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K-AR AGES OF VOLCANIC ROCKS, PLUTONIC ROCKS, AND ORE DEPOSITS IN NEVADA AND EASTERN CALIFORNIA – DETERMINATIONS RUN UNDER THE USGS-NBMG COOPERATIVE PROGRAM

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The following K-Ar ages were done as part of a cooperative study of the volcanic and plutonic stratigraphy and ages of mineralization in parts of Nevada and eastern California. This study was conducted by members of the U.S. Geological Survey and Nevada Bureau of Mines and Geology. Cooperators include D. I. Axelrod, B. R. Berger, H. R. Cornwall, D. C. Noble, K. C. Fink, Steve Kleeberger, F. J. Kleinhampl, S. W. Ivosevic, A. S. Radtke, B. G. Wachter, A. B. Wallace, and R. E. Wallace.

Mineral separates and whole rock samples were prepared at the Nevada Bureau of Mines and Geology or the U. S. Geological Survey from samples collected by the contributors or other geologists listed in the sample descriptions. The determinations were run by J. L. Morton and M. L. Silberman of the U. S. Geological Survey. Argon analyses were performed by standard isotope dilution procedures, using a 60° sector, 15.2 cm radium Neir-type mass spectrometer operated in the static mode for mass analysis (Dalrymple and Lanphere, 1969). Potassium analyses were performed by a lithium metaborate flux fusion-flame photometry technique, the lithium serving as an internal standard (Ingamells, 1970) or by X-ray fluorescence. Overall analytical uncertainty of reported ages is approximately 3%, unless otherwise specified, and is a combined estimate of the precision of the argon and potassium analyses at one standard deviation. Constants used in the calculation of ages are:

$$\lambda_\beta = 4.963 \times 10^{-10}\ \mathrm{yr}^{-1}$$
$$\lambda_\epsilon = 0.572 \times 10^{-10}\ \mathrm{yr}^{-1}$$
$$\lambda_\epsilon = 8.78 \times 10^{-13}\ \mathrm{yr}^{-1}$$
$$^{40}\mathrm{K}/\mathrm{K}_{\mathrm{total}} = 1.167 \times 10^{-4}\ \mathrm{mole/mole}$$

These constants represent a change based on new data on abundance of ^{40}K (Garner and others, 1975) and its decay constants (Beckinsale and Gale, 1969) from those reported in previous articles. Consequently the ages reported here may differ by 1 to 2% from those of the same samples reported in the references cited. Where relevant, these changes are mentioned in the sample descriptions.

Sample locations are listed on the accompanying map (fig. 1). Where appropriate, short discussions of the significance of individual ages or groups of ages are included under comments in the sample description part of this report. Further discussion of results, if warranted, will be made elsewhere.

Samples are listed under the following headings:

1) Ages of intermediate and mafic volcanic rocks from the Sierra Nevada and Western Nevada
2) Ages of felsic extrusive rocks from the western Great Basin
3) Ages of plutonic and intrusive rocks from Nevada
4) Ages of basalts from central Nevada
5) Ages of mineralization and alteration

SAMPLE DESCRIPTIONS

Intermediate and Mafic Volcanic Rocks – Sierra Nevada and Western Nevada

1. MA-11 K-Ar
Mustang Andesite. Porphyritic hornblende andesite (SE¼ sec. 18, T19N, R22E; 39°30.6′N, 119°32.9′W; Storey Co., NV). Analytical data: $K_2O = 2.411\%$, $^*Ar^{40} = 3.199 \times 10^{-11}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 62\%$; collected by: D. C. Noble, Michigan Tech University; dated by: M. L. Silberman and J. L. Morton, U. S. Geological Survey. Comment: see MA-4B (No. 2). (whole rock) 9.2±0.3 m.y.

2. MA-4B K-Ar
Mustang Andesite. Porphyritic hornblende andesite (NE¼ sec. 18, T19N, R22E; 39°31.0′N, 119°32.9′W; Storey Co., NV). Analytical data: $K_2O = 2.307\%$, $^*Ar^{40} = 3.042 \times 10^{-11}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 76\%$; collected by: D. C. Noble, Michigan Tech University; dated by: M. L. Silberman and J. L. Morton, U. S. Geological Survey. Comment: The Mustang Andesite was previously assigned a Pleistocene(?) age (Thompson and White, 1964). Its late Miocene radiometric age suggests that the underlying Clark Mountain sequence of Lousetown Formation is late Miocene or older and has a different age than the type section near Lousetown Creek. These age determinations suggest some revision of the stratigraphy of the Northern Virginia Range is in order. Work on this in cooperation with George Thompson of Stanford University is in progress. (whole rock) 9.1±0.3 m.y.

3. CP-1 K-Ar
Hornblende-pyroxene andesite (SE¼ sec. 27, T10N, R18E; 38°40.5′N, 119°58.9′W, Alpine Co., CA).

[ISOCHRON/WEST, no. 20, December 1977]

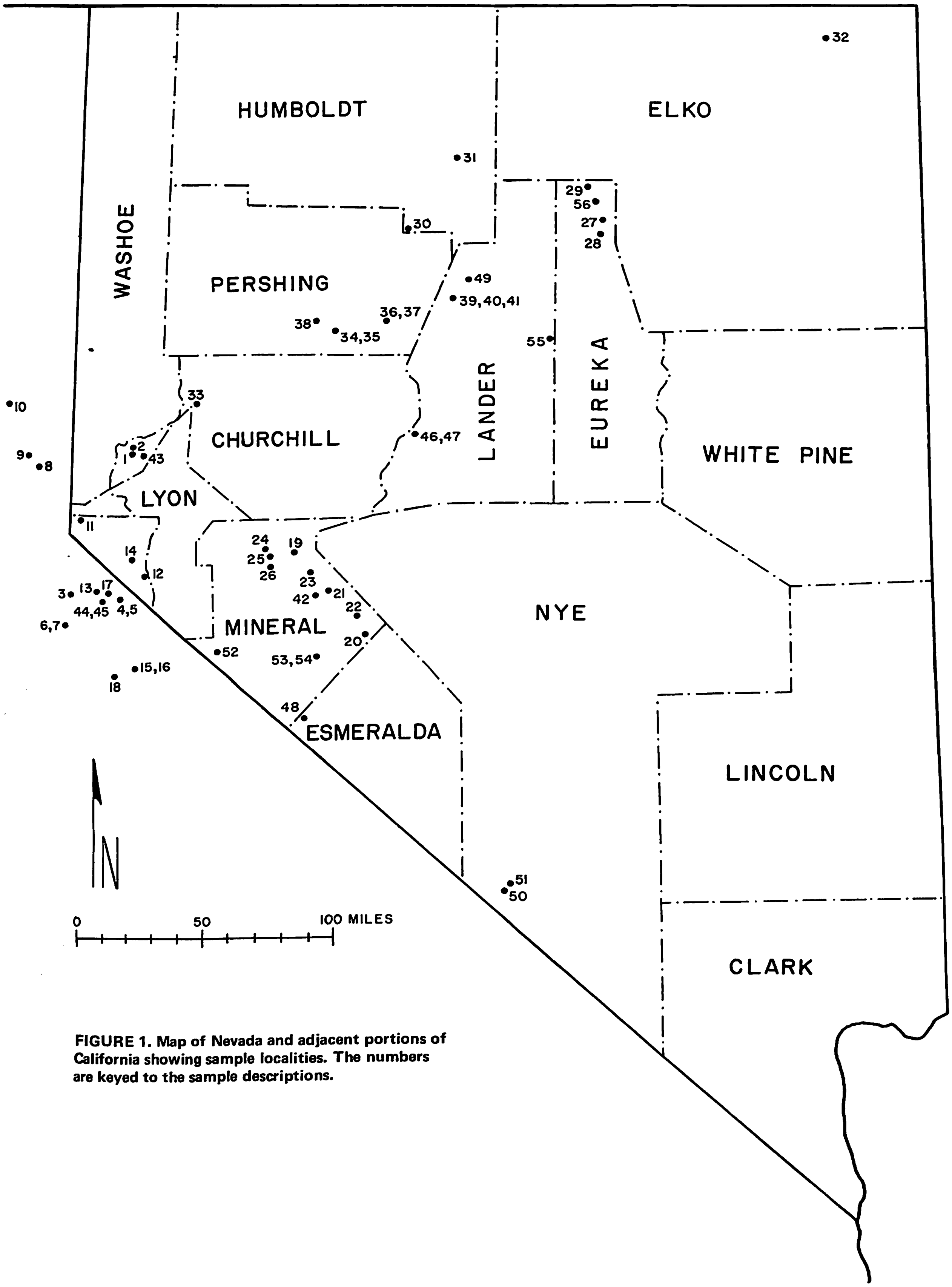

FIGURE 1. Map of Nevada and adjacent portions of California showing sample localities. The numbers are keyed to the sample descriptions.

3. (continued)
Analytical data: $K_2O = 0.395\%$, $^*Ar^{40} = 8.450 \times 10^{-12}$, 6.790×10^{-12} moles/gm, $^*Ar^{40}/\Sigma Ar^{40} =$ 10%, 9%; collected by: D. C. Noble, Michigan Tech University; dated by: M. L. Silberman, U. S. Geological Survey. (plagioclase) 13.4±1.5 m.y.

4. LS-1 K-Ar
Hornblende-pyroxene andesite (sec. 6, T9N, R22E; 38°39.42'N, 119°35.92'W; Alpine Co., CA). Analytical data: $K_2O = 0.701\%$, $^*Ar^{40} = 1.136 \times 10^{-11}$ moles/gm, $^*Ar^{40} = 45\%$; dated by: M. L. Silberman, U. S. Geological Survey. Comment: See LS-2 (No. 5). (plagioclase) 11.2±0.3 m.y.

5. LS-2 K-Ar
Pyroxene-hornblende andesite (sec. 6, T9N, R22E; 38°39.42'N, 119°35.92'W; Alpine Co., CA). Analytical data: $K_2O = 0.480\%$, $^*Ar^{40} = 1.038 \times 10^{-11}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 30\%$; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Samples LS-1 and LS-2 were collected at different localities from a polymict volcanic breccia. Most of the volcanic breccias in this part of the Sierra Nevada have a variety of lithologies in the clasts. Probably the youngest of a group of ages from several clasts at any given locality would be the closest one to the age of eruption due to the possibility of including older material during the eruption or transportation processes. Since only two samples were dated at this locality, the age should be considered a maximum. (hornblende) 15.0±0.5 m.y.

6. MR-2 K-Ar
Hornblende andesite breccia (NW¼ sec. 33, T8N, R18E; 38°30.4'N, 120°0.6'W; Alpine Co., CA). Analytical data: $K_2O = 0.6045\%$, $^*Ar^{40} = 6.393 \times 10^{-12}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 21\%$; collected by: H. F. Bonham, Nevada Bureau of Mines, D. I. Axelrod, University of California at Davis, D. C. Noble, Michigan Tech University, and M. L. Silberman, U. S. G. S.; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Hornblende andesite breccia; monolithologic blocks in matrix of the same material. The flow overlies gravelly tuffaceous sediments that contain plants. (hornblende) 7.3±0.3 m.y.

7. MR-1 K-Ar
Hornblende andesite (NW¼ sec. 33, T8N, R18E; 38° 30.3'N, 120°0.5'W; Alpine Co., CA). Analytical data: $K_2O = 0.862\%$, $^*Ar^{40} = 1.502 \times 10^{-11}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 25\%$; collected by: D. I. Axelrod, University of California at Davis; dated by: M. L. Silberman, U. S. Geological Survey. (hornblende) 12.1±0.5 m.y.

8. BH-T K-Ar
Pyroxene-hornblende andesite (sec. 15, T17N, R15E; 39°19.33'N, 120°17.58'W; Nevada Co., CA). Analytical data: $K_2O = 0.367\%$, $^*Ar^{40} = 1.406 \times 10^{-11}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 62\%$; collected by: D. I. Axelrod, University of California at Davis; dated by: M. L. Silberman, U. S. Geological Survey. Comment: This is the oldest age of an andesite flow unit from this part of the Sierra Nevada. (plagioclase) 26.4±0.8 m.y.

9. CP-4 K-Ar
Andesite (sec. 2, T17N, R14E; 39°21.92'N, 120° 21.83'W; Nevada Co., CA). Analytical data: (Plagioclase) $K_2O = 0.329\%$, $^*Ar^{40} = 6.405 \times 10^{-12}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 46\%$, (Hornblende) $K_2O = 0.581\%$, $^*Ar^{40} = 1.085 \times 10^{-11}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 43\%$; collected by: D. I. Axelrod, University of California at Davis; dated by: M. L. Silberman, U. S. Geological Survey.
(plagioclase) 13.5±0.4 m.y.
(hornblende) 12.9±0.4 m.y.

10. BONTA K-Ar
Hornblende andesite from volcanic mud-flow breccia (SW¼ sec. 16, T22N, R13E; 39°46.2'N, 120°31.5'W; Plumas Co., CA). Analytical data: (Plagioclase) $K_2O = 0.252\%$, $^*Ar^{40} = 3.995 \times 10^{-12}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 15\%$, (Hornblende) $K_2O = 0.473\%$, $^*Ar^{40} = 7.437 \times 10^{-12}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} =$ 29%; collected by: D. I. Axelrod, University of California at Davis, and H. F. Bonham, Jr., Nevada Bureau of Mines and Geology; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Age is concordant, but the same comment applies here as for samples LS-1 and LS-2 (Nos. 4 and 5).
(plagioclase) 11.0±0.9 m.y.
(hornblende) 10.9±0.4 m.y.

11. GLENDALE K-Ar
Andesite (SW¼ sec. 12, T14N, R18E; 39°5.33'N, 119°54.67'E; Douglas Co., NV). Analytical data: $K_2O = 7.435\%$, $^*Ar^{40} = 9.314 \times 10^{-11}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 57\%$; collected by: H. F. Bonham, Jr., Nevada Bureau of Mines and Geology; dated by: M. L. Silberman, U. S. Geological Survey. (biotite) 8.7±0.3 m.y.

12. SW-1 K-Ar
Andesite (boundary secs. 12 and 13, T10N, R23E; 38°44.0'N, 119°21.5'W; Douglas Co., NV). Analytical data: $K_2O = 0.643\%$, $^*Ar^{40} = 1.375 \times 10^{-11}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40} = 44\%$; collected by: D. C. Noble, Michigan Tech University; dated by: M. L. Silberman, U. S. Geological Survey. (hornblende) 14.8±0.4 m.y.

13. MN-4 K-Ar
Hornblende-pyroxene andesite (E side of highway 89, 2.5 km N of Markleeville; 38°42.92'N, 119°47.33'W; Alpine Co., CA). Analytical data: $K_2O = 0.640\%$, $*Ar^{40} = 9.727 \times 10^{-12}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 32\%$; collected by: D. C. Noble, Michigan Tech University; dated by: M. L. Silberman, U. S. Geological Survey. (hornblende) 10.5±0.3 m.y.

14. OP-1 K-Ar
Hornblende-biotite-pyroxene dacit (NE¼ sec. 34, T12N, R22E; 38°51.83'N, 119°29.92'W; Douglas Co., NV). Analytical data: $K_2O = 1.158\%$, $*Ar^{40} = 1.836 \times 10^{-11}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 41\%$; collected by: D. C. Noble, Michigan Tech University; dated by: M. L. Silberman, U. S. Geological Survey. (hornblende) 11.0±0.3 m.y.

15. ME-3 K-Ar
Pyroxene-olivine latite breccia from Mt. Emma (boundary secs. 1 and 2, T5N, R22E; 38°18.5'N, 119°31.0' W; Mono Co., CA). Analytical data: $K_2O = 8.06\%$, $*Ar^{40} = 1.032 \times 10^{-10}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 65\%$; collected by: G. R. Priest, Mackay School of Mines and Geology; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Last volcanic rocks emplaced in Little Walker volcanic center, East Central California. These rocks were emplaced after the caldera collapse and eruption of the Eureka Valley Tuff (Priest and others, 1974). (biotite) 8.9±0.3 m.y.

16. ME-4 K-Ar
Pyroxene-olivine latite breccia from Mt. Emma (boundary secs. 1 and 2, T5N, R22E; 38°18.5'N, 119°31.0' W; Mono Co., CA). Analytical data: $K_2O = 8.10\%$, $*Ar^{40} = 1.066 \times 10^{-10}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 51\%$; collected by: G. R. Priest, Mackay School of Mines and Geology; dated by: M. L. Silberman, U. S. Geological Survey. Comment: See sample ME-3 (No. 15). (biotite) 9.1±0.3 m.y.

17. M-3 K-Ar
Biotite-hornblende andesite flow (north-central sec. 29, T10N, R21E; 38°41.3'N, 119°41.7'W; Alpine Co., CA). Analytical data: (Biotite) $K_2O = 8.735\%$, $*Ar^{40} = 1.195 \times 10^{-10}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 59\%$, (Plagioclase) $K_2O = 0.591\%$, $*Ar^{40} = 8.319 \times$ $\times 10^{-12}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 24\%$; collected by: B. G. Wachter, Stanford University and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Part of Goskey Canyon Volcanics of Wachter (1971) which underlie the dominantly rhyolitic Markleeville Volcanics. (biotite) 9.5±0.3 m.y.
(plagioclase) 9.7±0.4 m.y.

18. N621 K-Ar
Basalt of Brown Bear Pass, alkali-rich, holocrystalline basalt (south-central sec. 4, T4N, R21E; 38° 40.0'W; Tuolumne Co., CA). Analytical data: 1) $K_2O = 1.73\%$, $*Ar^{40} = 5.019 \times 10^{-11}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 40\%$, 2) $K_2O = 1.75\%$, $*Ar^{40} = 4.866 \times 10^{-11}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 32\%$; collected by: J. G. Quade, University of Nevada, Reno, and D. C. Noble, Michigan Tech University; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Two separate samples from the same flow are dated. The unit lies at the base of several thousand feet of andesites and marks the lower age limit for major calc-alkaline andesite eruptions in this part of the Sierra Nevada.
(whole rock) 20.0±0.8 m.y.
(whole rock) 19.2±0.8 m.y.

19. 2384-1 K-Ar
Porphyritic hornblende andesite of Nugent, WA (NE¼ sec. 8, T11N, R32E; 38°50.0'N, 118°23.0'W; Mineral Co., NV). Analytical data: (Hornblende) $K_2O = 0.581\%$, $*Ar^{40} = 1.945 \times 10^{-11}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 60\%$, (Plagioclase) $K_2O = 0.767\%$, $*Ar^{40} = 2.441 \times 10^{-11}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 77\%$; collected by: F. J. Kleinhampl and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: One of the older andesites in the eastern part of the Walker Lane. Andesitic volcanism tends to decrease in age from east to west in the Walker Lane (Silberman and others, 1975; Ekren and others, 1977).
(hornblende) 23.1±0.7 m.y.
(plagioclase) 22.0±0.7 m.y.

20. 16149-1 K-Ar
Porphyritic hornblende andesite intrusion (38°23.3' N, 117°51.5'W; E side of Pilot Mts., 3 km E of Lindsey Mine, Mineral Co., NV). Analytical data: $K_2O = 0.732\%$, $*Ar^{40} = 2.617 \times 10^{-11}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 55\%$; collected by: F. J. Kleinhampl and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Older andesite, probably equivalent to intermediate lavas of Nugent, WA (Ekren and others, 1977).
(hornblende) 24.7±0.7 m.y.

21. 2605-5 K-Ar
Porphyritic pyroxene andesite of Mt. Ferguson (N center sec. 15, T9N, R34E; 38°38.6'N, 118°10.5'W; Mineral Co., NV). Analytical data: $K_2O = 0.224\%$, $*Ar^{40} = 4.999 \times 10^{-11}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 40\%$; collected by: F. J. Kleinhampl, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Most of Mt. Ferguson

21. (continued)
and surrounding area is underlain by andesite. Pyroxene in this sample is largely altered to iron oxide, but the plagioclase is quite fresh (Ekren and others, 1977).
(plagioclase) 15.4±0.5 m.y.

22. 11920-2 K-Ar
Porphyritic hornblende andesite breccia, overlies tuff containing petrified wood (38°32.2'N, 117°57.8'W; 4 km NW of windmill in Stewart Valley, Mineral Co., NV). Analytical data: (Hornblende) K_2O = 0.676%, $*\mathrm{Ar}^{40} = 1.503 \times 10^{-11}$ moles/gm, $*\mathrm{Ar}^{40}/\Sigma\mathrm{Ar}^{40}$ = 55%, (Plagioclase) K_2O = 0.336%, $*\mathrm{Ar}^{40} = 7.341 \times 10^{-11}$ moles/gm, $*\mathrm{Ar}^{40}/\Sigma\mathrm{Ar}^{40}$ = 48%; collected by: M. L. Silberman and F. J. Kleinhampl, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Equivalent to intermediate lavas, rocks of Mt. Ferguson (Ekren and others, 1977).
(hornblende) 15.4±0.5 m.y.
(plagioclase) 15.1±0.5 m.y.

The previous samples (nos. 1-22) are all intermediate to mafic lavas erupted from about 27 to 7 m.y. ago in the Walker Lane (southwest Nevada) and Sierra Nevada. Prior to the eruption of these andesites, volcanic rocks of pre-Miocene age were chiefly rhyolite to quartz-latite ash-flow tuffs. Between about 25 and 20 m.y. ago, thick piles of andesite breccias and flows were erupted largely in southwestern Nevada (Tonopah, Goldfield) and the eastern part of the Walker Lane (Gillis-Gabbs Valley ranges). The greatest volume of andesite was erupted all along the Walker Lane between about 17 and 12 m.y. ago. Large volumes of andesite were also erupted in the Sierra Nevada during this time. Andesitic volcanism continued until about 7 to 8 m.y. ago, largely in the western part of the Walker Lane and in the Sierra Nevada. There is a strong indication of a westward progression of andesitic eruption in the region (Silberman and others, 1975). After about 5 to 6 m.y. ago, most volcanic activity in this entire region (Western Nevada and the Sierra Nevada) is basaltic. This includes bimodal rhyolites and differentiated rocks of tholeiitic to sub-alkaline affinity. The change in nature of the volcanic activity in the region coincides approximately with a change in relative plate motion at the latitudes in question (Atwater and Molnar, 1973).

Felsic Extrusive Rocks – Western Great Basin

23. 2306-7 K-Ar
Hu-pwi rhyodacite, Poinsettia Tuff member, pyroxene rhyodacite tuff (NE¼ sec. 10, T10N, R33E; 38°45.0'N, 118°18.1'W; Mineral Co., NV). Analytical data: (Plagioclase) K_2O = 0.824%, $*\mathrm{Ar}^{40} = 2.635 \times 10^{-11}$ moles/gm, $*\mathrm{Ar}^{40}/\Sigma\mathrm{Ar}^{40}$ = 72%, (Biotite) K_2O = 8.39%, $*\mathrm{Ar}^{40} = 2.811 \times 10^{-11}$ moles/gm, $*\mathrm{Ar}^{40}/\Sigma\mathrm{Ar}^{40}$ = 64%; collected by: F. J. Kleinhampl and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Reference: Ekren and others (1977).
(plagioclase) 22.1±0.7 m.y.
(biotite) 23.1±0.7 m.y.

24. MLS-73-9 K-Ar
Quartz latite ash flow tuff of Gabbs Valley (NE¼ sec. 33, T12N, R30E; 38°51.6'N, 118°37.6'W; Mineral Co., NV). Analytical data: K_2O = 7.915%, $*\mathrm{Ar}^{40} = 2.941 \times 10^{-11}$ moles/gm, $*\mathrm{Ar}^{40}/\Sigma\mathrm{Ar}^{40}$ = 61%; collected by: M. L. Silberman and F. J. Kleinhampl, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey; reference: Ekren and others (1977).
(sanidine) 25.6±0.8 m.y.

25. MLS-73-10 K-Ar
Quartz latite ash flow tuff of Gabbs Valley (southern sec. 4, T11N, R30E; 38°49.8'N, 118°36.0'W; Mineral Co., NV). Analytical data: K_2O = 10.265%, $*\mathrm{Ar}^{40} = 3.981 \times 10^{-11}$ moles/gm, $*\mathrm{Ar}^{40}/\Sigma\mathrm{Ar}^{40}$ = 82%; collected by: M. L. Silberman and F. J. Kleinhampl, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey; reference: Ekren and others (1977).
(sanidine) 26.7±0.8 m.y.

26. 3289-10 K-Ar
Quartz latite ash flow, Mickey Pass Tuff, Guild Mine member (sec. 28, T11N, R30E; 38°46.7'N, 118° 36.0'W; Mineral Co., NV). Analytical data: (Sanidine) K_2O = 10.630%, $*\mathrm{Ar}^{40} = 4.363 \times 10^{-11}$ moles/gm, $*\mathrm{Ar}^{40}/\Sigma\mathrm{Ar}^{40}$ = 87%, (Plagioclase) K_2O = 1.068%, $*\mathrm{Ar}^{40} = 3.878 \times 10^{-11}$ moles/gm, $*\mathrm{Ar}^{40}/\Sigma\mathrm{Ar}^{40}$ = 82%; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Base of ash flow tuff sequence. The ages are notably discordant. Based on other ages reported in Ekren and others (1977), the plagioclase appears to be too young. Some of the plagioclase has glass inclusions, but it is not sieve textured. These ash flow tuffs are part of the Hartford Hill "Tuff," which is being subdivided into formational units (Proffitt and Proffitt, 1976; E. C. Bingler, written communication, 1977) in the entire Walker Lane region.
(sanidine) 28.3±0.9 m.y.
(plagioclase) 25.0±0.8 m.y.

Plutonic and Intrusive Rocks – Nevada

27. L-317 K-Ar
Granite (W center sec. 2, T34N, R50E, 40°51'N,

27. (continued) 116°18.5'W; Eureka Co., NV). Analytical data: K_2O = 8.31%, $*Ar^{40}$ = 1.336 x 10^{-9} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 85%; collected by: J. G. Evans, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Intrudes and metamorphoses Eureka Quartzite and Hansen Creek Dolomite. Wallrocks are hydrothermally altered (Evans, 1972). (biotite) 108±3 m.y.

28. L-340 K-Ar
Diorite (center sec. 27, T34N, R50E; 40°47.3'N, 116° 19.3'W; Eureka Co., NV). Analytical data: K_2O = 8.505%, $*Ar^{40}$ = 4.762 x 10^{-10} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 89%; collected by: J. G. Evans, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Intrudes and metamorphoses Ordovician and Silurian cherts and shales (Evans, 1972). (biotite) 38.5±1.2 m.y.

29. GS-B10 K-Ar
Gold strike diorite (sec. 30, T36N, R50E; 40°58.3'N, 116°21.8'W; Eureka Co., NV). Analytical data: K_2O = 3.55%, $*Ar^{40}$ = 4.093 x 10^{-10} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 55%; collected by: A. S. Radtke and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman and J. L. Morton, U. S. Geological Survey. Comment: Medium-grained diorite, veined by small quartz veins and stockworks. Biotite is bronzy and has lost potassium. Age must be considered a minimum. (biotite) 78.4±3.9 m.y.

30. MB43 K-Ar
Biotite-hornblende quartz monzonite (center sec. 31, T33N, R39E; 40°41.5'N, 117°37.8'W; Humboldt Co., NV). Analytical data: (Biotite) K_2O=9.08%, $*Ar^{40}$ = 2.172 x 10^{-9} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 94%, (Hornblende) K_2O = 0.701%, $*Ar^{40}$ = 1.821 x 10^{-10} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 87%; collected by: M. L. Silberman and R. J. Roberts, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Ages are quoted by Silberling (1975). Intrudes and metamorphoses Havallah sequence of Pennsylvanian-Permian age. A metasomatic zone related to this pluton is displaced by a strand of the Clear Creek thrust fault system thus demonstrating that the faulting is younger than Middle Jurassic. The ages are discordant, but the hornblende is believed to be relatively close to the age of emplacement. Middle Cretaceous igneous activity in this region (105 to 87 m.y., Silberman and McKee, 1971) has apparently not caused any appreciable argon loss from the hornblende, but it could explain the lower biotite age. (biotite) 159±5 m.y.
(hornblende) 172±5 m.y.

31. RILEY K-Ar
Porphyritic dacite dike, at the Riley Mine (NW¼ sec. 9, T38N, R42E; 40°11.5'N, 117°15.2'W; Humboldt Co., NV). Analytical data: (Biotite) K_2O = 8.79%, $*Ar^{40}$ = 1.193 x 10^{-9} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 95%, (Hornblende) K_2O = 1.31%, $*Ar^{40}$ = 1.786 x 10^{-10} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 85%; collected by: B. R. Berger, Continental Oil Co.; dated by: M. L. Silberman, U. S. Geological Survey. Comment: The dike intrudes granodiorite of the Osgood Mountains and limestone of the Preble Formation (Hotz and Willden, 1964). Its age is the same as that reported by Silberman and others (1974) for granodiorite of the Osgood Mountains and for andesite porphyry dikes in the north pit of the Getchell Mine, several kilometers to the north. (biotite) 91.9±2.8 m.y.
(hornblende) 92.1±2.8 m.y.

32. 6300B K-Ar
Granodiorite dike (NE¼SW¼SW¼ sec. 18, T45N, R65E; Contact mining district, Elko Co., NV) intruding the Contact pluton. Analytical data: K_2O = 0.233%, $*Ar^{40}$ = 4.292 x 10^{-11} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 60%; submitted by: J. H. Schilling, Nevada Bureau of Mines and Geology; dated by: M. L. Silberman, U. S. Geological Survey. (hornblende) 124±6 m.y.

33. DP2 K-Ar
Gabbro (SE¼SE¼SE¼ sec. 29, T22N, R27E; 39° 44.3'N, 118°58.0'N; Churchill Co., NV). Analytical data: (Plagioclase) K_2O = 1.431%, $*Ar^{40}$ = 1.962 x 10^{-11} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 21%, (Hornblende) K_2O = 0.434%, $*Ar^{40}$ = 1.646 x 10^{-11} moles/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 25%; collected by: R. T. Forest and W. R. Benoit, Phillips Petroleum Co., Reno, NV; dated by: M. L. Silberman, U. S. Geological Survey. Comment: X-ray fluorescence analyses (hornblende K_2O = 0.40%, plagioclase K_2O = 1.46%) confirm the flame photometer results. The unusually high atmospheric argon content of both minerals is typical of rocks that have undergone hydrothermal alteration. Discordance indicates resetting of plagioclase and perhaps both minerals by post crystallization thermal activity. The 26-m.y.-hornblende age is typical of ages of andesites in the region, and the high Sr content (1550 ppm) of the plagioclase is typical of those andesites. (plagioclase) 9.5±0.6 m.y.
(hornblende) 26.2±1.2 m.y.

Basalts – Central Nevada

34. 6-12-75 K-Ar
Porphyritic basalt (NW¼SW¼ sec. 31, T27N, R35E;

34. (continued)
40°10.0'N, 118°5.6'W; Pershing Co., NV). Analytical data: K$_2$O = 1.161%, *Ar^{40} = 1.874 x 10^{-11} moles/gm, *Ar^{40}/ΣAr^{40} = 30%; collected by: R. E. Wallace, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Untreated.
(whole rock) 11.2±0.3 m.y.

35. 6-12-75A K-Ar
Porphyritic basalt (NW¼SW¼ sec. 31, T27N, R35E; 40°10.0'N, 118°5.6'W; Pershing Co., NV). Analytical data: K$_2$O = 1.213%, *Ar^{40} = 1.944 x 10^{-11} moles/gm, *Ar^{40}/ΣAr^{40} = 31%; collected by: R. E. Wallace, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Same hand specimen as 6-12-75, but prepared using an HF and HNO$_3$ acid treatment. The sample was used to test the effect of the procedure on reducing radiogenic argon content and on the age of the sample. The ages of both samples are identical
(whole rock) 11.1±0.3 m.y.

36. L. McKinney K-Ar
Porphyritic basalt, holocrystalline groundmass, plagioclase phenocrysts, mostly sieve textured (SW¼ sec. 18, T27N, R38E unsurveyed; 40°12.4'N, 117°45.2'W; Pershing Co., NV). Analytical data: K$_2$O = 1.926%, *Ar^{40} = 3.686 x 10^{-11} moles/gm, *Ar^{40}/ΣAr^{40} = 22%; collected by: R. E. Wallace, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.
(whole rock) 13.2±0.4 m.y.

37. U. McKinney K-Ar
Vesicular basalt, similar to L. McKinney, has small olivine phenocrysts (SW¼ sec. 18, T27N, R38E unsurveyed; 40°12.4'N, 117°45.2'W; Pershing Co., NV). Analytical data: K$_2$O = 1.894%, *Ar^{40} = 3.231 x 10^{-11} moles/gm, *Ar^{40}/ΣAr^{40} = 25%; collected by: R. E. Wallace, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Overlies sample L. McKinney (No. 36).
(whole rock) 11.8±0.4 m.y.

38. COAL CAN K-Ar
Porphyritic olivine basalt, plagioclase and olivine phenocrysts, fine-grained, holocrystalline groundmass (center SE¼ sec. 23, T27N, R33E; 40°11.5'N, 118°14.2'W; Pershing Co., NV). Analytical data: K$_2$O = 1.444%, *Ar^{40} = 2.216 x 10^{-11} moles/gm, *Ar^{40}/ΣAr^{40} = 26%; collected by: R. E. Wallace, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. (whole rock) 10.6±0.4 m.y.

39. BS-1 K-Ar
Porphyritic basalt, contains large phenocrysts of plagioclase (NW¼ sec. 31, T29N, R42E unsurveyed; 40°20.8'N, 117°17.8'W; Lander Co., NV). Analytical data: K$_2$O = 2.455%, *Ar^{40} = 4.381 x 10^{-12} moles/gm, *Ar^{40}/ΣAr^{40} = 6%; collected by: M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman and J. L. Morton, U. S. Geological Survey. Comment: This and the following two samples are from the same specimen collected from one of a chain of cinder cones along the northwest flank of the Fish Creek Mountains. Samples were prepared using different techniques of acid treatment and analyzed for potassium and argon separately (see BS-1A, BS-1B). This specimen was not treated but ground to 60 to 100 mesh.
(whole rock) 1.24±0.21 m.y.

40. BS-1A K-Ar
Porphyritic basalt (NW¼ sec. 31, T29N, R42E unsurveyed; 40°20.8'N, 117°17.8'W; Lander Co., NV). Analytical data: K$_2$O = 2.453%, *Ar^{40} = 4.483 x 10^{-12}, 4.648 x 10^{-12} moles/gm, *Ar^{40}/ΣAr^{40} = 16%, 28%; collected by: M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: This specimen was treated with HF and HNO$_3$ (see sample 6-12-75A, No. 35). Argon was analyzed twice, and both analyses show great improvement in radiogenic argon content over the untreated sample. The difference in radiogenic argon content between the two argon analyses probably resulted from variations in atmospheric blanks in the extraction lines.
(whole rock) 1.29±0.03 m.y.

41. BS-1B K-Ar
Porphyritic basalt (NW¼ sec. 31, T29N, R42E unsurveyed; 40°20.8'N, 117°17.8'W; Lander Co., NV). Analytical data: K$_2$O = 2.463%, *Ar^{40} = 4.960 x 10^{-12} moles/gm, *Ar^{40}/ΣAr^{40} = 12%; collected by: M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: This sample was treated with bromoform and phosphoric acid. It has better radiogenic argon content than the untreated sample, and it is the same age within analytical uncertainty. This treatment did not appear to be as effective in reducing atmospheric argon content as the HF and HNO$_3$ method. Neither appears to affect the age of the samples.
(whole rock) 1.40±0.14 m.y.

Mineralization and Alteration

42. SA-1 K-Ar
Altered Guild Mine member of Micky Pass Tuff

42. (continued)
(SE¼ sec. 13, T9N, R33E; 38°38.2′N, 118°14.9′W; Mineral Co., NV). Analytical data: K$_2$O = 7.79%, *Ar^{40} = 2.200 x 10^{-10} moles/gm, *Ar^{40}/ΣAr^{40} = 47%; collected by: M. L. Silberman and F. J. Kleinhampl, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: This sample comes from an eight-square-mile hydrothermally altered area of rhyolite ash-flow tuff in the Gabbs Valley Range in a block between right-lateral strike-slip faults. For several miles quartz-alunite alteration zones are exposed along the fault to the east that passes through Benton Springs (Ekren and others, 1977). At the sample locality, pinkish alunite up to 1 mm across replaces feldspar phenocrysts and pumice lapilli. The rock is totally recrystallized to a quartz-alunite assemblage, with alunite intergrown with quartz in the groundmass as well as replacing feldspars and pumice. We estimate that 10 to 15% of the rock has been replaced by alunite. Alunite has proven to be very useful in dating alteration and mineralization (Ashley and Silberman, 1976). The source of the hydrothermal fluids causing the alteration is unknown, but the faults apparently acted as conduits. Rhyolite intrusions occur within the region, one just across the strike-slip fault that bounds the altered area, but some of these cut intermediate lavas of Mt. Ferguson (F. J. Kleinhampl and R. W. Kopf, unpublished mapping, 1971), which are dated at approximately 15 m.y.; they are younger than the alunite alteration. It is possible that a range in age is present in these rhyolites and that they supplied the heat necessary to drive hydrothermal fluids. The area has been prospected for Au and Ag, but grab samples show little present.
(alunite) 19.5±0.6 m.y.

43. GB1 K-Ar
Quartz-adularia-calcite vein (1000 ft level, Gooseberry Mine; sec. 25, T19N, R22E; 39°29.2′N, 119°27.8′W; Storey Co., NV). Analytical data: K$_2$O = 6.945%, *Ar^{40} = 1.031 x 10^{-10} moles/gm, *Ar^{40}/ΣAr^{40} = 33%; collected by: M. L. Silberman, U. S. Geological Survey, A. B. Wallace, Mackay School of Mines, and Steve Kleeberger, Apco Oil Co.; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Sample from the 1000-ft level in Gooseberry Mine. Gold-silver ore occurs in a quartz-calcite vein with minor amounts of pyrite, chalcopyrite, tetrahedrite, and variable amounts of Ag and Au (Rose, 1969). At the surface the vein ranges from a few inches to several feet in width. Wallrock consists of altered, pyrite-bearing Kate Peak dacite. At the surface it is argillized, probably from acid-sulfate alteration due to oxidation of sulfides. At the 1000-ft level where sampled, the vein is 7 to 8 ft wide and consists of quartz and coarse-grained calcite with finer grained intergrown adularia. At this level wallrock alteration consists of a K-silicate (K-feldspar-quartz-K-mica) assemblage. The adularia age of 10.3 m.y. is the same as that reported for gold-bearing quartz-adularia veins at Talapoosa, about 20 km to the east (Garside and Silberman, 1973). The youngest age reported on the Kate Peak Formation is 12.4 m.y. (Silberman and McKee, 1972), but the unit has not been dated near either Talapoosa or the Gooseberry Mine. Vein samples (grab) collected at the 1000-ft level yielded 0.4 and 0.8 ppm Au and 30 and 20 ppm Ag. Higher values are reported by Rose (1969) from dump samples.
(adularia) 10.3±0.3 m.y.

44. ZACA K-Ar
Quartz-sericite altered rhyolite (Monitor mining district; sec. 31, T10N, R21E; 38°40.2′N, 119°42.3′W; Alpine Co., CA). Analytical data: K$_2$O = 9.70%, *Ar^{40} = 6.688 x 10^{-11}, 7.165 x 10^{-11} moles/gm, *Ar^{40}/ΣAr^{40} = 57%, 81%; collected by: B. G. Wachter, Stanford University; dated by: M. L. Silberman, U. S. Geological Survey. Comment: See comment under sample Z-4/69 (No. 45).
(sericite) 4.95±0.24 m.y.

45. Z-4/69 K-Ar
K-silicate altered rhyolite (Monitor mining district; sec. 31, T10N, R21E; 38°40.2′N, 119°42.3′W; Zaca Mine, Alpine Co., CA). Analytical data: K$_2$O = 7.667%, *Ar^{40} = 5.266 x 10^{-11} moles/gm, *Ar^{40}/ΣAr^{40} = 48%; collected by: M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: The Monitor mining district is in an area of complex and varied volcanic activity and contains a variety of ore deposits. Ore is apparently largely restricted to limited horizons in the dominantly rhyolitic Markleeville volcanics of Wachter (1971), a unit which includes flows, pyroclastic deposits, and small intrusive plugs. At the Zaca Mine, Ag-Au, Pb, Zn, and Cu-bearing sulfides occur as disseminations and veins in intrusive rhyolite. K-silicate and sericitic alteration have affected parts of the body. The sericite was sampled from an open pit at Colorado Hill from which considerable Ag was mined. The altered rock, which consisted of K-feldspar, quartz, and minor sericite with sulfides was sampled in an adit nearby. The two samples gave ages that are in agreement within analytical uncertainty. This is another example of the use of whole rock alteration assemblages to determine age of mineralization. (See discussion of Aurora sample CH8Z1 No. 52.) The Markleeville

45. (continued)
volcanics may be equivalent to the Noble Canyon Rhyolite, dated by Dalrymple (1964) at 4.8 m.y. (using new constants, 4.9 m.y.), but the unit has not been dated at Markleeville. This is one of the youngest ore deposits in the Sierra Nevada.
(whole rock) 4.76±0.19 m.y.

46. KF-1-6 K-Ar
Altered diorite (New Pass Mine; sec. 9, T20N, R40E; 39°36.5'N, 117°28.6'W; Lander Co., NV). Analytical data: K_2O = 5.760%, *Ar^{40} = 7.146 x 10^{-10} moles/gm, *$Ar^{40}/\Sigma Ar^{40}$ = 68%; collected by: Ken Fink, Stanford University; dated by: M. L. Silberman and J. L. Morton, U. S. Geological Survey. Comment: Very fine grained muscovite. See comment on K-silicate date (sample 47). This age is younger than the whole-rock age, but agrees within analytical uncertainty. (muscovite) 84.2±2.5 m.y.

47. KF-1-6 K-Ar
Quartz-sericite-K-feldspar altered diorite (New Pass Mine; sec. 9, T20N, R40E; 39°36.5'N, 117°28.6'W; Lander Co., NV). Analytical data: K_2O = 3.435%, *Ar^{40} = 4.424 x 10^{-10} moles/gm, *$Ar^{40}/\Sigma Ar^{40}$ = 80%; collected by: Ken Fink, Stanford University; dated by: M. L. Silberman and J. L. Morton, U. S. Geological Survey. Comment: The host rock for the gold deposits of the New Pass Mine is diorite. Galena, sphalerite, tetrahedrite, arsenopyrite, pyrite, chalcopyrite, and gold are found along shears and disseminated in quartz veins (Fink, 1976). The diorite has been altered to a K-silicate assemblage adjacent to the gold-bearing veins. Sericite was separated from one hand specimen while the sulfides were removed from a second specimen, and the silicate portion was run as a whole-rock sample. The ages agree within analytical uncertainty. The mineralization age of 85.7±1.6 m.y. (Av.) is nearly within one of the episodes of plutonism defined for north-central Nevada (87 to 105 m.y.) by Silberman and McKee (1971). (K-silicate) 87.3±2.6 m.y.

48. IVO-1 K-Ar
Quartz-adularia vein (Buena Vista mining district; SW¼ sec. 21, T1N, R33E; 37°55.4'N, 118°18.8'W; Esmeralda Co., NV). Analytical data: K_2O = 4.745%, *Ar^{40} = 3.529 x 10^{-11} moles/gm, *$Ar^{40}/\Sigma Ar^{40}$ = 14%; collected by: S. W. Ivosevic, Freeport Exploration Co.; dated by: M. L. Silberman, U. S. Geological Survey. Comment: The sample was from a thick (25 ft) quartz vein containing lenses of coarse adularia up to 3 ft thick, which cuts latitic tuff (S. W. Ivosevic, written communication, 1976). The 5.2-m.y. age of mineralization makes this one of the youngest dated hydrothermal vein deposits in the Great Basin. (adularia) 5.2±0.5 m.y.

49. M151A K-Ar
Porphyritic quartz monzonite, quartz sericitic alteration; muscovite with minor iron oxide and leucoxene replacing biotite (McCoy porphyry copper prospect; NE¼ sec. 2, T29N, R42E unsurveyed; 40°25.0'N, 117°13.2'W; Lander Co., NV). Analytical data: K_2O = 10.055%, *Ar^{40} = 1.328 x 10^{-9} moles/gm, *$Ar^{40}/\Sigma Ar^{40}$ = 92%; collected by: B. W. Miller, Mackay School of Mines; dated by: M. L. Silberman and J. L. Morton, U. S. Geological Survey. Comment: Data are discussed in detail in Miller and Silberman (1977). (muscovite) 89.5±2.7 m.y.

50. MLS-73-2 K-Ar
Quartz-adularia-calcite vein, formed by replacement of rhyolite ash-flow tuff (Montgomery-Shoshone Mine, Rhyolite mining district; NE¼ sec. 10, T12S, R46E; 36°54.5'N, 116°48.6'W; Nye Co., NV). Analytical data: K_2O = 3.17%, *Ar^{40} = 4.343 x 10^{-11}, 4.311 x 10^{-11} moles/gm, *$Ar^{40}/\Sigma Ar^{40}$ = 38%, 54%; collected by: M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Sample contains 4.5 ppm Au, 22 ppm Ag. Mineral separate is composed of intergrown fine-grained quartz and adularia. Ore at Montgomery-Shoshone Mine is located in brecciated, altered rhyolite ash-flow tuff in the footwall of the Montgomery-Shoshone fault (Cornwall and Kleinhampl, 1964), a high-angle normal fault with several thousand feet displacement. See additional comments on sample MLS-73-1 (No. 51). (adularia) 9.5±0.2 m.y.

51. MLS-73-1 K-Ar
Porphyritic latite (Rhyolite mining district; SW¼ sec. 2, T12S, R46E; 36°55.0'N, 116°48.3'W; Nye Co., NV). Analytical data: K_2O = 7.22%, *Ar^{40} = 1.119 x 10^{-10} moles/gm, *$Ar^{40}/\Sigma Ar^{40}$ = 34%; collected by: M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: The latite overlies and intrudes ash-flow tuffs which form the host rocks for gold deposits at the Montgomery-Shoshone Mine (Cornwall and Kleinhampl, 1964). K-Ar ages reported on the ash-flow tuffs and rhyolite flows believed related to them range from 11.1 to 12.5 m.y. (Marvin and others, 1973; 11.4 to 12.8 using new constants). The age of the latite is in keeping with its stratigraphic position. The K-Ar

51. (continued)
mineralization age suggests that hydrothermal activity occurred after major rhyolite volcanism ceased.
(biotite) 10.7±0.3 m.y.

52. CH8Z1 K-Ar
Altered wallrock of Aurora andesite, adjacent to Juniata vein (Juniata (Chesco) Mine, Aurora mining district; south-center sec. 17, T5N, R28E; 38°17.1'N, 118°52.8'W; Mineral Co., NV). Analytical data: $K_2O = 8.04\%$, $*Ar^{40} = 1.252 \times 10^{-10}$, 1.270×10^{-10} moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 29\%, 29\%$; collected by: M. L. Silberman and F. J. Kleinhampl, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Hydrothermal alteration associated with gold-silver mineralization has resulted in recrystallization of originally porphyritic andesite to an assemblage of quartz-K-feldspar-muscovite-pyrite-chlorite adjacent to large quartz veins at Aurora, Nevada. Mineralization was dated directly at Aurora by K-Ar measurements of adularia separated from gold-silver-bearing quartz-adularia veins at 10.3±0.2 m.y. (10.6 m.y. using new constants, reported here). A whole-rock sample from adjacent to one of the larger veins (reported above) gave an age identical to that from adularia, dated elsewhere in the district. The host rocks give K-Ar ages of 13.5 to 15.4 m.y. from unaltered samples (Kleinhampl and others, 1975). Apparently, the whole-rock samples, with K-silicate alteration assemblages, are useful for determining ages of alteration-mineralization. See discussion of Monitor mining district samples (Nos. 44 and 45).
(whole rock) 10.9±0.3 m.y.

53. CD138 K-Ar
Silver Dyke vein (dump at the main adit at the Silver Dyke Mine; SE¼ sec. 4, T5N, R34E unsurveyed; 38°18.9'N, 118°11.9'W; Mineral Co., NV). Analytical data: $K_2O = 3.18\%$, $*Ar^{40} = 8.059 \times 10^{-11}$, 7.838×10^{-11} moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 45\%, 51\%$; collected by: L. J. Garside, Nevada Bureau of Mines, and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: See CD142 (No. 54). (K-feldspar) 17.3±0.2 m.y.

54. CD142 K-Ar
K-feldspar-quartz-sulfide veinlet in diorite (dump of Silver Dyke Mine; SE¼ sec. 4, T5N, R34E unsurveyed; 38°18.9'N, 118°11.9'W; Mineral Co., NV). Analytical data: $K_2O = 11.33\%$, $*Ar^{40} = 1.264 \times 10^{-9}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 92\%$; collected by: B. R. Berger, Conoco Oil Co., and L. J. Garside and H. F. Bonham, Nev. Bureau of Mines and Geology; dated by: M. L. Silberman, U. S. Geological Survey. Comment: The Silver Dyke vein system is a steeply dipping, discontinuous quartz vein system that cuts a diorite intrusion and Permian(?) and Mesozoic rocks as well as Miocene intermediate volcanic rocks (L. J. Garside, unpublished mapping). Both silver and tungsten (the latter as scheelite) have been produced by several mines along the system with a total production of 1.2 million dollars. The veins carry few sulfides. Sample CD138 comes from the dump of the lowest adit of the Silver Dyke Mine and consists of white, vitreous quartz with some diorite inclusions and minor adularia. The diorite in Silver Dyke Canyon also contains small veinlets of quartz and coarsely crystalline, pink adularia with molybdenite, chalcopyrite, bornite, and pyrite. Adularia separated from one of these veinlets gave the older age. Silberman and others (1975) report a K-Ar age of 15 m.y. from an adularia-quartz vein that cuts Mesozoic sandstones and conglomerates at Camp Douglas, 3 km north of Silver Dyke.

The vein system at Camp Douglas also cuts Miocene intermediate volcanic rocks. The age date indicates that several periods of hydrothermal mineralization have affected this region.
(K-feldspar) 75.9±2.3 m.y.

55. AR-298 K-Ar
Rhyolite porphyry (Cortez Mine; sec. 19, T27N, R48E; 40°11.6'N, 116°36.8'W; Lander Co., NV). Analytical data: $K_2O = 8.20\%$, $*Ar^{40} = 4.169 \times 10^{-10}$ moles/gm, $*Ar^{40}/\Sigma Ar^{40} = 85\%$; collected by: A. S. Radtke, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: The sample comes from the glassy margin of an Oligocene rhyolite porphyry dike at the Cortez Mine. It contains inclusions of unmineralized Roberts Mountains Limestone, but fracture surfaces have pyrite which contains gold. It yielded the same K-Ar age as other samples of quartz porphyry from the Cortez Mine (Wells and others, 1971). Spatial association with the Cortez-disseminated gold deposits led Wells and others (1971) to suggest that mineralization may have been associated with intrusion of these dikes. The presence of unmineralized limestone in this sample as inclusions does not disprove that suggestion. The quartz porphyry could have picked up the inclusions at deeper levels than the present. Mineralization could have occurred by the action of fluids heated by the dikes, slightly later than emplacement, and these fluids could have been responsible for deposition of pyrite on fracture surfaces in the dike itself.
(biotite) 35.0±1.1 m.y.

56. 6460-1 K-Ar

Altered dike in upper plate of Roberts Mountains thrust (6460 bench, SW corner of main pit, Carlin Mine; sec. 14, T35N, R50E; 40°55'N, 116°20'W; Eureka Co., NV). Analytical data: $K_2O = 5.66\%$, $^*Ar^{40} = 1.107 \times 10^{-9}$ moles/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 83%; collected by: A. S. Radtke and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Sample is oxidized and contains considerable pyrite. Its relationship to mineralization is unknown. The sample contained 0.1 ppm Au. Biotite is partially sericitized. Age is probably a minimum figure.

(biotite) 131±4 m.y.

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