

***A summary of radiometric ages of tertiary volcanic rocks in Nevada and eastern California. Part 1: Central Nevada***

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A SUMMARY OF RADIOMETRIC AGES OF TERTIARY VOLCANIC ROCKS IN NEVADA  
AND EASTERN CALIFORNIA. PART I: CENTRAL NEVADA<sup>1</sup>

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The 173 available radiometric age determinations on volcanic rocks in central Nevada represent 150 separate sampling localities (fig. 1). Of these ages, 112 are from 10 different literature sources, published during the period 1965-71; 61 are new unpublished dates. Sample descriptions given here by locality number (keyed to map, fig. 1) include age, type of rock, and locality, and, for new ages, the analytical data used in their calculation. Most (164) of the ages were determined by the K-Ar method; 11 were determined by the fission track method.

For the published K-Ar ages, argon was measured by standard isotope dilution procedures, potassium by flame photometry or atomic absorption. (For details of analytical procedure, refer to literature sources given with sample descriptions.) The 61 ages not previously published were determined in the laboratories of the U. S. Geological Survey in Menlo Park, Calif., and Denver, Colo. Argon analyses from which these age determinations were calculated were done by McKee, Silberman, Marvin, and Obradovich, using standard isotope dilution procedures (Dalrymple and Lanphere, 1969). Potassium was determined by flame photometry using a lithium internal standard by Lois Schlocker (Menlo Park), Violet Merritt and Wayne Mountjoy (Denver).

The estimated analytical uncertainties of the new K-Ar ages where indicated are at one standard deviation. Constants used in the calculation of the new K-Ar ages are:  $\lambda_e = 0.585 \times 10^{10} \text{ yr}^{-1}$ ,  $\lambda_\beta = 4.72 \times 10^{10} \text{ yr}^{-1}$ ,  $K^{40}/K_{\text{total}} = 1.22 \times 10^{-4} \text{ gm/gm}$ . (Abbreviations used:  $\text{Ar}^{40*}$  = radiogenic argon-40;  $\Sigma\text{Ar}^{40}$  = total argon-40.)

#### GEOLOGIC DISCUSSION

The region covered in this summary lies between longitudes 118°-115°, latitudes 41°-39°—an area of about 22,500 square miles that includes Lander and Eureka Counties and parts of Humboldt, Pershing, Churchill, Nye, White Pine and Elko Counties, Nevada.

#### ROCKS DATED

All rocks included in this report are volcanic; most are rhyolite ash-flow sheets. A lesser number of rhyolite lava flows and flow-domes, dacite to andesite lava flows, and basalt flows have been dated, and in a general way the number of dates for each rock type reflects the relative volume of the various types within the region.

Most of the K-Ar determinations are on mineral separates of biotite, sanidine, hornblende, plagioclase, pyroxene; a few are on whole-rock basalts. Fission track ages are on accessory sphene, zircon, and apatite.

#### CHRONOLOGY

Volcanic activity started abruptly about 36 m.y. ago in this region after a period of quiescence of 50 m.y. or more. The first eruptive products were andesite to dacite flows that were extruded at a number of separate localities scattered across central Nevada. These flows formed local accumulations usually less than 1,000 feet thick on an erosion surface of slight to moderate relief that developed during the latter part of the Mesozoic and the first half of the Cenozoic. In places, especially near Eureka, a landscape with considerable topographic expression probably related to older structures was modified by the emplacement of a number of shallow intrusive and flow rocks. Andesitic to dacitic flows dominate the stratigraphic column for several million years (36 to 34 m.y. ago), but become less significant by about 33 m.y. ago. Local andesitic volcanism was superseded by an episode of extrusion of rhyolite ash flows; at some localities these flows are interbedded with younger andesite flows, but they generally overlie andesite. The rhyolite ash flows spread symmetrically from their sources, presumably calderas, as thin

<sup>1</sup> Publication authorized by the Director, U. S. Geological Survey.

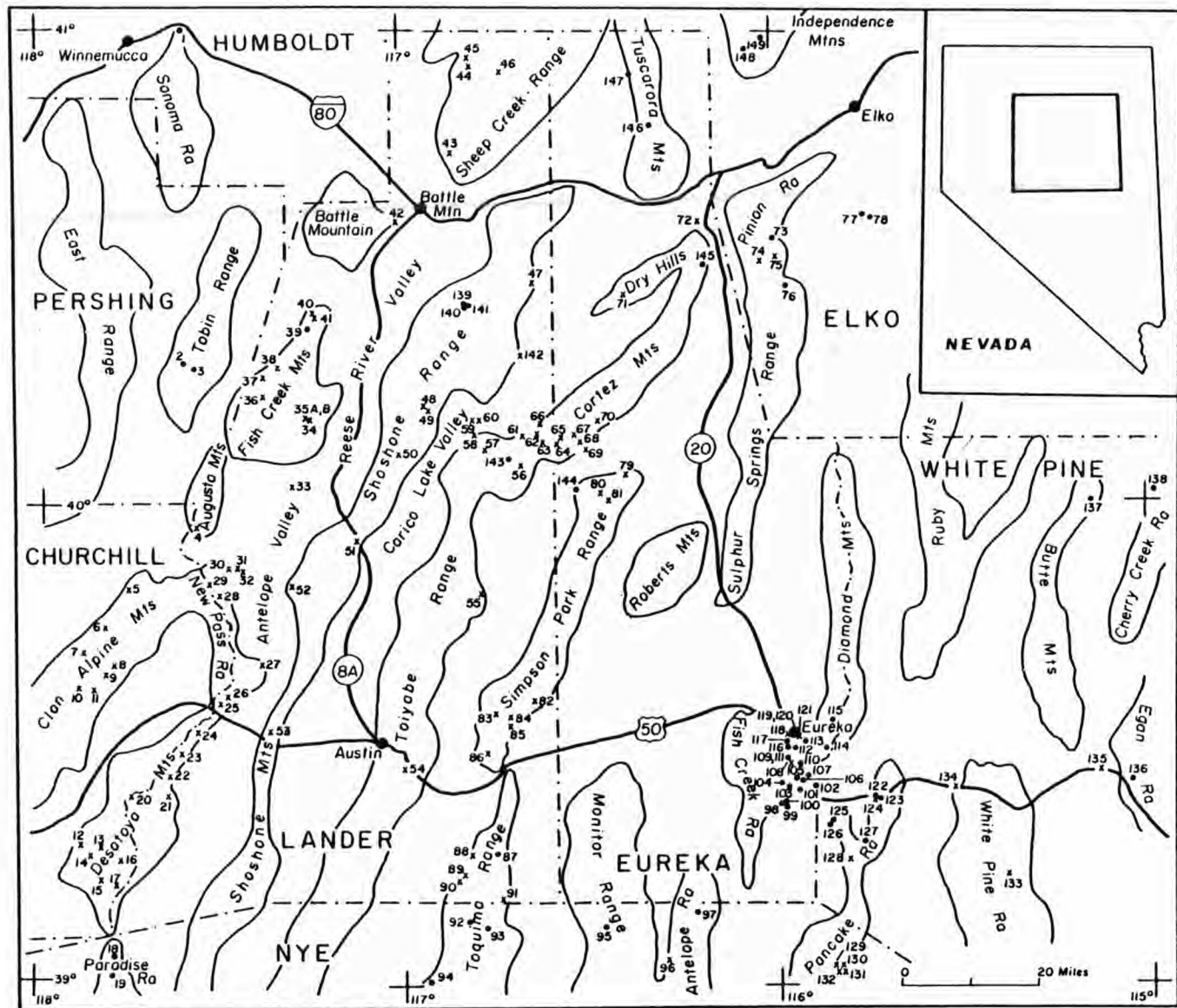


Figure 1. Localities of radiometrically dated Tertiary volcanic rocks in central Nevada. Published dates are indicated by "x", new dates by dots. The numbers are keyed to the sample descriptions.

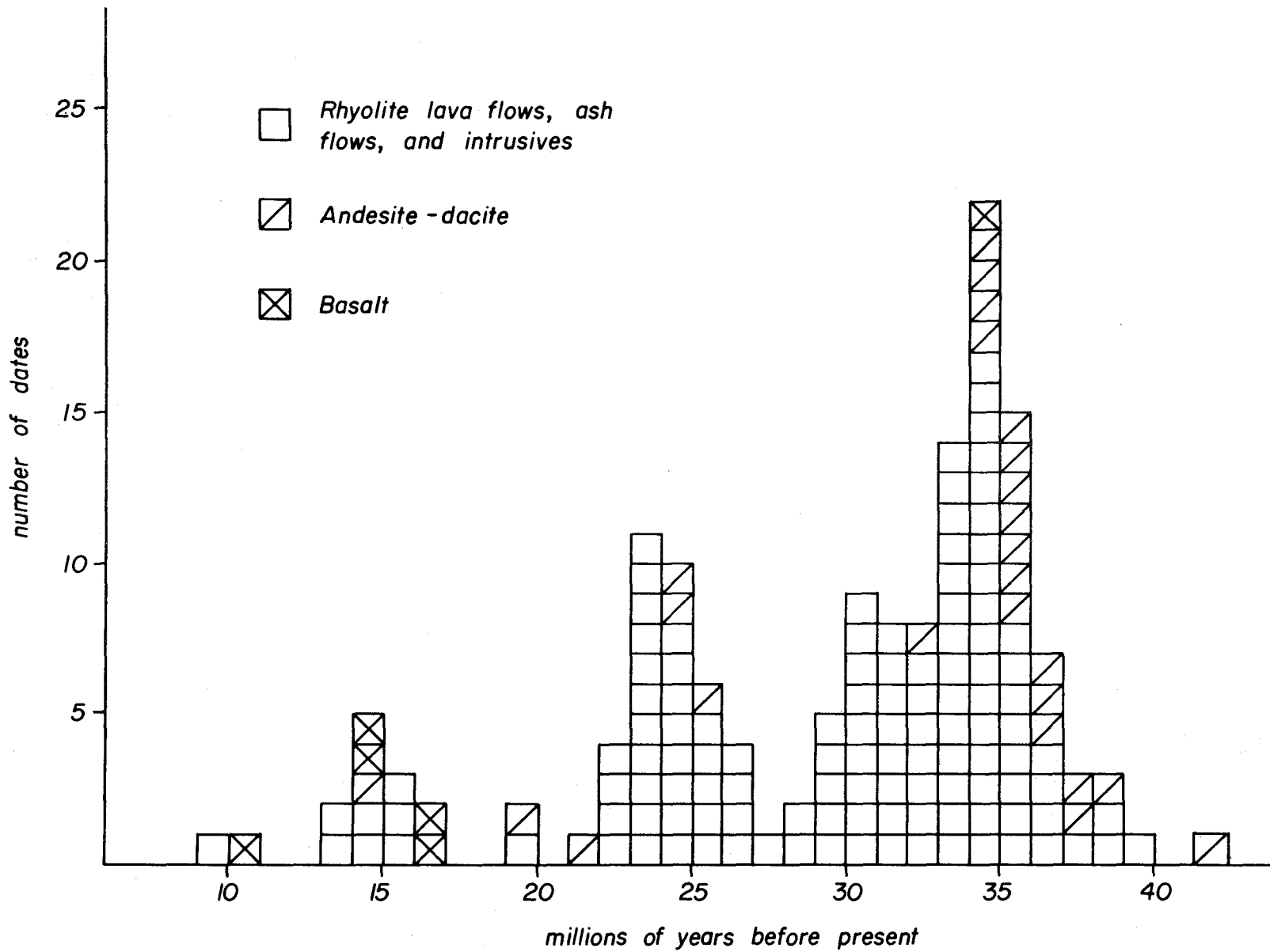


Figure 2. Histogram of radiometric ages of volcanic rocks in central Nevada.

stratified sheets that show horizontal zones of varying compaction and welding typical of ash flows. The sheetlike bodies of tuff indicate that there was little topographic relief (in comparison to present-day Basin and Range topography), and there is no evidence of development of relief during the 10 to 12 m.y. period of volcanism of this type in central Nevada. The tuffs were extruded through a stable crust. About 50 individual ash-flow sheets have been mapped in central Nevada (see, for example, Cook 1965; Scott, 1966; Sargent and McKee, 1969; Kleinhampl and Ziony, 1969; McKee and Stewart, 1971; Stewart and McKee, 1970; Hose and Blake, 1970; Riehle and others, 1971; and others); the number of flow sheets in the region is probably nearly twice this. The ash-flow sheets range in age from about 34 to 20 m.y.

The youngest volcanic rocks in central Nevada are largely basalt and olivine basalt flows along with some rhyolite lava flows, and a few ash flows. The sedimentary rocks that became a significant part of the Tertiary record later than about 15 m.y. ago are generally tuffaceous and contain large amounts of air- or water-borne ash. The age of the basalts and associated rhyolites is 16 m.y. and younger, and these rocks are found mainly near the margins of the region here delineated.

A significant hiatus in volcanic activity exists in the interval 17 to 19 m.y. ago and is very obvious in central Nevada as well as in the entire Great Basin (McKee and others, 1970). This period separates the older (36 to 20 m.y.) rhyolite ash flow and andesite volcanism from the younger (16 m.y. and younger) basaltic episode of volcanism. Basin and Range faulting accompanied the second phase of volcanic activity and is probably related by some mechanism of regional tectonic importance. A second, less pronounced period of volcanic quiescence may have occurred about 27 to 29 m.y. ago. There are few dates in this age interval and if the number of dates roughly corresponds to volume of rock type erupted, this was a time of non-eruption in central Nevada.

The histogram (fig. 2) plots all the ages listed in the sample description section and shown on the map (fig. 1). The preponderance of dates on rhyolitic tuffs between 22 to 35 m.y. old probably reflects their relative volume compared with other igneous rocks in the region. The histogram also points up the hiatus 17 to 19 m.y. ago, separating the older group of andesites and rhyolites from the younger basalt-rhyolite suite.

#### SAMPLE DESCRIPTIONS

##### Sonoma Range

Number shown on Figure 1.

1. K-Ar (sanidine) 15.3±0.8 m.y.  
Rhyolite welded tuff (117°34'18"W, 41°00'48"N; Humboldt Co., NV). Analytical data: (Sanidine) K<sub>2</sub>O = 9.92%,  $\bar{A}r^{40} = 2.25 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 88\%$ . Collected by: James Gilluly, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.

##### Tobin Range

2. K-Ar (sanidine) 33.6±1.1 m.y.  
Rhyolite welded tuff (117°34'54"W; 118°19'12"N; Pershing Co., NV). Analytical data: (Sanidine) K<sub>2</sub>O = 11.95%,  $\bar{A}r^{40} = 5.99 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 91\%$ . Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

3. Fission track (zircon) 24.6±1.3 m.y.  
Fish Creek Mountains Tuff. Rhyolite welded tuff (117°33'12"W, 40°18'20"N; Pershing Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

## Augusta Mountains

4. Speed and Armstrong (1971) K-Ar (clinopyroxene)  $24 \pm 5$  m.y.  
No. YU Aug 1  
Andesite flow ( $117^{\circ}34'36''$ W,  $39^{\circ}56'47''$ N; Churchill Co., NV). Collected by: R. C. Speed, Northwestern Univ.; dated by: R. L. Armstrong, Yale Univ.

## Clan Alpine Mountains

5. Riehle and others (1971) K-Ar (biotite)  $29.9 \pm 1.0$  m.y.  
"Basal tuff". Rhyolite welded tuff ( $117^{\circ}45'30''$ W,  $39^{\circ}48'44''$ N; Churchill Co., NV). Collected by: R. C. Speed, Northwestern Univ.; dated by: E. H. McKee, U. S. Geological Survey.
6. Riehle and others (1971) K-Ar (biotite)  $28.4 \pm 1.0$  m.y.  
"Rhyolite of War Canyon". Rhyolite welded tuff ( $117^{\circ}49'20''$ W,  $39^{\circ}43'40''$ N; Churchill Co., NV). Collected by: R. C. Speed, Northwestern Univ.; dated by: E. H. McKee, U. S. Geological Survey.
7. Riehle and others (1971) Fission track (zircon)  $29.9 \pm 1.0$  m.y.  
"Foliated rhyolite". Rhyolite flow dome ( $117^{\circ}53'35''$ W,  $39^{\circ}40'30''$ N; Churchill Co., NV). Collected by: J. R. Riehle, State University of New York at Binghamton; dated by: E. H. McKee, U. S. Geological Survey.
8. Riehle and others (1971) K-Ar (hornblende)  $35.0 \pm 1.2$  m.y.  
"Andesite unit". Andesite flow ( $117^{\circ}47'50''$ W,  $39^{\circ}38'40''$ N; Churchill Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.
9. Riehle and others (1971) K-Ar (biotite)  $29.9 \pm 1.0$  m.y.  
"Uniform dense rhyolite". Rhyolite flow ( $117^{\circ}49'30''$ W,  $39^{\circ}37'15''$ N; Churchill Co., NV). Collected by: J. R. Riehle, State Univ. of New York at Binghamton; dated by: E. H. McKee, U. S. Geological Survey.
10. Riehle and others (1971) K-Ar (biotite)  $24.5 \pm 0.8$  m.y.  
"Crystal tuff of Cherry Valley". Rhyolite welded tuff ( $117^{\circ}54'40''$ W,  $39^{\circ}35'15''$ N; Churchill Co., NV). Collected by: J. R. Riehle, State Univ. of New York at Binghamton; dated by: E. H. McKee, U. S. Geological Survey.
11. Riehle and others (1971) K-Ar (sanidine)  $22.1 \pm 0.7$  m.y.  
"Rhyolite of War Canyon". Rhyolite lava flow ( $117^{\circ}51'40''$ W,  $39^{\circ}35'05''$ N; Churchill Co., NV). Collected by: J. R. Riehle, State Univ. of New York at Binghamton; dated by: E. H. McKee, U. S. Geological Survey.

## Desatoya Mountains

12. Willden and Speed (written communication) K-Ar (biotite) 24.4 m.y.  
Nos. 67W261 and W262 (biotite) 23.6 m.y.  
Rhyodacite flow breccia ( $117^{\circ}53'12''$ W,  $39^{\circ}16'06''$ N, Churchill Co., NV). Collected by: C. R. Willden, U. S. Geological Survey; dated by: R. W. Kistler, U. S. Geological Survey. Comment: repeat age analysis.
13. Barrows (1971) K-Ar (biotite)  $23.0 \pm 0.8$  m.y.  
No. 2 (appendix I)

Rhyolite welded tuff (117°50'00"W, 39°16'24"N; Churchill Co., NV). Dated by: Geochron Laboratories, Inc.

14. Barrows (1971) K-Ar (biotite) 25.6±1.3 m.y.  
No. 5 (appendix I) (biotite) 27.1±1.2 m.y.

Rhyolite welded tuff (117°50'55"W, 39°14'12"N; Churchill Co., NV). Dated by: Geochron Laboratories, Inc. Comment: repeat analysis.

15. Barrows (1971) K-Ar (plagioclase) 21.4±4.0 m.y.  
No. 3 (appendix I)

Andesite flow (117°49'13"W, 39°12'00"N; Churchill Co., NV). Dated by: Geochron Laboratories, Inc.

16. Barrows (1971) K-Ar (K-feldspar) 25.3±1.3 m.y.  
No. 1 (appendix I)

Latite flow (117°46'40"W, 39°14'25"N; Churchill Co., NV). Dated by: Geochron Laboratories, Inc.

17. Barrows (1971) K-Ar (K-feldspar) 19.5±0.6 m.y.  
No. 4 (appendix I)

Air fall tuff(?) (117°47'18"W, 39°29'36"N; Churchill Co., NV). Dated by: Geochron Laboratories, Inc.

#### Paradise Range

18. K-Ar (biotite) 19.3±0.6 m.y.

Rhyodacite flow (117°46'21"W, 39°03'48"N; Nye Co., NV). Analytical data: K<sub>2</sub>O = 8.19%,  $\bar{A}r^{40} = 2.35 \times 10^{-10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 48\%$ . Collected by: F. J. Kleinhampl, U. S. Geological Survey; dated by: R. W. Kistler, U. S. Geological Survey.

19. K-Ar (sanidine) 23.1±0.7 m.y.

Toyabe Quartz Latite. Rhyolite welded tuff (117°46'30"W, 39°00'08"N; Nye Co., NV). Analytical data: K<sub>2</sub>O = 5.98%,  $\bar{A}r^{40} = 2.05 \times 10^{-10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 53\%$ . Collected by: F. J. Kleinhampl, U. S. Geological Survey; dated by: R. W. Kistler, U. S. Geological Survey.

20. McKee and Stewart (1971) K-Ar (biotite) 24.1±1.0 m.y.  
No. 13

"Tuff of Desatoya Mountains". Rhyolite welded tuff (117°44'30"W, 39°22'21"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

21. McKee and Stewart (1971) K-Ar (sanidine) 25.1±1.0 m.y.  
No. 15

Rhyolite welded tuff (117°38'05"W, 39°22'50"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

22. McKee and Stewart (1971) K-Ar (sanidine) 25.2±1.0 m.y.  
No. 16

Rhyolite welded tuff (117°22'18"W, 39°38'02"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.



23. McKee and Stewart (1971) K-Ar (sanidine) 24.8±1.0 m.y.  
No. 14

Rhyolite welded tuff (117°37'42"W, 39°28'12"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

24. McKee and Stewart (1971) K-Ar (sanidine) 25.2±1.0 m.y.  
No. 17 (biotite) 26.5±1.0 m.y.

"Tuff of McCoy Mine:" Rhyolite welded tuff (117°33'44"W, 39°30'45"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

#### New Pass Range

25. McKee and Stewart (1971) K-Ar (sanidine) 22.0±0.9 m.y.  
No. 11

New Pass Tuff. Rhyolite welded tuff (117°30'46"W, 39°34'12"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

26. McKee and Stewart (1971) K-Ar (biotite) 23.6±0.9 m.y.  
No. 10

Rhyolite welded tuff (117°30'06"W, 39°34'36"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

27. McKee and Stewart (1971) K-Ar (sanidine) 23.9±1.0 m.y.  
No. 3

Bates Mountain Tuff. Rhyolite welded tuff (117°23'34"W, 39°39'34"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

28. McKee and Stewart (1971) K-Ar (biotite) 30.3±1.2 m.y.  
No. 9 (sanidine) 28.5±1.1 m.y.

Rhyolite welded tuff (117°30'07"W, 39°48'08"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

29. McKee and Stewart (1971) K-Ar (sanidine) 23.6±0.9 m.y.  
No. 1

Rhyolite welded tuff (117°32'18"W, 39°50'06"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

#### Augusta Mountains

30. McKee and Silberman (1970) K-Ar (biotite) 28.0 m.y.  
No. 27

Rhyolite welded tuff (117°27'42"W, 39°51'56"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

31. McKee and Stewart (1971) K-Ar (sanidine) 26.9±1.0 m.y.  
No. 7

Edwards Creek Tuff, 3rd cooling unit. Rhyolite welded tuff (117°27'26"W, 39°51'57"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

32. McKee and Stewart (1971) K-Ar (sanidine) 27.0±1.0 m.y.  
No. 6

Edwards Creek Tuff, 4th cooling unit. Rhyolite welded tuff (117°27'09"W, 39°51'59"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

33. McKee and Stewart (1971) K-Ar (sanidine) 23.3±0.9 m.y.  
No. 2

Bates Mountain Tuff. Rhyolite welded tuff (117°15'46"W, 40°00'10"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

#### Fish Creek Mountains

34. McKee and Silberman (1970) K-Ar (sanidine) 24.5 m.y.  
No. 13

Fish Creek Mountains Tuff. Rhyolite welded tuff (117°15'04"W, 40°11'40"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

- 35A. McKee and Silberman (1970) K-Ar (sanidine) 23.6 m.y.  
No. 14

Fish Creek Mountains Tuff. Rhyolite welded tuff (117°15'12"W, 40°11'42"N, Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey. Comment: Same locality as No. 35B (below).

- 35B. Naeser and McKee (1970) Fission track (zircon) 23.9±1.1 m.y.  
No. 5

Fish Creek Mountains Tuff. Rhyolite welded tuff (117°15'12"W, 40°11'42"N; Lander Co., NV). Collected by: C. W. Naeser; dated by: C. W. Naeser, U. S. Geological Survey. Comment: same locality as No. 35A (above).

36. McKee and Silberman (1970) K-Ar (sanidine) 24.4 m.y.  
No. 15

Fish Creek Mountains Tuff. Rhyolite welded tuff (117°24'12"W, 40°12'30"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

37. Naeser and McKee (1970) Fission track (zircon) 25.5±1.3 m.y.  
No. 4

Fish Creek Mountains Tuff. Rhyolite welded tuff (117°21'39"W, 40°17'18"N; Lander Co., NV). Collected by: C. W. Naeser; dated by: C. W. Naeser, U. S. Geological Survey.

38. Naeser and McKee (1970) Fission track (sphene) 23.1±1.7 m.y.  
No. 3

Bates Mountain(?) Tuff. Rhyolite welded tuff (117°19'31"W, 40°18'22"N; Lander Co., NV). Collected by: C. W. Naeser; dated by: C. W. Naeser, U. S. Geological Survey.

39. K-Ar (sanidine) 32.7±1.3 m.y.

Caetano Tuff. Rhyolite welded tuff (117°14'30"W, 40°23'00"N; Lander Co., NV). Analytical data: K<sub>2</sub>O = 11.71%, Ar<sup>40</sup> = 2.46 x 10<sup>-10</sup> mole/gm; Ar<sup>40</sup>/ΣAr<sup>40</sup> = 88.6%. Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

40. McKee and Silberman (1970) K-Ar (biotite) 33.4 m.y.  
No. 10 (sanidine) 31.2 m.y.

Caetano Tuff. Rhyolite welded tuff (117°12'04"W, 40°24'48"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

41. Naeser and McKee (1970) Fission track (apatite) 33.3±2.7 m.y.  
No. 2

Caetano Tuff. Rhyolite welded tuff (117°13'12"W, 40°25'10"N; Lander Co., NV). Collected by: C. W. Naeser; dated by: C. W. Naeser, U. S. Geological Survey.

#### Battle Mountain

42. McKee and Silberman (1970) K-Ar (biotite) 33.6 m.y.  
No. 9

Caetano Tuff. Rhyolite welded tuff (116°59'42"W, 40°38'33"N; Lander Co., NV). Collected by: R. J. Roberts; dated by: M. L. Silberman, U. S. Geological Survey.

#### Sheep Creek Range

43. McKee and Silberman (1970) K-Ar (whole rock) 14.8 m.y.  
No. 23

Basalt flow (116°51'42"W, 40°45'12"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

44. McKee and Silberman (1970) K-Ar (sanidine) 13.9 m.y.  
No. 8

Rhyolite flow-dome (116°49'34"W, 40°56'20"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

45. McKee and Silberman (1970) K-Ar (sanidine) 13.8 m.y.  
No. 7

Rhyolite flow-dome (116°49'30"N, 40°57'00"W; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

46. McKee and Silberman (1970) K-Ar (whole rock) 10.0 m.y.  
No. 22

Basalt flow (116°43'24"W, 40°54'40"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

#### Shoshone Range

47. McKee and Silberman (1970) K-Ar (whole rock) 16.3 m.y.  
No. 24

Basaltic andesite flow (116°36'24"W, 40°28'08"N; Lander Co., NV). Collected by: C. T. Wrucke, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

48. Naeser and McKee (1970) Fission track (zircon) 30.6±1.4 m.y.  
No. 8

Rhyolite welded tuff (116°55'28"W, 40°12'50"N; Lander Co., NV). Collected by: C. W. Naeser, U. S. Geological Survey; dated by: C. W. Naeser, U. S. Geological Survey.

49. Naeser and McKee (1970) Fission track (zircon) 31.8±2.0 m.y.  
No. 9

Rhyolite welded tuff (116°55'28"W, 40°12'50"N; Lander Co., NV). Collected by: C. W. Naeser; dated by: C. W. Naeser, U. S. Geological Survey.

50. McKee and Silberman (1970) K-Ar (biotite) 31.3 m.y.  
No. 11 (sanidine) 31.0 m.y.

Caetano Tuff. Rhyolite welded tuff (117°01'41"W, 40°06'54"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

51. McKee and Silberman (1970) K-Ar (sanidine) 24.7±1.0 m.y.  
No. 16

Bates Mountain Tuff. Rhyolite welded tuff (117°08'57"W, 39°56'20"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

52. McKee and Silberman (1970) K-Ar (biotite) 26.3±1.0 m.y.  
No. 26

"Tuff of McCoy Mine." Rhyolite welded tuff (117°19'00"W, 39°49'36"N, Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

53. McKee and Stewart (1971) K-Ar (biotite) 26.2±1.0 m.y.  
No. 12

"Tuff of McCoy Mine." Rhyolite welded tuff (117°22'40"W, 39°31'36"N; Lander Co., NV). Collected by: J. H. Stewart, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

#### Toiyabe Range

54. McKee and Silberman (1970) K-Ar (biotite) 29.4 m.y.  
No. 25

Rhyolite welded tuff (117°00'27"W, 39°26'46"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

55. McKee and Silberman (1970) K-Ar (biotite) 33.5 m.y.  
No. 12

Caetano Tuff. Rhyolite welded tuff (116°47'48"W, 39°48'30"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

56. Armstrong (1970) K-Ar (whole rock) 31.2±1.0 m.y.  
No. 128

Caetano Tuff. Rhyolite welded tuff (116°41'05"W, 40°05'10"N; Lander Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

57. Armstrong (1970) K-Ar (glass) 9.2±0.4 m.y.  
No. 129

Vitric tuff (116°47'00"W, 40°07'40"N; Lander Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

## Toiyabe Range (Red Mountains)

58. Naeser and McKee (1970) Fission track (zircon)  $38.4 \pm 1.7$  m.y.  
No. 12  
Caetano Tuff. Rhyolite welded tuff ( $116^{\circ}48'18''$ W,  $40^{\circ}09'00''$ N; Lander Co., NV). Collected by: C. W. Naeser; dated by: C. W. Naeser, U. S. Geological Survey.

## Carico Lake Valley

59. Naeser and McKee (1970) Fission track (zircon)  $35.5 \pm 3.0$  m.y.  
No. 10  
Caetano Tuff. Rhyolite welded tuff ( $116^{\circ}48'00''$ W,  $40^{\circ}11'19''$ N; Lander Co., NV). Collected by: C. W. Naeser; dated by: C. W. Naeser, U. S. Geological Survey.
60. Naeser and McKee (1970) K-Ar (biotite)  $32.0 \pm 1.1$  m.y.  
No. 11  
Caetano Tuff. Rhyolite welded tuff ( $116^{\circ}47'45''$ W,  $40^{\circ}11'21''$ N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

## Toiyabe Range

61. Armstrong (1970) K-Ar (biotite)  $30.6 \pm 0.6$  m.y.  
No. 117  
Caetano Tuff. Rhyolite welded tuff ( $116^{\circ}38'50''$ W,  $40^{\circ}09'45''$ N; Lander Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.
62. Wells and others (1971) K-Ar (biotite)  $35.0 \pm 1.0$  m.y.  
No. J-269 (sanidine)  $34.5 \pm 1.1$  m.y.  
Quartz porphyry dike ( $116^{\circ}36'49''$ W,  $40^{\circ}9'40''$ N; Lander Co., NV). Collected by: J. D. Obradovich; dated by: J. D. Obradovich, U. S. Geological Survey.
63. Wells and others (1971) K-Ar (biotite)  $34.4 \pm 1.1$  m.y.  
No. J-272 (sanidine)  $32.6 \pm 1.0$  m.y.  
Caetano Tuff. Rhyolite welded tuff ( $116^{\circ}37'24''$ W,  $40^{\circ}09'06''$ N; Lander Co., NV). Collected by: J. D. Obradovich; dated by: J. D. Obradovich, U. S. Geological Survey.

## Cortez Mountains

64. Wells and others (1971) K-Ar (biotite)  $33.9 \pm 1.1$  m.y.  
No. J-259 (sanidine)  $35.0 \pm 1.2$  m.y.  
Quartz porphyry dike ( $116^{\circ}36'48''$ W,  $40^{\circ}11'46''$ N; Eureka Co., NV). Collected by: J. D. Obradovich; dated by: J. D. Obradovich, U. S. Geological Survey.
65. Wells and others (1971) K-Ar (biotite)  $34.4 \pm 1.2$  m.y.  
No. J-250 (sanidine)  $34.3 \pm 1.1$  m.y.  
Quartz porphyry plug ( $116^{\circ}33'46''$ W,  $40^{\circ}08'24''$ N; Eureka Co., NV). Collected by: J. D. Obradovich; dated by: J. D. Obradovich, U. S. Geological Survey.

66. Armstrong (1970) K-Ar (whole rock)  $32.1 \pm 0.6$  m.y.  
No. 118  
Rhyolite porphyry ( $116^{\circ}37'20''W$ ,  $40^{\circ}11'35''N$ ; Lander Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.
67. Armstrong (1970) K-Ar (whole rock)  $14.5 \pm 0.5$  m.y.  
No. 120  
Rhyolite ( $116^{\circ}32'15''W$ ,  $40^{\circ}09'20''N$ ; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.
68. Wells and others (1971) K-Ar (sanidine)  $15.3 \pm 0.4$  m.y.  
No. W-302  
Rhyolite flow ( $116^{\circ}31'45''W$ ,  $40^{\circ}09'07''N$ ; Eureka Co., NV). Collected by: J. D. Wells, U. S. Geological Survey; dated by: J. D. Obradovich, U. S. Geological Survey.
69. Wells and others (1971) K-Ar (plagioclase)  $16.3 \pm 0.9$  m.y.  
No. W-304  
Andesitic basalt flow ( $116^{\circ}32'56''W$ ,  $40^{\circ}12'50''N$ ; Eureka Co., NV). Collected by: J. D. Wells, U. S. Geological Survey; dated by: J. D. Obradovich, U. S. Geological Survey.
70. Armstrong (1970) K-Ar (whole rock)  $14.5 \pm 1.5$  m.y.  
No. 125  
Basaltic andesite ( $116^{\circ}28'25''W$ ,  $40^{\circ}11'30''N$ ; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

Dry Hills (Cortez Range)

71. Armstrong (1970) K-Ar (biotite)  $36.3 \pm 0.7$  m.y.  
No. 208  
Quartz latite welded tuff ( $116^{\circ}26'10''W$ ,  $40^{\circ}27'20''N$ ; Eureka Co., NV). Dated by: R. L. Armstrong, Yale Univ. Comment: Biotite separate was impure.

North of Cortez Mountains—Dry Hills

72. Armstrong (1970) K-Ar (whole rocks)  $15.0 \pm 1.0$  m.y.  
No. 112  
Rhyolite ( $116^{\circ}11'50''W$ ,  $40^{\circ}36'55''N$ ; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

Pi<sup>n</sup> on Range

73. K-Ar (biotite)  $38.6 \pm 0.8$  m.y.  
Tuff in Humboldt Formation ( $115^{\circ}59'45''W$ ,  $40^{\circ}34'40''N$ ; Elko Co., NV). Analytical data:  $K_2O = 8.22\%$ ,  $\bar{A}r^{40} = 4.74 \times 10^{-10}$  mole/gm,  $\bar{A}r^{40}/\Sigma Ar^{40} = 87\%$ . Collected by: J. F. Smith, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.
74. Armstrong (1970) K-Ar (whole rocks)  $36.0 \pm 1.4$  m.y.  
No. 110



Rhyolite porphyry (116°1'25"W, 40°31'10"N; Elko Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

75. Armstrong (1970) K-Ar (biotite) 36.2±0.7 m.y.  
No. 111

Quartz latite welded tuff (115°59'25"W, 40°31'20"N; Elko Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

#### Sulphur Spring Range

76. K-Ar (sanidine) 33.2±0.7 m.y.  
(biotite) 34.9±0.7 m.y.

Tuff in Humboldt Formation (115°55'35"W, 40°26'00"N; Elko Co., NV). Analytical data: (Sanidine) K<sub>2</sub>O = 4.46%,  $\bar{A}r^{40} = 2.20 \times 10^{-10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 74\%$ . (Biotite) K<sub>2</sub>O = 6.17%,  $\bar{A}r^{40} = 3.21 \times 10^{-10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 80\%$ . Collected by: J. F. Smith, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.

#### White Flats (14 mi. S. of Elko)

77. K-Ar (biotite) 33.9±0.9 m.y.

Tuff in Humboldt Formation (115°44'53"W, 40°36'58"N; Elko Co., NV). Analytical data: K<sub>2</sub>O = 7.99%,  $\bar{A}r^{40} = 4.04 \times 10^{-10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 45\%$ . Collected by: J. F. Smith, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.

78. K-Ar (biotite) 39.2±0.8 m.y.

Tuff in Humboldt Formation (115°44'52"W, 40°36'36"N; Elko Co., NV). Analytical data: K<sub>2</sub>O = 8.00%,  $\bar{A}r^{40} = 4.70 \times 10^{-10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 88\%$ . Collected by: J. F. Smith, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.

#### Simpson Park Mountains

79. Armstrong (1970) K-Ar (whole rock) 14.7±1.0 m.y.  
No. 123

Basaltic andesite (116°24'30"W, 40°03'25"N; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

80. Armstrong (1970) K-Ar (whole rock) 30.9±0.6 m.y.  
No. 121

Glassy rhyolite plug (116°28'50"W, 40°01'25"N; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

81. Armstrong (1970) K-Ar (whole rock) 30.9±0.7 m.y.  
No. 122

Glassy rhyolite flow (116°27'45"W, 40°00'20"N; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

82. McKee and Silberman (1970) K-Ar (biotite) 34.5 m.y.  
No. 21

34.

Dacite flow (116°39'41"W, 39°34'48"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

83. McKee and Silberman (1970) K-Ar (sanidine) 24.1 m.y.  
No. 17

Bates Mountain Tuff. Rhyolite welded tuff (116°45'12"W, 39°33'42"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

84. McKee and Silberman (1970) K-Ar (biotite) 31.1 m.y.  
No. 18

Rhyolite welded tuff (116°43'30"W, 39°33'03"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

85. McKee and Silberman (1970) K-Ar (biotite) 34.0 m.y.  
No. 19

"Tuff of Dry Creek." Rhyolite welded tuff (116°43'30"W, 39°31'47"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

86. McKee and Silberman (1970) K-Ar (hornblende) 35.4 m.y.  
No. 20

Andesite-dacite flow (116°47'36"W, 39°28'04"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

#### Toquima Range

87. K-Ar (biotite) 30.6±1.1 m.y.

Rhyolite welded tuff (116°45'50"W, 39°16'15"N; Lander Co., NV). Analytical data: (Biotite) K<sub>2</sub>O = 7.68%,  $\overset{*}{\text{Ar}}^{40} = 3.50 \times 10^{-10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 70.8\%$ . Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

88. Sargent and McKee (1969) K-Ar (sanidine) 23.7±1.0 m.y.  
No. 3

Bates Mountain Tuff. Rhyolite welded tuff (116°50'00"W, 39°16'03"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

89. Sargent and McKee (1969) K-Ar (sanidine) 22.2±0.9 m.y.  
No. 1

"Tuff of Clipper Gap Canyon." Rhyolite welded tuff (116°50'54"W, 39°13'26"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

90. Sargent and McKee (1969) K-Ar (biotite) 30.6±1.2 m.y.  
No. 6

Rhyolite welded tuff (116°51'25"W, 39°13'10"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.

91. Gromme and others (1971) K-Ar (sanidine) 31.3±0.8 m.y.  
No. P-1

"Tuff of Pancake Summit." Rhyolite welded tuff (116°45'00"W, 39°11'30"N; Lander Co., NV). Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.



92. K-Ar (biotite) 30.1±1.0 m.y.  
Rhyolite welded tuff (116°50'05"W, 39°08'16"N; Nye Co., NV). Analytical data: K<sub>2</sub>O = 7.58%,  $\overset{*}{\text{Ar}}^{40} = 3.39 \times 10^{10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 54\%$ . Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.
93. K-Ar (sanidine) 31.1±1.1 m.y.  
"Tuff of Stoneberger Canyon." Rhyolite tuff (116°48'15"W, 39°07'06"N; Nye Co., NV). Analytical data: K<sub>2</sub>O = 9.96%,  $\overset{*}{\text{Ar}}^{40} = 4.61 \times 10^{10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 85\%$ . Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.
94. K-Ar (sanidine) 32.3±1.1 m.y.  
"Tuff of Northumberland Canyon." Rhyolite tuff (116°56'44"W, 39°00'07"N; Nye Co., NV). Analytical data: K<sub>2</sub>O = 10.20%,  $\overset{*}{\text{Ar}}^{40} = 4.91 \times 10^{10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 92\%$ . Collected by: E. H. McKee; dated by: E. H. McKee, U. S. Geological Survey.
- Monitor Range
95. K-Ar (biotite) 35.3±0.8 m.y.  
(sanidine) 33.0±0.8 m.y.  
Rhyolite welded tuff, crystal rich (116°28'12"W, 39°06'54"N; Nye Co., NV). Analytical data: (Biotite) K<sub>2</sub>O = 7.72%,  $\overset{*}{\text{Ar}}^{40} = 4.06 \times 10^{10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 90\%$ . (Sanidine) K<sub>2</sub>O = 12.07%,  $\overset{*}{\text{Ar}}^{40} = 5.93 \times 10^{10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 98\%$ . Collected by: K J. Kleinhampl; dated by: R. W. Kistler, (sanidine), R. F. Marvin (biotite) U. S. Geological Survey.
- Antelope Range
96. Grommé and others (1971) K-Ar (sanidine) 30.1±1.0 m.y.  
No. P-2 (biotite) 30.7±1.1 m.y.  
"Tuff of Pancake Summit." Rhyolite welded tuff (116°39'12"W, 39°15'15"N; Nye Co., NV). Collected by: C. S. Grommé, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
97. K-Ar (biotite) 35.2±1.1 m.y.  
Rhyolite welded tuff, crystal rich (116°13'58"W, 39°09'18"N; Nye Co., NV). Analytical data: K<sub>2</sub>O = 8.12%,  $\overset{*}{\text{Ar}}^{40} = 4.26 \times 10^{10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 86\%$ . Collected by: F. J. Kleinhampl, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.
- Fish Creek Range
98. K-Ar (hornblende) 35.3±1.9 m.y.  
Quartz latite welded tuff (116°00'W, 39°22'N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 1.22%,  $\overset{*}{\text{Ar}}^{40} = 0.64 \times 10^{10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 65.4\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
99. K-Ar (biotite) 34.8±1.4 m.y.  
Laminated rhyolite (115°59'24"W, 39°21'54"N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 6.94%,  $\overset{*}{\text{Ar}}^{40} = 3.60 \times 10^{10}$  mole/gm;  $\overset{*}{\text{Ar}}^{40}/\Sigma\text{Ar}^{40} = 77.6\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
100. K-Ar (biotite) 34.3±1.0 m.y.  
Quartz latite welded tuff (115°59'W, 39°22'N; Eureka Co., NV). Analytical data: (Biotite) K<sub>2</sub>O = 7.97%,

$\text{Ar}^{40} = 4.07 \times 10^{-10}$  mole/gm,  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 79.0\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

101. K-Ar (biotite) 34.7±0.7 m.y.  
Intrusive rhyolite breccia (116°57'01"W, 39°24'03"N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 8.41%,  $\text{Ar}^{40} = 4.354 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 88.6\%$ . Collected by: T. B. Nolan and M. L. Silberman; U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.
102. K-Ar (biotite) 34.6±1.9 m.y.  
Rhyolite tuff (115°55'W, 39°25'N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 8.11%,  $\text{Ar}^{40} = 3.29 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 69.0\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey. Comment: same unit as Nos. 134 and 137.
103. K-Ar (biotite) 35.3±0.7 m.y.  
Porphyritic biotite-dacite flow (115°59'18"W, 39°24'10"N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 8.57%,  $\text{Ar}^{40} = 4.51 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 85.7\%$ . Collected by: T. B. Nolan and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.
104. K-Ar (hornblende) 37.8±1.3 m.y.  
Andesite-dacite intrusive(?) rock (116°00'W, 39°25'N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 0.621%,  $\text{Ar}^{40} = 0.35 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 54.1\%$ . Collected by: T. B. Nolan, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
105. K-Ar (sanidine) 34.6±0.7 m.y.  
Rhyolite intrusive rock (115°57'33"W, 39°25'13"N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 11.39%,  $\text{Ar}^{40} = 5.87 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 97.1\%$ . Collected by: T. B. Nolan and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.
106. K-Ar (biotite) 33.0±1.0 m.y.  
(sanidine) 34.7±0.7 m.y.  
Columnar jointed rhyolite flow (115°57'06"W, 39°25'12"N; Eureka Co., NV). Analytical data: (Biotite) K<sub>2</sub>O = 7.83%,  $\text{Ar}^{40} = 3.85 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 33.9\%$ . (Sanidine) K<sub>2</sub>O = 11.92%,  $\text{Ar}^{40} = 6.16 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 92.3\%$ . Collected by: T. B. Nolan and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.
107. K-Ar (biotite) 35.5±0.7 m.y.  
(sanidine) 35.0±0.7 m.y.  
Rhyolite intrusive (115°55'26"N, 39°25'00"W; Eureka Co., NV). Analytical data: (Biotite) K<sub>2</sub>O = 7.69%,  $\text{Ar}^{40} = 4.07 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 87.5\%$ . (Sanidine) K<sub>2</sub>O = 12.33%,  $\text{Ar}^{40} = 6.43 \times 10^{-10}$  mole/gm;  $\text{Ar}^{40}/\Sigma\text{Ar}^{40} = 97.9\%$ . Collected by: T. B. Nolan and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.
108. Armstrong (1970) K-Ar (biotite) 35.8±0.7 m.y.  
No. 104  
Andesite welded tuff (115°58'40"W, 39°26'45"N; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ., New Haven Conn.
109. K-Ar (biotite) 38.0±0.8 m.y.

Dacite tuff (115°59'W, 39°27'N; Eureka Co., NV). Analytical data:  $K_2O = 7.58\%$ ,  $\bar{Ar}^{40} = 4.30 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 91\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.

110A. K-Ar (biotite) 35.0±0.8 m.y.

Dacite (115°57'W, 39°27'N; Eureka Co., NV). Analytical data:  $K_2O = 8.44\%$ ,  $\bar{Ar}^{40} = 4.41 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 95\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.

110B. K-Ar (biotite) 35.0±0.8 m.y.

Rhyolite welded tuff (115°57'W, 39°27'N; Eureka Co., NV). Analytical data:  $K_2O = 7.70\%$ ,  $\bar{Ar}^{40} = 4.02 \times 10^{-10}$  mole/gm,  $\bar{Ar}^{40}/\Sigma Ar^{40} = 83\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey. Comment: Same locality as No. 110A (above).

111. K-Ar (biotite) 36.2±0.7 m.y.

Porphyritic dacite (115°57'30"W, 39°25'53"N; Eureka Co., NV). Analytical data:  $K_2O = 8.78\%$ ,  $\bar{Ar}^{40} = 4.74 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 88.9\%$ . Collected by: T. B. Nolan and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.

112. K-Ar (biotite) 36.8±1.3 m.y.

Andesite-dacite flow (115°58'W, 39°28'N; Eureka Co., NV). Analytical data:  $K_2O = 8.38\%$ ,  $\bar{Ar}^{40} = 4.59 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 73.9\%$ . Collected by: T. B. Nolan, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

113. K-Ar (hornblende) 35.6±1.3 m.y.

Andesite-dacite flow (115°56'30"W, 39°30'N; Eureka Co., NV). Analytical data:  $K_2O = 1.15\%$ ,  $\bar{Ar}^{40} = 0.61 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 57.1\%$ . Collected by: T. B. Nolan, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

#### Diamond Mountains

114. K-Ar (whole rock) 33.8±1.0 m.y.

Fine-grained basalt (115°52'18"W, 39°29'24"N; Eureka Co., NV). Analytical data:  $K_2O = 3.85\%$ ,  $\bar{Ar}^{40} = 1.94 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 94.0\%$ . Collected by: T. B. Nolan, M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.

115. K-Ar (biotite) 33.9±0.7 m.y.

Rhyolitic air fall tuff (115°52'16"W, 39°31'13"N; Eureka Co., NV). Analytical data:  $K_2O = 7.77\%$ ,  $\bar{Ar}^{40} = 3.92 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 74.1\%$ . Collected by: T. B. Nolan and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: Same unit as Nos. 137 and 105.

#### Fish Creek Range

116. K-Ar (biotite) 36.4±1.3 m.y.

Andesite-dacite intrusive rock (115°58'W, 39°28'N; Eureka Co., NV). Analytical data:  $K_2O = 7.94\%$ ,  $\bar{Ar}^{40} = 4.31 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 85.1\%$ . Collected by: T. B. Nolan, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

117. K-Ar (biotite)  $34.5 \pm 1.4$  m.y.  
 Rhyolite ( $115^{\circ}58'W$ ,  $39^{\circ}30'N$ ; Target Hill; Eureka Co., NV). Analytical data:  $K_2O = 7.49\%$ ,  $^{40}Ar^* = 3.85 \times 10^{-10}$  mole/gm;  $^{40}Ar^*/\Sigma Ar^{40} = 74.7\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
118. Armstrong (1970) K-Ar (biotite)  $35.6 \pm 0.7$  m.y.  
 No. 105  
 Rhyolite plug ( $115^{\circ}58'25''W$ ,  $39^{\circ}30'00''N$ ; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.
119. K-Ar (sanidine)  $33.7 \pm 0.7$  m.y.  
 Rhyolitic air fall tuff ( $115^{\circ}57'46''W$ ,  $39^{\circ}30'52''N$ ; Eureka Co., NV). Analytical data:  $K_2O = 12.52\%$ ,  $^{40}Ar^* = 6.29 \times 10^{-10}$  mole/gm;  $^{40}Ar^*/\Sigma Ar^{40} = 96.2\%$ . Collected by: T. B. Nolan and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.

## Diamond Mountains

120. K-Ar (whole rock)  $33.2 \pm 1.0$  m.y.  
 Fine-grained basalt ( $39^{\circ}30'54''W$ ,  $115^{\circ}47'30''N$ ; Eureka Co., NV). Analytical data:  $K_2O = 2.21\%$ ,  $^{40}Ar^* = 1.09 \times 10^{-10}$  mole/gm;  $^{40}Ar^*/\Sigma Ar^{40} = 58.6\%$ . Collected by: M. L. Silberman; dated by: M. L. Silberman, U. S. Geological Survey.
121. Armstrong (1970) K-Ar (whole rock)  $34.8 \pm 0.7$  m.y.  
 No. 106  
 Trachytic basalt ( $115^{\circ}57'20''W$ ,  $39^{\circ}30'55''N$ ; Eureka Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

## Pancake Range

122. K-Ar (sanidine)  $23.1 \pm 0.9$  m.y.  
 Bates Mountain Tuff. Rhyolite welded tuff ( $115^{\circ}22'24''W$ ,  $39^{\circ}45'N$ ; White Pine Co., NV). Analytical data:  $K_2O = 10.84\%$ ,  $^{40}Ar^* = 3.71 \times 10^{-10}$  mole/gm;  $^{40}Ar^*/\Sigma Ar^{40} = 82.4\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
123. K-Ar (sanidine)  $22.1 \pm 0.9$  m.y.  
 "Tuff of Clipper Gap Canyon." Rhyolite welded tuff ( $115^{\circ}22'24''W$ ,  $39^{\circ}45'N$ ; White Pine Co., NV). Analytical data:  $K_2O = 8.02\%$ ,  $^{40}Ar^* = 2.63 \times 10^{-10}$  mole/gm;  $^{40}Ar^*/\Sigma Ar^{40} = 82.0\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
124. Grommé and others (1971) K-Ar (biotite)  $32.9 \pm 1.2$  m.y.  
 No. P-4  
 "Tuff of Pancake Summit." Rhyolite welded tuff ( $115^{\circ}22'20''W$ ,  $39^{\circ}45'00''N$ ; White Pine Co., NV). Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
125. K-Ar (hornblende)  $34.7 \pm 1.3$  m.y.  
 Tuff ( $115^{\circ}52'30''W$ ,  $39^{\circ}20'00''N$ ; Black Point; White Pine Co., NV). Analytical data:  $K_2O = 1.26\%$ ,  $^{40}Ar^* = 0.65 \times 10^{-10}$  mole/gm;  $^{40}Ar^*/\Sigma Ar^{40} = 52.0\%$ . Collected by: T. B. Nolan, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

126. K-Ar (plagioclase) 34.7±1.9 m.y.  
Dacite-andesite flow (115°52'18"W, 39°19'38"N; White Pine Co., NV). Analytical data: K<sub>2</sub>O = 0.42%,  $\bar{A}r^{40} = 0.22 \times 10^{-10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 10.0\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
127. K-Ar (biotite) 34.3±0.7 m.y.  
Porphyritic hornblende-biotite dacite flow (115°46'32"W, 39°17'10"N; White Pine Co., NV). Analytical data: K<sub>2</sub>O = 8.55%,  $\bar{A}r^{40} = 4.38 \times 10^{-10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 92.7\%$ . Collected by: T. B. Nolan and M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.
128. Grommé and others (1971) K-Ar (biotite) 32.6±0.7 m.y.  
No. P-4  
"Tuff of Pancake Summit." Rhyolite welded tuff (115°49'00"W, 39°15'00"N; White Pine Co., NV). Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.
129. Grommé and others (1971) K-Ar (sanidine) 33.2±1.2 m.y.  
No. S-2 (biotite) 34.8±1.3 m.y.  
Stone Cabin Formation of Cook (1960). Rhyolite welded tuff (115°51'36"W, 39°01'48"N; Nye Co., NV). Collected by: C. S. Grommé, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
130. Grommé and others (1971) K-Ar (sanidine) 31.5±1.2 m.y.  
No. P-3 (biotite) 33.9±1.2 m.y.  
"Tuff of Pancake Summit." Rhyolite welded tuff (115°50'24"W, 39°01'48"N; Nye Co., NV). Collected by: C. S. Grommé, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
131. Grommé and others (1971) K-Ar (sanidine) 29.8±1.0 m.y.  
No. W-4 (biotite) 31.6±1.1 m.y.  
Window Butte Tuff of Cook (1960). Rhyolite welded tuff (115°49'48"W, 39°01'12"N; Nye Co., NV). Collected by: C. S. Grommé, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
132. Grommé and others (1971) K-Ar (sanidine) 30.3±1.0 m.y.  
No. W-3 (biotite) 31.7±1.0 m.y.  
Window Butte Tuff of Cook (1960). Rhyolite welded tuff (115°50'24"W, 39°01'48"N; Nye Co., NV). Collected by: C. S. Grommé, U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.
- White Pine Range
133. Armstrong (1970) K-Ar (biotite) 33.9±0.7 m.y.  
No. 54  
"Tuff of Pancake Summit." Rhyolite welded tuff (115°23'15"W, 39°15'15"N; White Pine Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.
134. Armstrong (1970) K-Ar (biotite) 23.0±1.0 m.y.  
No. 56  
Tuffaceous sedimentary rock (115°30'50"W, 39°23'55"N; White Pine Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

## Egan Range

135. Armstrong (1970) K-Ar (whole rock) 32.9±0.7 m.y.  
No. 201

Andesite porphyry (115°09'10"W, 39°25'40"N; White Pine Co., NV). Collected by: R. L. Armstrong; dated by: R. L. Armstrong, Yale Univ.

136. K-Ar (biotite) 35.1±1.4 m.y.

Lava flow, vitrophyre (115°03'W, 39°26'N; White Pine Co., NV). Analytical data: K<sub>2</sub>O = 8.65%,  $\bar{Ar}^{40} = 4.52 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 72.2\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

## Butte Mountains

137. K-Ar (biotite) 35.5±1.4 m.y.

Rhyolite flow, vitrophyre (115°09'W, 40°00'N; White Pine Co., NV). Analytical data: K<sub>2</sub>O = 8.34%,  $\bar{Ar}^{40} = 4.42 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 79.5\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

## Cherry Creek Range

138. K-Ar (biotite) 34.6±1.9 m.y.

Rhyolite flow, vitrophyre (114°58'W, 40°00'33"N; White Pine Co., NV). Analytical data: K<sub>2</sub>O = 8.38%;  $\bar{Ar}^{40} = 4.32 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 62.4\%$ . Collected by: M. C. Blake, Jr., U. S. Geological Survey; dated by: E. H. McKee, U. S. Geological Survey.

## Northern Shoshone Range

139. K-Ar (biotite) 34.7±1.4 m.y.

Quartz latite welded tuff (116°51'42"W, 40°24'14"N; Lander Co., NV). Analytical data: K<sub>2</sub>O = 8.69%,  $\bar{Ar}^{40} = 4.50 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 21.0\%$ . Collected by: C. T. Wrucke, M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.

140. K-Ar (biotite) 33.2±0.7 m.y.

Latite tuff breccia (116°51'43"W, 40°24'09"N; Lander Co., NV). Analytical data: K<sub>2</sub>O = 5.79%,  $\bar{Ar}^{40} = 2.86 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 65.2\%$ . Collected by: C. T. Wrucke, M. L. Silberman, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.

141. K-Ar (biotite)† 34.4±0.7 m.y.

Dacite plug (116°50'49"W, 40°23'57"N; Lander Co., NV). Analytical data: K<sub>2</sub>O = 8.50%,  $\bar{Ar}^{40} = 4.38 \times 10^{-10}$  and  $4.35 \times 10^{-10}$  mole/gm;  $\bar{Ar}^{40}/\Sigma Ar^{40} = 31.8$  and  $81.3\%$ . Collected by: C. T. Wrucke, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: † Average of two analyses.

142. McKee and Silberman (1970) K-Ar (biotite) 34.4; 35.3 m.y.  
No. 1 (sanidine) 34.7 m.y.

Rhyolite porphyry dike (116°41'08"W, 40°18'12"N; Lander Co., NV). Collected by: C. T. Wrucke, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey. Comment: repeat Ar analysis on same biotite.



## N. Toiyabe Range

143. Gilluly and Masursky (1965, p. 78) K-Ar (biotite) 31.5 m.y.  
Caetano Tuff. Rhyolite welded tuff (116°42'W, 40°06'N; Lander Co., NV). Analytical data: K<sub>2</sub>O = 9.56%.  $\bar{A}r^{40} = 4.48 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 58.6\%$ . Collected by: Harold Masursky, U. S. Geological Survey; dated by: G. H. Curtis, Univ. of California at Berkeley.

## Simpson Park Mountains

144. Gilluly and Masursky (1965, p. 81) K-Ar (biotite) 36.8 m.y.  
"Volcanic rocks of Fye Canyon." Rhyolite flow (116°01'W, 40°02'N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 8.00%,  $\bar{A}r^{40} = 4.39 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 69.2\%$ . Collected by: Harold Masursky, U. S. Geological Survey; dated by: G. H. Curtis, Univ. of California at Berkeley.
145. K-Ar (sanidine) 27.7±0.6 m.y.  
(biotite) 24.2±0.5 m.y.  
Quartz latite flow (116°10'53"W, 40°30'15"N; Eureka Co., NV). Analytical data: (Sanidine) K<sub>2</sub>O = 9.91%,  $\bar{A}r^{40} = 3.57 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 95\%$ . (Biotite) K<sub>2</sub>O = 7.34%,  $\bar{A}r^{40} = 3.02 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 77\%$ . Collected by: K. B. Ketner, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.

## Tuscarora Mountains

146. K-Ar (biotite) 36.6±0.7 m.y.  
Rhyolite dike (116°19'04"W, 40°49'14"N; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 8.77%,  $\bar{A}r^{40} = 4.78 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 89.7\%$ . Collected by: J. G. Evans, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.
147. K-Ar (sanidine) 14.2±0.3 m.y.  
Rhyolite flow (116°21'00"N, 40°54'06"W; Eureka Co., NV). Analytical data: K<sub>2</sub>O = 7.70%,  $\bar{A}r^{40} = 1.62 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 88.3\%$ . Collected by: J. G. Evans, U. S. Geological Survey; dated by: M. L. Silberman, U. S. Geological Survey.

## Independence Mountains

148. K-Ar (sanidine) 37.1±0.7 m.y.  
(biotite) 37.1±0.7 m.y.  
Andesite porphyry (116°05'20"W, 40°57'28"N, Elko Co., NV). Analytical data: (Sanidine) K<sub>2</sub>O = 11.26%,  $\bar{A}r^{40} = 6.23 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 92\%$ . (Biotite) K<sub>2</sub>O = 8.70%,  $\bar{A}r^{40} = 4.81 \times 10^{10}$  mole/gm,  $\bar{A}r^{40}/\Sigma Ar^{40} = 84\%$ . Collected by: K. B. Ketner, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.
149. K-Ar (biotite) 41.4±0.8 m.y.  
Andesite porphyry (116°02'00"W, 40°59'10"N; Elko Co., NV). Analytical data: K<sub>2</sub>O = 7.26%,  $\bar{A}r^{40} = 4.49 \times 10^{10}$  mole/gm;  $\bar{A}r^{40}/\Sigma Ar^{40} = 82\%$ . Collected by: K. B. Ketner, U. S. Geological Survey; dated by: R. F. Marvin, U. S. Geological Survey.

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