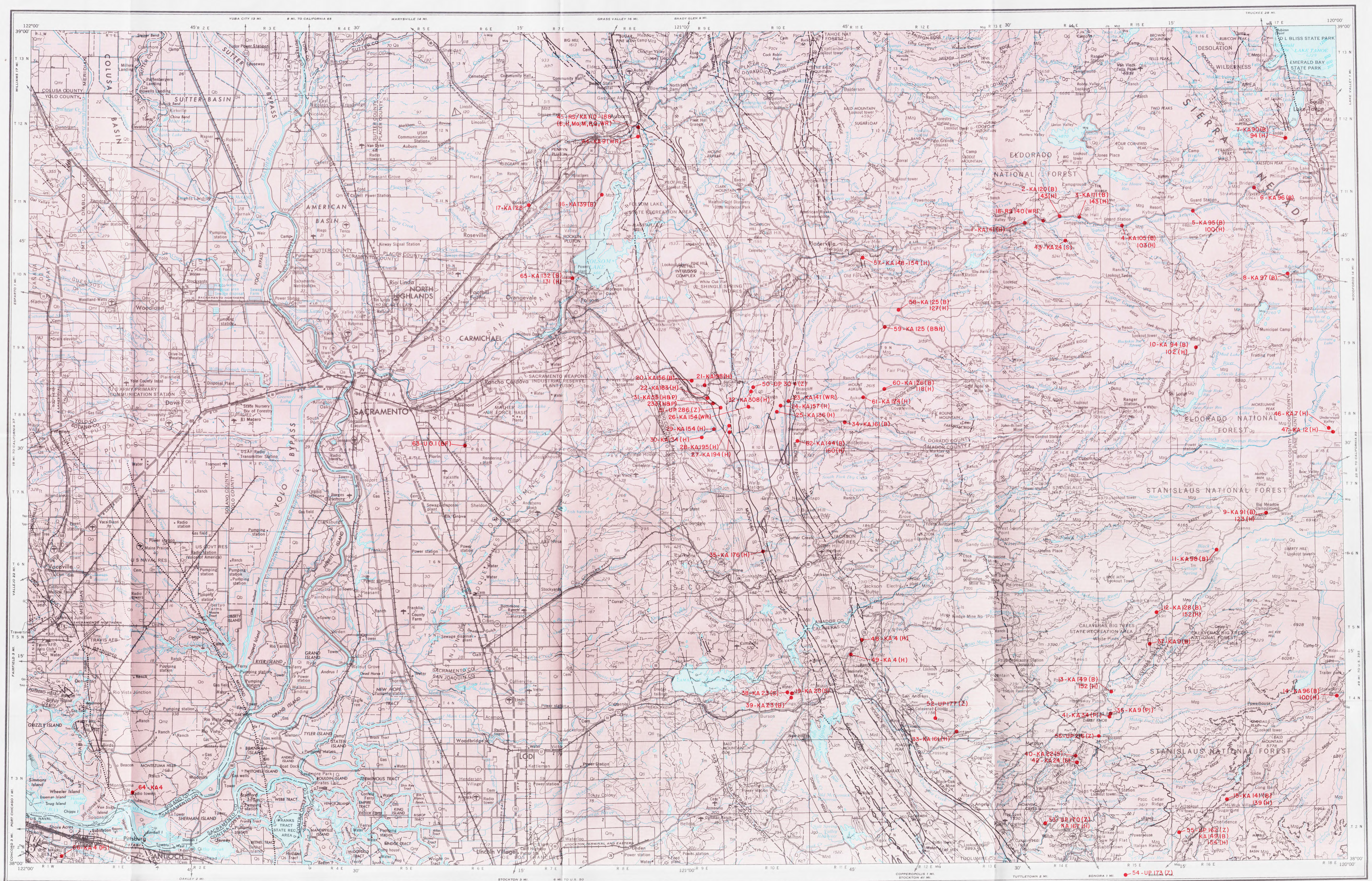
CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA—EDMUND G. BROWN JR., GOVERNOR
THE RESOURCES AGENCY—HUEY D. JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION—PRISCILLA C. GREW, DIRECTOR



Geology compiled 1979

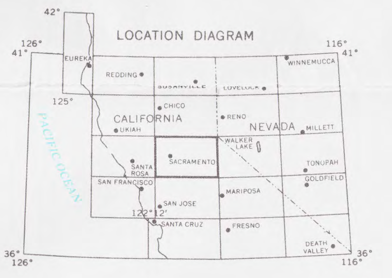
BASE MAP

Prepared by the U.S. Army Topographic Command (KCSX), Washington, D.C. Compiled in 1961 by photogrammetric methods and from United States quadrangles, 1:24,000, 1:25,000, and 1:50,000, 1941-55; USC&GS chart, 1957. Planimetry revised in part from aerial photographs taken 1954-60. Map field checked 1957. Revised by the U.S. Geological Survey 1970.

Selected hydrographic data compiled from USC&GS charts. This information is not intended for navigational purposes.

Minor corrections and additions to culture by California Division of Mines and Geology 1979.

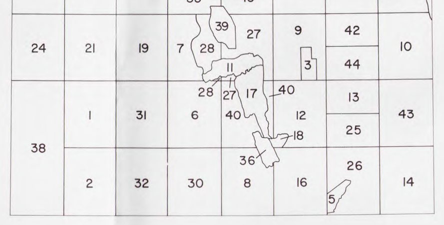
Depth contours in Lake Tahoe in feet—compiled from soundings shown on U.S. Coast and Geodetic Survey Chart 5001.



Scale 1:250,000

5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
5 0 5 10 15 Nautical Miles

TRANSVERSE MERCATOR PROJECTION



ABBREVIATED INDEX TO GEOLOGIC SOURCE DATA
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1. Atwater, B., 1979
2. Atwater, B., 1979
3. Aune, Q.A., 1965
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5. Baird, A.K., 1962
6. Bartow, J.A., and Marchand, D.E., 1979
7. Bartow, J.A., and Helley, E.J., 1979
8. Bartow, J.A., and Marchand, D.E., 1979
9. Bedrossian, T.L., 1979
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11. Behrman, P.G., 1978
12. Bortugno, E.J., 1979
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15. Burnett, J.L., 1971
16. Clark, L.D., Stromquist, A.A., and Tatlock, D.B., 1963
17. Duffield, W.A., and Sharp, R.V., 1975
18. Goldman, H.B., 1964
Rose, R.L., 1949
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19. Helley, E.J., 1979
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23. Helley, E.J., and Barker, J.A., 1979
24. Helley, E.J., and Barker, J.A., 1979
25. Jennings, C.W., 1979
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27. Lindgren, Waldemar and Turner, H.W., 1894
28. Lindgren, Waldemar, 1894
29. Loomis, A.A., 1964
30. Marchand, D.E., and Bartow, J.A., 1979
31. Marchand, D.E., and Atwater, B., 1979
32. Marchand, D.E., and Atwater, B., 1979
33. McJunkin, R.D., and Taylor, G.C., 1979
34. McJunkin, R.D., and Taylor, G.C., 1979
35. Olmsted, F.H., 1971
36. Parkison, G.A., 1976
37. Redmond, T.L., 1966
38. Sims, J.D., Fox, K.F., Jr., Bartow, J.A., and Helley, E.J., 1973
39. Springer, R.K., 1971
40. Taliaferro, N.L., 1950
41. Taylor, G.C., 1979
42. Taylor, G.C., and McJunkin, R.D., 1979
43. Wagner, D.L., 1979
44. Wagner, D.L., 1979
45. Wagner, D.L., 1979

ABBREVIATED EXPLANATION

Approximate stratigraphic relationships only; see Geologic Map Explanation for more accurate stratigraphic relationships and unit descriptions.

SEDIMENTARY AND METASEDIMENTARY ROCKS

CENOZOIC — QUATERNARY

- Q — Alluvium
- t — Mine and dredge tailings
- Qa — Levee and channel deposits
- Qb — Basin deposits *(Alluvium)*
- Qi — Intertidal deposits *(Peaty mud)*
- Qs — Dune sand
- Ql — Lake deposits
- Qo — Older alluvium
- Qg — Glacial deposits
- Qm — Modesto Formation *(Alluvium)* — Qm_1/Qm_2 Upper and lower members
- Qr — Riverbank Formation *(Alluvium)*
- Qmr — Modesto-Riverbank Formations *(Arkosic alluvium)*
- Qmz — Montezuma Formation *(Poorly consolidated, clayey sand)*
- Qtl — Turlock Lake Formation *(Sand, silt, and gravel)*
- Qrb — Red Bluff Formation *(Gravel in reddish, silty or sandy matrix)*
- QTnm — North Merced Gravel *(Thin pediment veneer)*

CENOZOIC — TERTIARY

- Tt — Tehama Formation *(Sand, silt, and volcaniclastic rocks)*
- Tl — Laguna Formation *(Consolidated alluvial deposits)*
- Tsp — San Pablo Group *(Marine sandstone and shale)*
- Tm — Mehrten Formation *(Andesitic conglomerate, sandstone, and breccia)*
- Tvs — Valley Springs Formation *(Rhyolitic tuff and sedimentary rocks)*
- Tmk — Markley Sandstone *(Marine)*
- Tn — Nortonville Shale *(Marine)*
- Td — Domengine Sandstone *(Marine)*
- Tc — Capay Formation *(Marine sandstone)*
- Tg — "Auriferous" Gravels
- Ti — Ione Formation *(Quartzose sandstone and kaolinitic clay)*
- Tmz — Martinez Formation *(Marine quartzose sandstone)*

MESOZOIC — CRETACEOUS

- Kg — Guinda Formation *(Marine sandstone)*
- Kc — Chico Formation *(Marine sandstone, shale, and conglomerate)*

MESOZOIC — JURASSIC

- Jss — Salt Springs Slate
- Jm — Mariposa Formation *(Slate, graywacke, and conglomerate)*
- Jls — Sailor Canyon Formation *(Metasedimentary rocks)*

PALEOZOIC

- ms — Metasedimentary rocks*
- ls — Crystalline limestone and dolomite*
- Pzcc — Calaveras Complex *(Metasedimentary rocks)*
- PzMz — Paleozoic-Mesozoic metamorphic rocks
- Pzg? — Augen gneiss of uncertain age
- Pzu? — Undifferentiated Paleozoic(?) rocks

VOLCANIC AND METAVOLCANIC ROCKS

- Qbs — Basalt
- Tlt — Lawlor Tuff
- Tv^d — Dacite, rhyodacite domes
- Tet — Eureka Valley Tuff
- Ttm — Table Mountain Latite
- Tpp — Putnam Peak Basalt
- Jch — Copper Hill Volcanics
- Jmb — Brower Creek Volcanics
- Jgo — Gopher Ridge Volcanics
- Jlr — Logtown Ridge Formation
- Jmv — Jurassic metavolcanic rocks
- mv — Metavolcanic rocks*
- Pzcv — Calaveras Complex volcanic rocks

PLUTONIC ROCKS

MESOZOIC

- Mzg — Mesozoic granitic rocks
- Mzd — Mesozoic dioritic rocks
- gb — Gabbroic rocks*
- um — Ultramafic rocks*

MAP SYMBOLS

Contact
(Observed or approximately located; queried where gradational or inferred.)

Fault
(Solid where well located; dashed where approximately located or inferred; dotted where concealed by younger rocks or water; queried where continuation or existence is uncertain. U, upthrown side; D, downthrown side, relative or apparent.)

Anticlinal fold
(Dotted where concealed by younger rocks or water.)

Synclinal fold
(Dotted where concealed by younger rocks or water.)

Overturned fold

Strike and dip of beds
(General strike and dip of stratified rocks.)

Strike and dip of foliation
(General strike and dip of foliation in metamorphic rocks.)

EXPLANATION

method * — mineral **
1-KA 138 (H) ●
location no. — age (m.y.) — sample location

* method
KA = K–Ar
RS = Rb–Sr
UP = U–Pb
U = U–series

** mineral or material
B = biotite; BF = bone fossil;
H = hornblende; M = muscovite;
Ma = mariposite; P = pyroxene;
Pl = plagioclase; Q = quartz;
S = sanidine; WR = whole rock;
Z = zircon

RADIOMETRIC AGES OF ROCK SAMPLES

This map and accompanying table present a summary of radiometric ages within the Sacramento 1° x 2° quadrangle. The ages in this compilation indicate those given in the references cited (based on decay constants accepted at the time of each publication), as well as ages recalculated using the standardized decay constants adopted by the IUGS Subcommission on Geochronology (Steiger and Jager, 1977). Tables for conversion of K–Ar ages from old constants to new constants (Dalrymple, 1979) were used for this purpose.

Each location plotted on the geologic map is accompanied by information pertaining to the dating method used, age, and mineral or material dated. For sake of compactness, the ages shown on the map have been rounded off to the closest whole number, except for ages of rocks less than one million years, which have been rounded off to the closest tenth of a million years. These data, and such additional information as sample location, name of the quadrangle in which located, description of the sample dated, and original sample number, are shown on the accompanying table.

These data were compiled from all known sources to September 1979. A few of the published ages were not included from the references cited because sample locations were not adequately described. If any published or unpublished references containing radiometric ages have been overlooked, the author would appreciate being informed. Please send any additional data to: Trinda L. Bedrossian, California Division of Mines and Geology, Ferry Building, Room 1004, San Francisco, CA 94111.

LOCATION NO.	METHOD[1]	SAMPLE LOCATION LATITUDE (NORTH)	SAMPLE LOCATION LONGITUDE (WEST)	QUADRANGLE	MINERAL (or material)[2]	AGE (IN MILLION YEARS) REPORTED IN ORIGINAL PUBLICATION	AGE (IN MILLION YEARS) RECALCULATED K–Ar AGES USING NEW CONSTANTS[3]	DESCRIPTION OF SAMPLE	REFERENCE (original sample number)
1	KA	38°46′17″	120°29′54″	Robbs Peak 15′	H	138	141.3	Unnamed Granitic Rock	Evernden and Kistler, 1970, Tables 5 and 6 (1700)
2	KA	38°46′23″	120°25′45″	do	B H	117 140	119.9 143.4	do	do (1699)
3	KA	38°46′15″	120°23′01″	do	B H	108 140	110.7 143.4	do	do (1698)
4	KA	38°45′50″	120°19′38″	do	B H	102 100	104.5 102.5	do	do (1683)
5	KA	38°47′02″	120°12′53″	Fallen Leaf Lake 15′	B H	92.8 97.6	95.1 100	do	do (1678)
6	KA	38°48′20″	120°07′18″	do	B	93.7	96	do	do (1679)
7	KA	38°51′59″	120°04′40″	do	B H	87.8 91.4	90 93.7	do	do (1514)
8	KA	38°42′20″	120°05′53″	Silver Lake 15′	B	94.3	96.7	do	do (1520)
9	KA	38°25″00″	120°07′01″	Big Meadow 15′	B H	89.1 120	91.3 122.9	do	do (1633)
10	KA	38°36′54″	120°13′21″	Silver Lake 15′	B H	91.7 99.6	94 102.1	do	do (1519)
11	KA	38°23′16″	120°11′01″	Big Meadow 15′	B	96	98.4	do	do (1636)
12	KA	38°18′02″	120°16′38″	Blue Mountain 15′	B H	125 148	128 151.5	do	do (1635)
13	KA	38°13′01″	120°22′13″	Columbia 15′	B H	145 148	148.5 151.5	do	do (1664)
14	KA	38°11′59″	120°00′07″	Long Barn 15′	B H	94 97.8	96.3 100.2	do	do (1541)
15	KA	38°04′18″	120°10′46″	do	B H	138 136	141.3 139.3	do	do (1624)
16	KA	*38°48′10″	121°07′30″	Auburn 15′	B	142.9 (136)[4]	139.6 139.3	Horseshoe Bar, "quartz diorite"	Curtis, Evernden, and Lipson, 1958, Table 1 (97)
17	KA	*38°47′30″	121°14′05″	do	M B	130.6 131.5 (125)[5]	127.5 128.4 128	Rocklin "granodiorite" (Rocklin pluton)	Curtis, Evernden, and Lipson, 1958, Table 1 (102,103)
18	RS	*38°46′16″	120°27′20″	Robbs Peak 15′	WR	140		Quartz diorite	Kistler and Peterman, 1973, Table 1, Appendix 1, (6)
19	KA	*38°12′30″	120°50′20″	Valley Springs 15′	S	19.9 ± 0.4	20.4 ± 0.4	Rhyolite (Valley Springs Formation)	Dalrymple, 1963, Table 1 (1168); Dalrymple, 1964, Table 2 (1168)
20	KA	**38°34′45″	120°58′55″	Placerville 15′	B	152 ± 2	155.6 ± 2	Metarhyolite	Behrman, 1978a, Table 10, p. 219 (3272); Behrman, 1978b, Table 2 (3272)
21	KA	**38°34′35″	120°58′05″	do	H	193 ± 6	197.5 ± 6	Mafic epidote amphibolite	Behrman, 1978a, Table 10, p. 219 (3274)
22	KA	**38°33′50″	120°57′55″	do	H	179 ± 12	183.2 ± 12	Mafic epidote amphibolite	do p. 219 (3083); Behrman, 1978b, Table 2 (3083)
23	KA	**38°33″00″	120°50′15″	do	WR	138 ± 6	141.3 ± 6	Augite porphyry rock metamorphosed to biotite greenschist	Behrman, 1978a, Tables 10 and 11 (3095)
24	KA	**38°32′58″	120°51′00″	do	H	153 ± 8	156.6 ± 8	Volcanic breccia	do (3192)
25	KA	**38°32′30″	120°51′15″	do	H	133 ± 6	136.2 ± 6	Dike rock; relict igneous brown amphibole and altered plagioclase	do (3086)
26	KA	**38°32′45″	120°54′10″	do	WR	150 ± 3	153.6 ± 3	Brecciated epidote amphibolite	Behrman, 1978a, Table 10 (3104); Behrman, 1978b, Table 2 (3104)
27	KA	**38°31′15″	120°55′40″	do	H	190 ± 2	194.4 ± 2	Meta–igneous rock	do (3081)
28	KA	**38°31′50″	120°55′43″	do	H	191 ± 2	195.4 ± 2	Metavolcanic (?) rock	do (3057)
29	KA	**38°31′30″	120°56′55″	do	H	150 ± 4	153.6 ± 4	Hypabyssal intrusive rock metamorphosed to greenschist/epidote amphibolite (in shear zone)	do (3092)
30	KA	**38°31′00″	120°58′15″	do	H	131 ± 6	134.2 ± 6	Hornblende microporphyry dike rock	Behrman, 1978a, Table 10 (3082)
31	KA	**38°33′48″	120°57′00″	do	H&P H&P	54 ± 12 228 ± 149	55.4 ± 12 233.1 ± 149	Eclogite retrograded to amphibolite	do (3056, 3103)
32	KA	**38°34′00″	120°53′50″	do	H	302 ± 35	308.4 ± 35	Hornblende–plagioclase amphibolite lens in serpentinite	do (3080); Behrman, 1978b, Table 2 (3080)
33	KA	**38°09′30″	120°35′00″	San Andreas 15′	H	157 ± 8	160.7 ± 8	Greenschist (Calaveras Fm)	Behrman, 1978a, Table 10, p. 221 (3090)
34	KA	*38°32′10″	120°45′00″	Placerville 15′	B	157.4 ± 4.7	161.1 ± 4.7	Granodiorite	Duffield and Sharp, 1975, p. 18 (no sample number given)
35	KA	*38°23′00″	120°52′50″	Sutter Creek 15′	H	172 ± 4.3	176.1 ± 4.3	Quartz diorite in melange	do
36	KA	*38°10′50″	120°21′30″	Columbia 15′	Pl	9.0 ± 0.2	9.2 ± 0.2	Latite (Table Mt. Latite)	Dalrymple, 1964, Table 1 (1110)
37	KA	*38°15′00″	120°18′00″	Blue Mountain 15′	B	9.2 ± 0.2	9.4 ± 0.2	Biotite–augite latite (Eureka Valley Tuff) near McKay	do (1124)
38	KA	*38°12′30″	120°50′30″	Valley Springs 15′	S	22.8 ± 0.5	23.4 ± 0.5	Tuff (Valley Springs Fm; type section)	do (1132)
39	KA	*38°12′12″	120°50′20″	do	B	21.9 ± 0.4	22.5 ± 0.4	Tuff (Valley Springs Fm; type section)	do, Table 1 (1072)
40	KA	*38°07′30″	120°24′15″	Columbia 15′	S	21.1 ± 0.4	21.7 ± 0.4	Tuff (Valley Springs Fm)	do (1101)

LOCATION NO.	METHOD[1]	SAMPLE LOCATION LATITUDE (NORTH)	SAMPLE LOCATION LONGITUDE (WEST)	QUADRANGLE	MINERAL (or material)[2]	AGE (IN MILLION YEARS) REPORTED IN ORIGINAL PUBLICATION	AGE (IN MILLION YEARS) RECALCULATED K–Ar AGES USING NEW CONSTANTS[3]	DESCRIPTION OF SAMPLE	REFERENCE (original sample number)
41	KA	*38°10′40″	120°21′15″	do	Pl	33.2 ± 0.7	34.1 ± 0.7	Welded tuff at Rattlesnake Hill	do (1122)
42	KA	*38°07′20″	120°24′12″	do	S	23.1 ± 0.5	23.7 ± 0.5	Tuff (Valley Springs Fm) near Ponderosa Way	do, Table 1 (1123)
43	KA	*38°44′30″	120°24′40″	Leek Spring Hill 15′	S	23.4 ± 0.5	24 ± 0.5	Rhyolite tuff near Plum Creek	do (1128)
44	KA	**38°52′45″	121°03′30″	Auburn 15′	WR	8.7 ± 0.4		Tuff breccia	O'Brient, 1978, p. 32–33 (ST–68–21)
Auburn Damsite Dike Rocks 45	RS	**38°53′15″	121°03′45″	do	WR,B,M, Q,P	132		Porphyritic biotite muscovite dacite dike	McMillan and O'Brient, 1978, Table III–2 (P–K–1, P–K–2, P–K–2a); Behrman, 1979
	KA	do	do	do	B	117 ± 6	119.9 ± 6	do	do (P–BP–1); do
	KA	do	do	do	M	112 ± 6	114.7 ± 6	do	do (P–BP–2); do
	KA	do	do	do	H	147 ± 7		Altered hornblende latite dike	do (P–S–5); do
	KA	do	do	do	WR	143 ± 7	146.4 ± 7	do	do (P–B); do
	KA	do	do	do	WR	141 ± 7	144.4 ± 7	do	do (P–OB–2); do
	KA	do	do	do	WR	129.6 ± 13	132.7 ± 13	do	do (DRP–4–Sta 31 + 00); do
	KA	do	do	do	WR	123 ± 7		Altered hornblende diorite	do (P–D–2a); do
	KA	do	do	do	Ma	120 ± 6	122.9 ± 6	Altered chlorite schist	do (P–34); do
	KA	do	do	do	WR	114 ± 6	116.8 ± 6	Altered latite	do (P–4a); do
	KA	do	do	do	WR	108 ± 6	110.7 ± 6	Altered chlorite schist	do (P–26a); do
	KA	do	do	do	H	184 ± 18	188.3 ± 18	Amphibolite; altered to greenschist	do (P–1); do
	KA	do	do	do	H	118 ± 6	120.9 ± 6	do	do (P–A–2); do
	KA	do	do	do	WR	107 ± 6	109.6 ± 6	do	do (P–A–1); do
	KA	do	do	do	WR	118 ± 6	120.9 ± 6	Altered rocks of Oregon Bar pluton	do (P–OB–3); do
46	KA	38°30′24″	120°00′36″	Silver Lake 15′	H	7.3 ± 0.3		Hornblende andesite breccia	Morton and others, 1977, p. 20–21 (MR–2)
47	KA	38°30′18″	120°00′30″	do	H	12.1 ± 0.5		Hornblende andesite	do (MR–1)
48	KA	**38°16′00″	120°44′05″	Mokelumne Hill 15′	H	4.12 ± 0.11		Rhyodacite of Hamby Dome	Bartow, 1979, Table 2 (GV 76–30)
49	KA	**38°15′03″	120°44′59″	do	H	4.03 ± 0.26		Dacite of Golden Gate Hill	do (GV 76–34)
50	UP	**38°34′20″	120°53′30″	Placerville 15′	Z	304		Meta–plagiogranite	Saleeby and Behrman, 1979, (CB–1)
51	UP	**38°33′00″	120°56′30″	do	Z	286		do	do (BMO–1)
52	UP	**38°10′30″	120°37′12″	San Andreas 15′	Z	177		Granodiorite	Saleeby and Sharp, 1979, (OGP–1)
53	UP KA	**38°02′50″	120°27′18″	Columbia 15′	Z H	170 167		Pyroxene diorite	Sharp and Saleeby, 1979, (CO–8) Sharp, 1979
54	UP			do	Z	173		Pyroxene diorite and quartz diorite	Sharp and Saleeby, 1979, (ST–88, ST–89)
55	UP KA	**38°02′00″	120°15′00″	Long Barn 15′	Z B H	162 149 154		Granodiorite	Saleeby and Sharp, 1979, (C–37) Sharp, 1979 do
56	UP	**38°09′00″	120°22′00″	Columbia 15′	Z	216		Blastomylonitic granite	Saleeby and Sharp, 1979, (S1–1)
57	KA	**38°43′25″	120°43′30″	Camino 15′	H	148.4 ± 1.1 154.4 ± 1.2		Hornblende diorite dike intruded into hornblende–biotite quartz diorite	Kistler and Fleck, 1979, (778–9B)
58	KA	**38°40′20″	120°40′10″	do	B H	124.6 ± 0.8 126.7 ± 0.8		Hornblende biotite–quartz diorite	do (778–9C)
59	KA	**38°39′00″	120°41′15″	do	B H	124.9 124.9		Biotite quartz diorite	do (778–10A)
60	KA	**38°34′18″	120°41′24″	do	B H	125.8 ± 0.8 118.4 ± 0.7		Biotite hornblende quartz diorite	do (778–10C)
61	KA	**38°33′25″	120°44′00″	do	H	124.3 ± 0.8		Biotite granodiorite	do (778–10E)
62	KA	**38°30′35″	120°49′30″	Placerville 15′	B H	144.3 ± 0.9 160.4 ± 1.0		Foliated biotite hornblende quartz diorite	do (778–10H)
63	U	**38°31′00″	121°22′20″	Fair Oaks 15′	BF	103,000 ± 6,000 yrs.		Riverbank Formation	Hansen and Begg, 1970, p. 417 (no sample number given)
64	KA	**38°05′00″	121°50′00″	Pittsburg 15′	(none given)	3.82	3.9	Volcanic tuff at depth of 600 feet (100 feet below contact with Montezuma Formation)	Pacific Gas and Electric Company, 1977, p. VI–88 (no sample number given)
65	KA	**38°42′20″	121°10′50″	Folsom 15′	B H	128.5 ± 3.2 128.3 ± 3.2	131.6 ± 3.2 131.4 ± 3.2	Rocklin pluton (southern part)	Swanson, 1978, Table 1 and Fig. 1 (no sample number given)
66	KA	38°00′30″	121°56′25″	Pittsburg 15′	Pl	3.96 ± 0.16	4.1 ± 0.16	Lawlor Tuff	Sarna–Wojcicki, 1976, Tables 1 (loc. 22) and 2 (loc. 22, sample KA 2310), map, p. 2 (loc. 22)

1. Method abbreviations: KA = Potassium/Argon; RS = Rubidium/Strontium; UP = Uranium/Lead; U = Uranium–series
2. Mineral or material abbreviations: BF = Bone fossil; B = Biotite; H = Hornblende; Ma = Mariposite; M = Muscovite; P = Pyroxene; Pl = Plagioclase; Q = Quartz; S = Sanidine; WR = Whole rock; Z = Zircon
3. Steiger, R.H., and Jager, E., 1977, Subcommission on geochronology: Earth and Planetary Science Letter, v. 36, p. 359–362.
4. Age from Evernden, Curtis, Obradovich, and Kistler, 1961, Appendix I, (97)
5. Age from Evernden and Kistler, 1970, Plate 1 (157), Plate 2.

* Latitude and longitude interpreted from written descriptions of locations given in original reference.
** Latitude and longitude interpreted from locations plotted on maps in original reference.

SOURCES OF INFORMATION

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LOCATION MAP OF ROCK SAMPLES DATED BY RADIOMETRIC METHODS, SACRAMENTO QUADRANGLE, CALIFORNIA, 1:250,000

Compiled by
Trinda L. Bedrossian and George J. Saucedo
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