Base from U.S. Geological Survey, 1957
(revised 1969)

APPROXIMATE MEAN DECLINATION, 1986

SCALE 1:250 000

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

Compiled in 1982.

This map is part of a folio of maps of the Walker Lake 1° by 2° quadrangle, California and Nevada, prepared under the Conterminous United States Mineral Assessment Program.

EXPLANATION

Each specimen is identified in table 1 (see map sheet 3) by its number and the letter for the quadrangle in which it occurs.

A LETTER DESIGNATION FOR 15-MINUTE QUADRANGLE

○3 LOCATION OF SPECIMEN WITHIN 15-MINUTE QUADRANGLE

INTRODUCTION

These maps are part of a folio of maps of the Walker Lake 1° by 2° quadrangle, California and Nevada, prepared under the Conterminous United States Mineral Assessment Program. Other publications in this folio include a geologic map of the quadrangle by Stewart and others (1982). A complete set of references for other publications pertaining to the study of the Walker Lake 1° by 2° quadrangle can be found in Stewart and others (1984).

Ages of igneous rock or mineral specimens dated by the K-Ar technique are tabulated in table 1, and their geographic locations shown on map sheet 1. Data for igneous rock specimens analyzed for Mb and Sr concentrations and Sr isotopic ratios are tabulated in table 2, and their geographic locations shown on map sheet 2. Most of the K-Ar ages are compiled from previous reports, and where necessary have been recalculated with the new IUGS decay and abundance constants for potassium (Steiger and Jager, 1977).

RUBIDIUM-STRONTIUM WHOLE-ROCK ISOCHRONS

Ages of igneous rocks in the Walker Lake 1° by 2° quadrangle that have been determined by the Rb-Sr whole-rock technique are tabulated below: n, number of specimens used for the isochrons; r_i, initial $^{87}Sr/^{86}Sr$ of the pluton or metavolcanic rocks; and t, age in millions of years. Some of these ages should be considered provisional in that continuing application of the Rb-Sr whole-rock technique is not only expected to produce better resolution, but in some problematic cases to yield ages that may lie outside the range of error indicated.

Igneous rock unit	n	r_i	t
Bryan Meadow granodiorite	5	0.7047	94.4± 6.7
Carson Pass Tonalite[2]	3	0.7054	101.4± 7.0
Granodiorite of Kinney Lakes	12	0.7057	85.9± 3.9
China Garden pluton	8	0.7459	90.7± 4.1
West Antelope metavolcanic rocks	8	0.7464	93.1± 7.7
Granite of Desert Creek	7	0.7496	153.9± 4.5
Granite of East York	4	0.7452	148.9±11.7
Granite of Mill Creek	7	0.7572	84.2± 0.6
Granite of Sonora Bridge	5	0.7457	95.3± 2.5
Swauger Creek mafic complex	8	0.7482	90.3± 2.2
Granite of Devils Gate-Mack Canyon-Murphy Creek, undivided	5	0.7525	83.2± 1.4
Granodiorite of Wheeler Crest	5	0.7638	201.2±10.6
Granodiorite of Alum Creek and granite of Cory Creek	8	0.7539	98.3± 5.0
Quartz monzodiorite, Terrington batholith	3	0.7401	184.6± 5.7
Quartz monzonite, Terrington batholith	3	0.7397	172.9± 1.2
Quartz monzonite of Garfield Hills	9	0.7418	111.1± 4.1
Granite of Walker Lake	4	0.7433	96.1± 1.2
Granodiorite of Green Creek, granitic rocks of Rattlesnake Gulch, and hornblende diorite of Sinsemmon Meadow	5	0.7543	93.8± 1.5
Granodiorite of Lobdell Summit and granite of Baldwin Canyon	9	0.7524	106.3± 7.7
Granodiorite of Lake Harriet	4	0.7464	129.3±13.4
Porphyritic granodiorite of Nye Canyon	4	0.7556	84.2± 6.7
Granitic rocks of Babbitt, and of Cottonwood Creek, and mafic pillow breccia of Ashby	4	0.7502	188.2± 5.5
Metavolcanic rocks of Mt. Grant and Dunlap Formation	5	0.7455	186.4± 5.1
Metahypodacite of Steelhead Lake	5	0.7551	163.9± 5.0
Metahypodacite of Virginia Lakes, and of Cooney Lake, and meta-volcanic breccia of Black Mountain	34	0.7558	224.6±14.0

[1]^{87}Rb decay constant=1.42x10^{-11} yr^{-1}

[2]Parker (1961)

DISCUSSION

The oldest igneous rocks dated in the Walker Lake 1° by 2° quadrangle are volcanic rocks and volcanic detrital hornblende, in the Black Dyke and Mina Formations of Speed (1977), dated at about 270 Ma (Permian) by the K-Ar technique. Mesozoic volcanic rocks have been dated by the Rb-Sr technique at 225±14 Ma (Triassic) and 164±5 Ma (Jurassic) in the Saddleback Lake roof pendant, at 193±3 Ma (Jurassic) on Mount Grant and in the volcanic rocks at Acme Tank and Ashby, at 142±17 Ma (Jurassic or Cretaceous) in the Pilot Mountains (Speed and Kistler, 1980), and at 103±6 Ma (Cretaceous) in the Excelsior Mountains (Speed and Kistler, 1980).

Volcanic rocks of Tertiary age, dated by the K-Ar technique, range in age from 30 Ma to less than 1 Ma (sheet 3). No apparent pattern of compositional variation in the volcanic rocks is evident in the area, but a trend from older volcanic rocks in the eastern part to younger volcanic rocks in the western part of the area is apparent.

The granitoid rocks in the quadrangle are of Mesozoic age and range from about 201 m.y. to 79 m.y. old. The distribution of exposures of granitoid rocks and their ages are shown on a generalized map (fig. 1). Plutons in the Sierra Nevada in the western third of the area are mostly Cretaceous in age (117 Ma (Dodge and Calk, in press) to 85 Ma), but a Jurassic pluton (151 Ma) crops out in the extreme southwest corner of the area (Stern and others 1981). Early Jurassic plutons (201 Ma to 191 Ma) are exposed in the vicinity of Virginia and Lundy Canyons near the eastern escarpment of the Sierra Nevada. Other Early Jurassic plutons (187 Ma) are in the Pine Grove Hills and the Wassuk Range. Small isolated diorite masses in the Wassuk Range and Gillis Range are 168±6 m.y. old and are apparently penecontemporaneous with the Dunlap Formation at Acme Tank and Ashby. These plutons apparently represent the roots of volcanoes on the periphery of an elliptical-shaped caldera, associated with the volcanic rocks, that has dimensions of 45 km by 20 km (fig. 1). Sr whole-rock isochrons for the granodiorite and quartz monzonite phases of the main Terrington batholith are 168±4 Ma and 173±1 Ma, respectively. Dilles and others (1983) reported U-Pb zircon ages of 169 Ma and 168 Ma for the Terrington pluton. The majority of other scattered plutonic rocks to the east of the Sierra Nevada are of Cretaceous age (fig. 1).

Initial strontium isotopic compositions of granitoid rocks are sensitive indicators of the source material of granitic magmas and of the type of crust underlying the plutons. In the western United States, the region where all plutons have initial $^{87}Sr/^{86}Sr$ values greater than 0.706 is apparently underlain by sialic crust of Precambrian age (Kistler and Peterman, 1973, 1978; Armstrong and others, 1977). Plutons with initial $^{87}Sr/^{86}Sr$ values less than 0.704 are intruded into areas underlain by oceanic crust (Kistler and Peterman, 1973). Plutons with the initial ratios between 0.704 and 0.706 commonly occur between areas of higher and lower values. These may overlie crust transitional between oceanic and sialic types or may indicate derivation from two or more source terranes.

In the Walker Lake 1° by 2° quadrangle, only plutons in exposures of the Sierra Nevada composite batholith have initial $^{87}Sr/^{86}Sr$ values greater than 0.706. In a regional study of initial strontium isotopic compositions of plutons in California, Nevada, Arizona, and Utah, the boundary between plutons with initial $^{87}Sr/^{86}Sr$ greater than 0.706 and less than 0.706, interpreted to mark the margin of Precambrian sialic crust, has been found to be offset about 90 km in a right-lateral sense along a northwest-trending fault in the eastern Sierra Nevada (Kistler and others, 1980). Other offsets by right-lateral faulting in the isotopic boundary are observed in the central Sierra Nevada (60 km). The major displacements apparently occurred during the Middle Jurassic, about 180 m.y. ago. The location of the boundary between plutons with initial $^{87}Sr/^{86}Sr$ greater than 0.706 and less than 0.706 and of the faults that displace it are indicated on figure 1.

REFERENCES

Armstrong, R. L., Taubeneck, W. H., and Hales, P. O., 1977, Rb-Sr and K-Ar geochronometry of Mesozoic granitic rocks and their Sr isotopic compositions, Oregon, Washington, and Idaho: Geological Society of America Bulletin, v. 88, p. 397-411.

Dilles, J. H., Wright, J. E., and Proffett, J. M., Jr., 1983, Chronology of Early Mesozoic plutonism and volcanism in the Terrington District, western Nevada: Geological Society of America Abstracts with Programs, v. 15, no. 5, p. 283.

Dodge, F. W. C., and Calk, L. C., Lake Eleanor quadrangle, central Sierra Nevada, California--analytical data: U.S. Geological Survey Bulletin (in press).

John, D. A., 1983, Map showing distribution, ages, and petrographic characteristics of Mesozoic plutonic rocks in the Walker Lake 1° by 2° quadrangle, California and Nevada: U.S. Geological Survey Miscellaneous Field Studies Map MF-1382-B, 1:250,000.

Kistler, R. W., and Peterman, Z. E., 1973, Variations in Sr, Rb, K, Na and initial $^{87}Sr/^{86}Sr$ in granitic rocks and intruded wall rocks in central California: Geological Society of America Bulletin, v. 84, p. 3489-3512.

Kistler, R. W., 1978, Reconstruction of crustal blocks of California on the basis of initial strontium isotopic compositions of Mesozoic granitic rocks: U.S. Geological Survey Professional Paper 1071, 17 p.

Kistler, R. W., Robinson, A. C., and Fleck, R. J., 1980, Mesozoic right-lateral fault in eastern California: Geological Society of America Abstracts with Programs, v. 12, no. 3, p. 115.

Parker, R. B., 1961, Petrology and structural geometry of pre-granitic rocks in the Sierra Nevada, Alpine County, California: Geological Society of America Bulletin, v. 72, no. 12, p. 1789-1806.

Speed, R. C., 1977, Excelsior Formation, west central Nevada: stratigraphic appraisal, new divisions, and paleogeographic interpretations, in Stewart, J. H., Stevens, C. H., and Fritsche, A. E., eds., Paleozoic paleogeography of the western United States: Society of Economic Paleontologists and Mineralogists, Pacific Coast Paleogeography Symposium 1, p. 325-336.

Speed, R. C., and Kistler, R. W., 1980, Cretaceous volcanism, Excelsior Mountains, Nevada: Geological Society of America Bulletin, v. 91, part 1, p. 293-296.

Steiger, R. H., and Jager, E., 1977, Subcommission on geochronology: convention on the use of decay constants in geo- and cosmochronology: Earth Planetary Science Letters, v. 36, p. 359-362.

Stern, T. W., Bateman, P. C., Morgan, B. A., Newell, M. F., and Peck, D. L., 1981, Isotopic U-Pb ages of zircon from the granitoids of the central Sierra Nevada, California: U.S. Geological Survey Professional Paper 1185, 17 p.

Stewart, J. H., Carlson, J. E., and Johannesen, D. C., 1982, Geologic map of the Walker Lake 1° by 2° quadrangle, California and Nevada: U.S. Geological Survey Miscellaneous Field Studies Map MF-1382-A, 1:250,000.

Stewart, J. H., Chaffee, M. A., Dohrenwend, J. C., John, D. A., Kistler, R. W., Kleinkopf, F. J., Menzie, W. D., Plouff, D., Rowan, L. C., and Silberling, N. J., 1984, The Conterminous United States Mineral Appraisal Program: Background information to accompany folio of geologic, geochemical, geophysical, and mineral resource maps of the Walker Lake 1° by 2° quadrangle, California and Nevada: U.S. Geological Survey Circular, 927, 22 p.

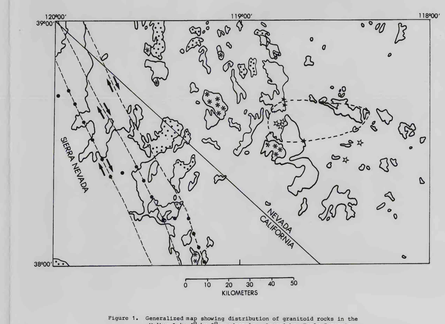

Figure 1. Generalized map showing distribution of granitoid rocks in the Walker Lake 1° by 2° quadrangle. Asterisks, Early Jurassic plutons (201 Ma to 187 Ma); dots, Mid-Jurassic plutons; short dashes, limits of Walker Lake caldera; solid stars, subvolcanic plutons on rim of the Walker Lake caldera; open stars, volcanic rocks on Mt. Grant and in the Dunlap Formation at Acme Tank and Ashby. Granitoids without decoration are of Cretaceous age. Named lines are locations of cryptic right-lateral faults indicated by offsets in the strontium isotopic boundary between plutons with initial $^{87}Sr/^{86}Sr$ values greater than and less than 0.706; solid circles delineate this boundary in the Sierra Nevada.

Explanatory pamphlet accompanies map

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LOCATIONS OF SPECIMENS DATED BY THE K-Ar TECHNIQUE

MAPS SHOWING ISOTOPIC DATING IN THE WALKER LAKE 1° BY 2° QUADRANGLE, CALIFORNIA AND NEVADA

By

Allen C. Robinson and Ronald W. Kistler

1986