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# *Tabulation of radiometric ages--Including unpublished K-Ar and fission-track ages for rocks in southeastern Arizona and southwestern New Mexico*

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*This is one of many related papers that were included in the 1978 NMGS Fall Field Conference Guidebook.*

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# TABULATION OF RADIOMETRIC AGES-INCLUDING UNPUBLISHED K-AR AND FISSION-TRACK AGES-FOR ROCKS IN SOUTHEASTERN ARIZONA AND SOUTHWESTERN NEW MEXICO

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This tabulation was prepared as an aid to understanding the regional geology of southeastern Arizona and southwestern New Mexico. Figure 1 shows the location of dated samples; Table 1 gives the radiometric age, published reference, latitude, longitude and other information. Tables 2 and 3 contain unpublished analytical data for K-Ar and fission-track ages, respectively. Almost all of the tabulated ages have been calculated or recalculated with decay constants recommended by I UGS Subcommission on Geochronology in 1976; recalculated ages are slightly greater than their published counterparts. A number of new radiometric ages appear in accompanying articles of this guidebook, but they are not included in this tabulation.

In recent years, the Denver geochronology labs of the U.S. Geological Survey have determined 36 radiometric ages in connection with new geologic investigations and the extension of older studies. These new ages aid in better correlation of volcanic rocks and some plutonic rocks whose localities are noted on the eastern part of Figure 1. Additional age information is now available to help explain the complex magmatic and tectonic history of the gneissic core complex of the Rincon Mountains, shown in the western part of Figure 1.

Samples from localities A, 1, 4, 5, 12 and 13 are from igneous units of the Hidalgo Volcanics, a formation that contains many extrusive units. Fission-track ages of zircons (other minerals are prophylitized) indicate that andesites and dacites of the Hidalgo Volcanics are of various ages (Late Cretaceous, Paleocene, Eocene or Oligocene). Some of these rocks may be spatially and/or genetically related to intrusive bodies (Thorman, 1977; Drewes, in press; Thorman and Drewes, this guidebook). Radiometric ages for samples 3, 4 and 2, in the northern part of the Pyramid Mountains near Lordsburg, indicate the age of emplacement of the Lordsburg stock and the age of mineralization in the Lordsburg mining district. The stock formed about 59 m.y. ago; the basaltic andesite flow (locality 4) may be a late extrusive phase of the intrusive. Mineralization in the quartz veins probably occurred about 56.5 m.y. ago as a late phase of the intrusive and extrusive activity (Thorman and Drewes, this guidebook). The felsic dikes are about 52 m.y. old. The dikes and quartz veins are part of the same fracture system but do not intersect.

Both intrusive and extrusive igneous activity during the Oligocene is verified by ages for samples at locations, B, C, 7, 9, 13, 21, 22 and 33. These apparent ages are in agreement

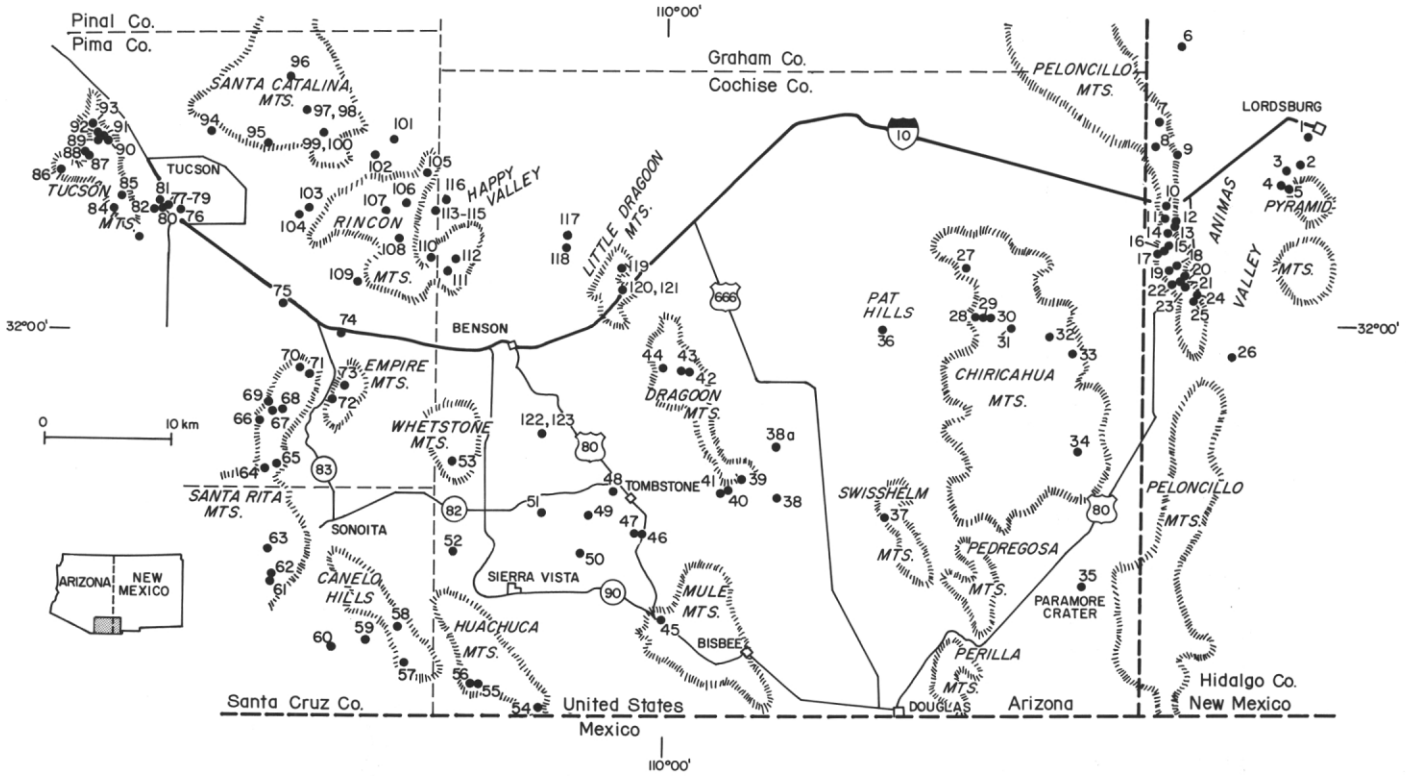



*Figure 1. Localities of dated samples tabulated in Table 1 for southeastern Arizona and southwestern New Mexico.*

*Table 1. Radiometric ages of igneous and metamorphic rocks in southeastern Arizona and southwestern New Mexico.*

| Sample locality | Location | Rock type, material(s) dated sample No. | Age in m.y.[1] (age method) | Reference, comments |
|---|---|---|---|---|
| | | **NEW MEXICO** | | |
| A | 31°59'26"N 108°29'48"W | Andesite of Hidalgo Volcanics (Lasky, 1947), zircon, 76T3 | 69.6±3.2 (F-T) | Unpublished; analytical data listed in Table 3; locality east of the map area of Figure 1. |
| B | 32°00'42"N 108°29'50"W | Quartz, latite welded tuff, volcanics of Pothook, zircon, 76T13 | 36.2±3.6 (F-T) | Thorman, 1977; analytical data listed in Table 3; locality is east of map area of Figure 1. |
| C | 32°00'40"N 108°29'43"W | Welded tuff, volcanics of Pothook, zircon, 76T13 | 33.9±3.1 (F-T) | Thorman, 1977; sample collected about 200 m higher in the stratigraphic section than preceding sample. |
| | | **PYRAMID MOUNTAINS AND VICINITY** | | |
| Map No. | | | | |
| 1 | 32°19'41"N 108°43'36"W | Basaltic andesite of Hidalgo Volcanics, zircon, 76D152 | 54.9±2.7 (F-T) | Unpublished; analytical data listed in Table 3. |
| 2 | 32°16'47"N 108°44'56"W | Felsic dike, zircon, 76D59 | 52.7±2.7 (F-T) | Ditto |
| 3 | 32°16'30"N 108°46'20"W | Granodiorite from Lordsburg stock, biotite, 77D197 | 58.8±2.0 (K-Ar) | Unpublished; analytical data listed in Table 2. |
| 4 | 32°14'57"N 108°46'05"W | Basaltic andesite flow of Hidalgo Volcanics, zircon, 76D145 | 57.9±2.7 (F-T) | Unpublished; analytical data listed in Table 3. |
| 5 | 32°15'02"N 108°46'48"W | Andesite of Hidalgo(?) Volcanics, zircon, 76D54 | 67.3±7.1 (F-T) | Ditto |
| | | **NORTHERN PELONCILLO MOUNTAINS AND VICINITY** | | |
| 6 | 32°29'10"N 108°58'40"W | Andesite flow, whole-rock, 75D325 | 18.6±0.6 (K-Ar) | Unpublished; analytical data listed in Table 2; Summit Hills locality. |
| 7 | 32°21'N 109°01'15"W | Rhyodacite of Doubtful Canyon; biotite, zircon; 76D122 | 33.0±1.1(B) (K-Ar) 28.7±1.4(Z) (F-T) | Unpublished; analytical data listed in Tables 2 and 3. The discordance of these two ages is not understood. |
| 8 | 32°18'50"N 109°01'45"W | Olivine basalt plug, whole-rock, 75D301 | 6.1±0.2 (K-Ar) | Unpublished; analytical data listed in Table 2. |
| 9 | 32°18'27"N 108°58'33"W | Vitrophyre, rhyodacite of Braidfoot Ranch; zircon, 75D308 | 31.4±1.4 (F-T) | Unpublished; analytical data listed in Table 3. |
| 10 | 32°13'15"N 109°00'15"W | Quartz latite porphyry; biotite, K-feldspar; 73NP-23 | 27.0±0.8(B) 26.1±0.8(F) (K-Ar) | Hoggatt and others, 1977. |
| 11 | 32°11'49"N 109°00'13"W | Altered granite porphyry, muscovite, 73NV-4 | 31.4±0.9 (K-Ar) | Ditto |
| 12 | 32°11'33"N 108°58'45"W | Andesite of Hidalgo Volcanics, zircon, 75D235(B) | 44.7±2.7 (F-T) | Unpublished; analytical data listed in Table 3. |
| 13 | 32°10'44"N 108°59'17"W | Quartz latite porphyry, older andesite of Hidalgo Volcanics; apatite, zircon; 75D218 | 27.5±4.8(A) 32.7±1.5(Z) (F-T) | Unpublished; analytical data listed in Table 3. |
| 14 | 32°09'46"N 108°59'34"W | Altered granite porphyry, muscovite-chlorite, 73NP-7 | 31.7±1.0 (K-Ar) | Hoggatt and others, 1977. |
| 15 | 32°08'25"N 108°59'45"W | Quartz latite porphyry; biotite, plagioclase; S-193 | 27.7±0.8(B) 25.8±0.8(Pl) (K-Ar) | Hoggatt and others, 1977; biotite age preferred. |
| 16 | 32°07'29"N 109°00'31"W | Granite porphyry, biotite, S-254 | 32.2±1.0 (K-Ar) | Hoggatt and others, 1977. |
| 17 | 32°07'49"N 109°00'16"W | Granite porphyry, orthoclase, 73NP-5 | 31.0±0.9 (K-Ar) | Hoggatt and others, 1977; published argon values of $5.0407 \times 10^{-10}$ mol/gm should read $5.407 \times 10^{-10}$ mol/gm. |

*Table 1. (Cont'd)*

| Map No. | Location | Rock type, material(s) dated, sample No. | Age in m.y.[1] (age method) | Reference, comments |
|---|---|---|---|---|
| 18 | 32°06'24"N 108°58'59"W | Granite of Granite Gap, biotite, 73NP-2 | 32.5±1.0 (K-Ar) | Hoggatt and others, 1977. |
| 19 | 32°06'23"N 108°59'28"W | Aplite of Granite Gap, biotite, 73NP-12 | 30.3±0.9 (K-Ar) | Hoggatt and others, 1977. |
| 20 | 32°05'33"N 108°57'59"W | Granite of Granite Gap; biotite, plagioclase, K-feldspar; S-136 | 31.8±1.0(B) 32.1±1.0(Pl) 29.8±0.9(F) (K-Ar) | Hoggatt and others, 1977; biotite and plagioclase ages preferred. |
| 21 | 32°05'35"N 108°58'00"W | Quartz monzonite, biotite, 77T60 | 33.0±1.1 (K-Ar) | Unpublished; analytical data listed in Table 2; Granite Gap locality. |
| 22 | 32°05'10"N 108°58'50"W | Quartz monzonite, biotite, 77T61 | 32.9±1.1 (K-Ar) | Ditto |
| 23 | 32°05'01"W 108°58'04"W | Pegmatite(Precambrian); microcline, muscovite; 73NP-19 | 55.3±1.7(F) 69.9±2.1(M) (K-Ar) | Hoggatt and others, 1977; hybrid ages. |
| 24 | 32°03'24"N 108°56'45"W | Granite porphyry (Precambrian); muscovite, K-feldspar; 73NP-18 | 34.4±1.0(M) 57.8±1.7(F) (K-Ar) | Ditto |
| 25 | 32°02'53"N 108°57'00"W | Quartz latite porphyry, biotite, S-37A | 27.4±0.8 (K-Ar) | Hoggatt and others, 1977. |
| | | **ANIMAS VALLEY** | | |
| 26 | 31°57'N 108°52'W | Basalt of Animas, whole-rock, 77D98 | 0.14±0.02 (K-Ar) | Unpublished; analytical data listed in Table 2. |
| | | **ARIZONA** | | |
| | | **CHIRICAHUA MOUNTAINS** | | |
| 27 | 32°06'N 109°24'W | Granodiorite, biotite, No. 99 | 31.5±1.1 (K-Ar) | Marvin and others, 1973, p. 22. |
| 28 | 32°02'N(?) 109°20'W(?) | Welded rhyolite tuff, unit 8, Rhyolite Canyon Fm.; sanidine, DM-3-67 | 25.4±0.7 (K-Ar) | Marjaniemi, 1968 |
| 29 | 32°02'N(?) 109°20'W(?) | Welded rhyolite tuff, unit 2, Rhyolite Canyon Fm.; sanidine, DM-2-67 | 25.6±0.8 (K-Ar) | Ditto |
| 30 | 32°02'N(?) 109°20'W(?) | Rhyodacite flow, unit 7, Faraway Ranch Fm. of Enlows (1951); biotite, DM-1-67 | 28.6±2.0 28.3±0.8 (K-Ar) | Ditto |
| 31 | 32°00'24"N 109°18'42"W | Welded rhyolite tuff, unit 6, Rhyolite Canyon Fm.; sanidine, PED-12-62 | 16.6±1.6 (–20+35 mesh) 24.7±0.7 (–65+100 mesh) (K-Ar) | Marjaniemi, 1968; Damon and Bikerman, 1964. The younger age is spurious. |
| 32 | 31°59'N 109°14'W | Quartz monzonite of Jhus Canyon, biotite, No. 100 | 31.7±1.2 (K-Ar) | Marvin and others, 1973, p. 22. |
| 33 | 31°57'44"N 109°11'13"W | Dacite porphyry, zircon, 76D178 | 28.6±1.2 (F-T) | Unpublished; analytical data listed in Table 3. |
| 34 | 31°47'04"N 109°10'21"W | Rhyolite tuff, sanidine, DM-1-68 | 25.1±1.2 (K-Ar) | Ditto |
| | | **PARAMORE CRATER** | | |
| 35 | 31°33'35"N 109°10'20"W | Basalt, whole-rock, 72D6 | 1.0±0.1 (K-Ar) | Marvin and Cole, 1978 |
| | | **PAT HILLS** | | |
| 36 | 32°00'N 109°34'W | Andesite, biotite (minor epidote), 74D161 | 34.5±1.5 (K-Ar) | Ditto |
| | | **SWISSHELM MOUNTAINS** | | |
| 37 | 31°41'N 109°34'W | Granodiorite, biotite, 74D151 | 34.0±0.8 (K-Ar) | Ditto |

*Table 1. (Cont'd)*

| Map No. | Location | Rock type, material(s) dated, sample No. | Age in m.y.[1] (age method) | Reference, comments |
|---|---|---|---|---|
| | | **DRAGOON MOUNTAINS AND VICINITY** | | |
| 38 | 31°43'N 109°47'W | Welded tuff, Sugarloaf Quartz Latite; biotite, No. 93 | 74.5±2.9 (K-Ar) | Marvin and others, 1973, p. 21. |
| 38a | 31°48'N 109°47'W | Andesite member of Sugarloaf Quartz Latite; hornblende, No. 91 | 33.9±2.6 (K-Ar) | Ditto |
| 39 | 31°45'N 109°51'W | Gleeson Quartz Monzonite, biotite, 74D161 | 185±4 (K-Ar) | Marvin and Cole, 1978. |
| 40 | 31°44'N 109°52'30"W | Gleeson Quartz Monzonite, muscovite, No. 94 | 183±5 (K-Ar) | Marvin and others, 1973, p. 21; published $K_2O$ value of 11.94% should read 9.91%. |
| 41 | 31°44'N 109°53'W | Quartz latite tuff, S O Volcanics; biotite, No. 91 | 48±2 (K-Ar) | Marvin and others, 1973, p. 21; published $K_2O$ value of 9.77% should be 8.11%. |
| 42 | 31°56'N 109°59'30"W | Quartz, monzonite, Stronghold Granite, biotite; No. 89 | 24.1±2.0 (K-Ar) | Marvin and others, 1973, p. 21. The published age is in error. |
| 43 | 31°55'24"N 109°58'00"W | Quartz monzonite, Stronghold Granite; biotite, CMB-1-62 | 22±3 (K-Ar) | Damon and Bikerman, 1964. |
| 44 | 31°56'N 110°00'W | Quartz monzonite, Stronghold Granite; biotite, No. 90 | 27±2 (K-Ar) | Marvin and others, 1973, p. 21. |
| | | **MULE MOUNTAINS** | | |
| 45 | 31°30'10"N 110°00'09"W | Juniper Flat Granite, biotite, No. 98 | 171±7 (K-Ar) 182±7 184±8 (Rb-Sr) | Marvin and others, 1973, p. 22; Creasey and Kistler, 1962, p. D1, No. 1. |
| | | **TOMBSTONE AREA AND TO THE WEST** | | |
| 46 | 31°39'12"N 110°02'42"W | Rhyolite, biotite, No. 95 | 66±3 (K-Ar) | Marvin and others, 1973, p. 22; Creasey and Kistler, 1962, p. D1, No. 2. |
| 47 | 31°39'N 110°03'W | Rhyolite porphyry; sanidine, biotite; 74D143 | 65.1±1.6(s) 66.6±1.6(B) (K-Ar) | Marvin and Cole, 1978. |
| 48 | 31°43'48"N 110°06'09"W | Schieffelin Graniodiorite; biotite, No. 97 | 76±3 (K-Ar) | Marvin and others, 1973, p. 22; Creasey and Kistler, 1962, p. D1, No. 3. |
| 49 | 31°41'N 110°09'W | Granodiorite; biotite, 74D84 | 149±3 (K-Ar) | Marvin and Cole, 1978 |
| 50 | 31°37'N 110°10'W | Granodiorite; biotite, 74D91 | 76.3±1.8 (K-Ar) | Ditto |
| 51 | 31°41'15"N 110°14'45"W | Rhyodacite, Uncle Sam Porphyry; biotite, No. 96 (68D582) | 73.5±2.8 (K-Ar) | Marvin and others, 1973, p. 22. |
| 52 | 31°37'N 110°25'W | Rhyolite tuff, Pantano(?) Fm.; biotite, No. 71 | 39.8±1.5 (K-Ar) | Marvin and others, 1973, p. 19. |
| | | **WHETSTONE MOUNTAINS** | | |
| 53 | 31°46'18"N 110°25'21"W | Granodiorite; biotite, hornblende; No. 79 (A25) | 76±4(B) 76±4(H) (K-Ar) | Marvin and others, 1973, p. 20. |
| | | **HUACHUCA MOUNTAINS** | | |
| 54 | 31°21'15"N 110°15'15"W | Huachuca Quartz Monzonite; biotite, No. 63 | 167±6 (K-Ar) | Marvin and others, 1973, p. 18. |
| 55 | 31°23'20"N 110°23'W | Welded tuff, Canelo Hills Volcanics; biotite, whole-rock; No. 65 (HH443) | 147±6(B) (K-Ar) 149±11(WR) (Rb-Sr) | Ditto |
| 56 | 31°24'N 110°23'W | Welded tuff, Canelo Hills Volcanics; biotite, No. 69(HH450) | 169±6 (K-Ar) | Marvin and others, 1973, p. 19. |

*Table 1. (Cont'd)*

| Map No. | Location | Rock type, material(s) dated, sample No. | Age in m.y.[1] (age method) | Reference, comments |
|---|---|---|---|---|
| | | **CANELO HILLS AND VICINITY** | | |
| 57 | 31°24'45"N 110°30'45"W | Latitic tuff, volcanics of Dove Canyon; biotite, No. 68(62P35) | 73±4 (K-Ar) | Ditto |
| 58 | 31°29'30"N 110°32'W | Rhyolitic tuff, Canelo Hills Volcanics; biotite, No. 70(62P4) | 177±8 (K-Ar) | Ditto |
| 59 | 31°28'45"N 110°36'W | Latitic welded tuff, trachyandesite of Meadow Valley; biotite, No. 67 (61C-S-40) | 73.9±3.0 (K-Ar) | Ditto |
| 60 | 31°27'40"N 110°40'W | Rhyolite tuff; biotite, hornblende; No. 51(62D250) | 24±2(B) 29±3(H) (K-Ar) | Marvin and others, 1973, p. 17. |
| | | **SANTA RITA MOUNTAINS** | | |
| 61 | 31°35'05"N 110°46'55"W | Dacite porphyry, Gringo Gulch Volcanics; hornblende, No. 27(64D660) | 61.3±4.3 (K-Ar) | Marvin and others, 1973, p. 14; Drewes, 1972. |
| 62 | 31°35'10"N 110°46'40"W | Microgranodiorite, Gringo Gulch Volcanics; biotite, zircon; No. 28 (63D281) | 62±3(B) (K-Ar) 50±10(Z) (Pb-α) | Ditto |
| 63 | 31°37'25"N 110°47'30"W | Porphyritic dacite dike (Paleocene); hornblende, zircon; No. 32(63D379) | 69±3(H) (K-Ar) 60±10(Z) (Pb-α) | Marvin and others, 1973, p. 15; Drewes, 1972. |
| 64 | 31°45'30"N 110°48'05"W | Rhyolite vitrophyre dike, Box Canyon dike swarm; sanidine, No. 15 (65D899) | 26.5±1.3 (K-Ar) | Marvin and others, 1973, p. 13; Drewes, 1972. |
| 65 | 31°46'00"N 110°46'45"W | Quartz latite porphyry plug; biotite, No. 23(68D1472) | 57.0±2.3 (K-Ar) | Marvin and others, 1973, p. 14; Drewes, 1972. |
| 66 | 31°50'15"N 110°48'25"W | Granodiorite; biotite, No. 21(66D51) | 54.8±2.0 53.3±2.0 (K-Ar) | Ditto |
| 67 | 31°51'45"N 110°47'00"W | Quartz latite porphyry plug; biotite, No. 25(67D245) | 57.6±2.1 (K-Ar) | Ditto |
| 68 | 31°51'15"N 110°45'30"W | Quartz latite porphyry plug; biotite, No. 24(66D185) | 57.1±2.1 (K-Ar) | Ditto |
| 69 | 31°52'31"N 110°47'20"W | Quartz latite porphyry plug; biotite, No. 22(70D1612) | 55.2±2.0 (K-Ar) | Ditto |
| 70 | 31°55'50"N 110°43'36"W | Quartz monzonite; biotite, No. 37 | 75.5±2.7 (K-Ar) | Marvin and others, 1973, p. 15. |
| 71 | 31°55'20"N 110°42'30"W | Quartz diorite; biotite, No. 36 | 75.3±2.9 (K-Ar) | Ditto |
| | | **EMPIRE MOUNTAINS AND AREA TO THE NORTH AND NORTHWEST** | | |
| 72 | 31°52'48"N 110°39'51"W | Dacite, Pantano Fm.; biotite, No. 73 (F-94-68) | 28.7±1.1 (K-Ar) | Marvin and others, 1973, p. 19. |
| 73 | 31°54'N 110°38'W | Quartz monzonite; biotite, No. 74 (F-32-68) | 71.9±2.6 (K-Ar) | Ditto |
| 74 | 31°59'48"N 110°38'36"W | Rhyolite ash-flow, Pantano Fm.; sanidine, biotite; PED-13-62 | 37.6±1.7(S) 33.6±2.6(B) (K-Ar) | Damon and Bikerman, 1964. |
| 75 | 32°04'05"N 110°49'31"W | Andesitic basalt (2420-2426 m), whole-rock; andesitic basalt (2895-2898 m), whole rock; andesitic basalt (2972-3002 m), whole-rock; quartz monzonite (3753 m), whole-rock; | 23.9±0.6 (K-Ar) 16.5±0.6 (K-Ar) 18.6±2.0 (K-Ar) 47.7±0.6 (K-Ar) 120±60 (Rb-Sr) | Eberly and Stanley, 1978; core samples from Exxon State (32) No. 1 well. The younger ages—16.5 and 18.6 m.y.—may be related to sills or dikes. The 47.7 m.y. age is a hybrid age. |

*Table 1. (Cont'd)*

| Map No. | Location | Rock type, material(s) dated, sample No. | Age in m.y.[1] (age method) | Reference, comments |
|---|---|---|---|---|
| | | **TUCSON MOUNTAINS AND VICINITY** | | |
| 76 | 32°12'56"N 110°58'06"W | Basaltic andesite; whole-rock, PED-17-63 | 27.6±1.2 (K-Ar) | Bikerman and Damon, 1966. |
| 77 | 32°12'32"N 110°59'19"W | Crystal-vitric tuff; sanidine, PED-1-62B | 27.4±0.9 (K-Ar) | Ditto |
| 78 | 32°12'32"N 110°59'22"W | Gray tuff, sanidine, PED-17-62, PED-76-63 | 30.5±0.9 26.4±0.9 (K-Ar) | Bikerman and Damon, 1966; 30.5 m.y. age is spurious. |
| 79 | 32°12'30"N 110°59'19"W | Basaltic andesite; whole-rock, PED-15-63 | 25.9±6.0 (K-Ar) | Bikerman and Damon, 1966. |
| 80 | 32°12'28"N 110°59'56"W | Turkey Track Porphyry (of Pantano Fm.); plagioclase, PED-16-63 | 28.6±2.7 (K-Ar) | Ditto |
| 81 | 32°12'47"N 111°00'20"W | Basaltic andesite (youngest); whole-rock, PED-8-63 | 20.3±3.0 (K-Ar) | Ditto |
| 82 | 32°12'26"N 111°00'38"W | Shorts Ranch Andesite of Brown (1939); biotite, PED-15-62 | 58.1±1.7 (K-Ar) | Ditto |
| 83 | 32°09'23"N 111°02'54"W | Rhyolite; biotite, PED-19-62 | 61.9±1.8 (K-Ar) | Ditto |
| 84 | 32°12'56"N 111°05'57"W | Cat Mountain Rhyolite of Brown (1939); K-feldspar, MB-1-62 | 71.9±2.4 (K-Ar) | Ditto |
| 85 | 32°13'35"N 111°05'08"W | Cat Mountain Rhyolite, K-feldspar, MB-3-62 | 66.4±2.8 (K-Ar) | Ditto |
| 86 | 32°16'22"N 111°12'34"W | Amole Granite of Brown (1939); biotite, PED-3-64 | 73.0±3.4 (K-Ar) | Ditto |
| 87 | 32°17'40"N 110°09'45"W | Amole Quartz Monzonite; biotite, PED-11-63 | 74.5±2.2 (K-Ar) | Ditto |
| 88 | 32°17'38"N 110°09'46"W | Amole granophyre; biotite, PED-12-63 | 76.8±2.2 (K-Ar) | Ditto |
| 89 | 32°19'34"N 111°08'22"W | Rillito Andesite of Brown (1939); biotite, PED-9-63 | 39.4±1.3 (K-Ar) | Ditto |
| 90 | 32°19'28"N 111°07'37"W | Upper Andesite; biotite, MB-2-62 | 28.5±1.9 (K-Ar) | Ditto |
| 91 | 32°19'43"N 111°08'06"W | Vitrophyre, Contzen Pass unit; biotite, 5A-2 | 26.6±1.2 (K-Ar) | Ditto |
| 92 | 32°19'43"N 111°08'21"W | Safford Tuff of Brown (1939); biotite, PED-10-63 | 25.2±1.4 (K-Ar) | Ditto |
| 93 | 32°20'44"N 111°08'55"W | Dacite neck in Safford Tuff; biotite, PED-1-64 | 25.1±0.9 (K-Ar) | Ditto |
| | | **SANTA CATALINA MOUNTAINS** | | |
| 94 | 32°20'36"N 110°55'24"W | Banded gneiss, muscovite, PED-56-66 | 31.9±0.9 (K-Ar) | Mauger and others, 1968; cooling age. |
| 95 | 32°19'24"N 110°48'36"W | Banded gneiss, muscovite, PED-4-58 | 26.5±1.1 (K-Ar) | Damon and others, 1963; cooling age. |
| 96 | 32"25'N(?) 110°45'W(?) | Pegmatite in Leatherwood Quartz Diorite of Bromfield (1952); very coarse muscovite, PED-15-59 | 47.9±2.2 (K-Ar) | Ditto |
| 97 | 32°22'00"N 110°43'00"W | Granitic gneiss; muscovite, No. 100 | 33±3 (K-Ar) | Cantanzero and Kulp, 1964. Zircon concentrate gave a Pb-206/Pb-207 age of 1390±30 m.y.; K-Ar age is a cooling age. |

*Table 1. (Cont'd)*

| Map No. | Location | Rock type, material(s) dated, sample No. | Age in m.y.[1] (age method) | Reference, comments |
|---|---|---|---|---|
| 98 | 32°22'06"N 110°43'00"W | Granitic gneiss; muscovite, biotite; PED-4a-58 | 30.2±0.9(M) 25.4±1.0(B) (K-Ar) 36.9±1.0(M) 23.3±1.4(B) (Rb-Sr) | Damon and others, 1963; Livingston and others, 1967; cooling ages. |
| 99 | 32°20'18"N 110°41'24"W | Banded gneiss (light band); muscovite, biotite, orthoclase, plagioclase, PED-18-62L | 26.0±1.0(M) 25.6±1.0(B) 27.5±0.8(F) 30.0±1.0(Pl) (K-Ar) | Mauger and others, 1968; cooling ages. |
| 100 | 32°20'18"N 110°41'24"W | Banded gneiss (dark band); biotite, PED-18-62d | 28.3±0.9 (K-Ar) | Mauger and others, 1968; cooling ages. |

NOTE: Three Rb-Sr ages have been published by Shakel (1972) for samples from a geochemically disturbed terrain in southwestern Santa Catalina Mountains. These ages suggest a Precambrian history for the gneiss of the Santa Catalina Group but the ages need to be verified by more analyses.

**RINCON MOUNTAINS AND VICINITY**

| | | | | |
|---|---|---|---|---|
| 101 | 32°19'00"N 110°32'30"W | Wrong Mountain Quartz Monzonite; biotite, muscovite; 77D68 | 21.9±0.8(B) 35.1±1.2(M) (K-Ar) | Unpublished; analytical data listed in Table 2; these ages are probably cooling ages. |
| 102 | 32°17'30"N 110°35'00"W | Wrong Mountain Quartz Monzonite; muscovite, 77D81 | 45.8±1.6 (K-Ar) | Ditto |
| 103 | 32°12'30"N 110°42'30"W | Rincon Valley Granodiorite; biotite, muscovite, whole-rock, apatite; 74D62 | 1340±60(B) 1415±50(M) (K-Ar) 1410±50(WR) (Rb-Sr) 26.1±5.0(A) (F-T) | Drewes, in press; Marvin and Cole, 1978; F-T age is cooling age. |
| 104 | 32°12'N 110°44'W | Rincon Valley Granodiorite; biotite, muscovite, apatite, zircon; 74D57. | 1395±50(B) 1390±50(M) (K-Ar) 55.0±4.2(A) 800+(Z) (F-T) | Marvin and Cole, 1978; Drewes, in press; F-T ages are cooling ages. |
| 105 | 32°15'30"N 110°28'40"W | Quartz monzonite; biotite, muscovite; 71D194 | 27.6±0.9(B) 28.5±0.6(M) (K-Ar) | Marvin and Cole, 1978. |
| 106 | 32°13'48"N 110°31'00"W | Schist of Rincon Mountains; muscovite, PED-29-60 | 27.7±1.0 (K-Ar) | Livingston and others, 1967; cooling age. |
| 107 | 32°12'24"N 110°33'12"W | Pegmatite; very coarse muscovite, PED-30-60 | 33.5±1.1 (K-Ar) | Damon and others, 1963; cooling age. |
| 108 | 32°09'N 110°32'W | Wrong Mountain Quartz Monzonite; biotite, apatite, zircon; 73D52 | 25.0±0.8(B) (K-Ar) 25.3±2.9(A) 20-30(Z) (F-T) | Drewes, in press; Marvin and Cole, 1978; cooling ages. |
| 109 | 32°05'00"N 110°37'00"W | Quartz monzonite, Rincon Valley Granodiorite; biotite, hornblende; No. 87 (69D61) | 1450±50(B) 1560±100(H) (K-Ar) | Marvin and others, 1973, p. 21. |
| 110 | 32°07'N 110°28'W | Wrong Mountain Quartz Monzonite; biotite, muscovite, apatite, zircon; No. 80 (71D17) | 24.1±0.9(B) 25.4±0.9(M) (K-Ar) 23.3±5.8(A) 24.6±4.0(Z) (F-T) | Drewes, 1974; Marvin and others, 1973, p. 20; Marvin and Cole, 1978; cooling ages. |

*Table 1. (Cont'd)*

| Map No. | Location | Rock type, material (s) dated, sample No. | Age in m.y.' (age method) | Reference, comments |
|---|---|---|---|---|
| 111 | 32°06'N 110°26'W | Quartz monzonite, Rincon Valley Granodiorite; biotite, No. 86(69D46) | 1550±60 (K-Ar) | Drewes, 1974; Marvin and others, 1973, p.19. |
| 112 | 32°07'N 110°25'W | Granodiorite of Happy Valley; biotite, No. 81 | 26.9±0.9 (K-Ar) | Ditto |
| | | HAPPY VALLEY | | |
| 113 | 32°12'00"N 110°27'00"W | Granodiorite of Happy Valley; biotite, No. 82 (69D93) | 28.0±1.1 (K-Ar) | Drewes, 1974; Marvin and others, 1973, p. 20. |
| 114 | 32°12'00"N 110°27'00"W | Pegmatite; muscovite, No. 83 (69D95) | 37.7±1.6 (K-Ar) | Marvin and others, 1973, p. 20. |
| 115 | 32°12'00"N 110°27'00°W | Mica schist, Pinal Schist; biotite, No. 84 84(69D92) | 29.1±1.1 (K-Ar) | Ditto |
| 116 | 32°13'30"N 110°25'30"W | Mica schist, Pinal Schist; biotite, muscovite; No. 85(70D143) | 34.6±1.2(B) 29.6±0.9(M) (K-Ar) | Ditto |
| | | LITTLE DRAGOON MOUNTAINS AND VICINITY | | |
| 117[120] | 32°03'40"N(?) 110°04'30"W(?) | Texas Canyon Quartz Monzonite; biotite | 1655±20 (U-Pb) | Silver and Deutsch, 1963. |
| 118 | 32°09'00"N 110°13'00"W | Granodiorite; zircon | 1715±15 (U-Pb) | Silver, 1967 |
| 119 | 32°08'00"N 110°12'00"W | Rhyolite, zircon Texas Canyon Quartz Monzonite; biotite, No. 88(A15) | 51±3 53±3 (K-Ar) | Marvin and others, 1973, p. 21. |
| | 32°06'00°N 110°05'00"W | se; PED-11-60 | 49.5(B+Ch) 48.5(M) (-48 + 60 mesh) 55.4(M) (+20 mesh) 31.0(F) 70.4(Pl+Qtz) (K-Ar) | Livingston and others, 1967; published sample location is in error; K-Ar ages for orthoclase and plagioclase are spurious. |
| 121 | 32°03'40"N(?) 110°04'30"W(?) | Texas Canyon Quartz Monzonite; biotite, muscovite; PED-6-64 | 50.9(B) (-80+100 mesh) 51.7(B) (-35 + 45 mesh) 53.6(M) (K-Ar) | Livingston and others, 1967; published sample location is in error. |
| | | SOUTH OF BENSON | | |
| 122 | 31°49'30°N(?) 110°15'W(?) | Vitric ash, middle member, St. David Fm. of Hagen (1974); glass, RS-35a-68 | 2.7±0.4 (K-Ar) | Johnson and others, 1975. |
| 123 | 31°49'30"N(?) 110°15'W(?) | Ash, St. David Fm.; zircon | 3.1 ±0.7 (F-T) | Johnson and others, 1975. No analytical data published. |

(F-T) = fission-track
(Z) = zircon
(A) = apatite
(B) = biotite
(M) = muscovite

(F) = K-feldspar
(PI) = plagioclase
(H) = hornblende
(WR) = whole-rock
(B+Ch) = biotite-chlorite
(Pl+Qtz) = plagioclase-quartz

*Table 2. Unpublished analytical data for K-Ar ages listed in Table 1.*

| Map No. | Analyzed material | $K_2O$% | Radiogenic $Ar^{40}$ ($10^{-10}$ moles/gram) | %Radiogenic $Ar^{40}$ | Age in m.y. ($\pm 2\sigma$) |
|---|---|---|---|---|---|
| 3 | biotite | 7.17<br>7.19 | 6.179 | 90 | 58.8±2.0 |
| 6 | whole-rock | 2.43<br>2.43 | 0.6549 | 71 | 18.6±0.6 |
| 7 | biotite | 8.50<br>8.54 | 4.080 | 76 | 33.0±1.1 |
| 8 | whole-rock | 1.58<br>1.63 | 0.1402 | 46 | 6.1±0.2 |
| 21 | biotite | 9.11<br>9.11 | 4.371 | 88 | 33.0±1.1 |
| 22 | biotite | 9.06<br>9.07 | 4.337 | 80 | 32.9±1.1 |
| 26 | whole-rock | 1.17, 1.17<br>1.19, 1.20 | 0.00235 | 5 | 0.14±0.02 |
| 34 | sanidine | 8.94 | 3.253 | 91 | 25.1±1.2 |
| 101 | biotite | 7.70<br>7.75 | 2.447 | 51 | 21.9±0.8 |
| | muscovite | 9.99<br>9.95 | 5.088 | 82 | 35.1±1.2 |
| 102 | muscovite | 9.41<br>9.23 | 6.220 | 82 | 45.8±1.6 |

Analysts: R. F. Marvin, H. H. Mehnert and V. M. Merritt
Decay constants: $K^{40}\lambda\epsilon = 0.581 \times 10^{-10}$/yr $\lambda\beta = 4.962 \times 10^{-10}$/yr
Atomic abundance: $K^{40} = 1.167 \times 10^{-4}$

with ages determined by Hoggatt and others (1977). A Miocene andesite flow (locality 6) occurs northwest of Lordsburg, and a Pleistocene basalt flow (locality 26) is found in the Animas Valley.

Additional ages for rocks in the Rincon Mountains (localities 101 through 104, 108 and 110) suggest that the magmatic history of the gneissic core complex was probably long-lived and complex. The ages together with the field observations reported by Drewes (1976) and Thorman and Drewes (1978) indicate that the tectonic development of the area was polyphased, overlapping the magmatic history. A gneissic quartz monzonite pluton in this area was mapped by Creasey and Theodore (1975); the age was estimated to be Miocene (25 m.y.) by Creasey and others (1977). A sample from this pluton at locality 102 gave a K-Ar muscovite age of about 46 m.y. This age, and other similar ages (Damon and others, 1963; Livingston and others, 1967), suggest that the magmatic event involved more than the single emplacement of a batholith; apparently several thermal events, or possibly magma regeneration, occurred over a protracted span of time, perhaps from Paleocene to Oligocene.

A sample from locality 101 was collected from another slightly gneissic stock (or lobe of the batholith) of the crystalline core of the gneissic dome. The significant age difference between muscovite (35 m.y.) and biotite (21 m.y.) may reflect a post-emplacement thermal event. The stock is noteworthy because it intrudes thrust-faulted terrane, consisting of tectonic slices of intensely foliated rocks of the crystalline core. Geologic mapping of sediments a few kilometers to the east of this stock indicates sliding of these sediments, including the Pantano Formation, off the core rocks during the Miocene or some later time. Thus, tectonic activity, as well as magmatic activity, was a recurrent or long-lived event.

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*Table 3. Analytical data for new fission-track ages.*

| Sample locality | Mineral Analyzed | $P_s \times 10^6$ t/cm² | $P_i \times 10^6$ t/cm² | $\phi \times 10^{15}$ n/cm² | U ppm | Age in m.y. (±2σ) |
|---|---|---|---|---|---|---|
| A | zircon (6 grains) | 3.75 (869) | 6.34 (234) | 1.06 | 190 | 37.4±1.6 |
| B | zircon (6 grains) | 4.07 (1017) | 7.34 (910) | 1.06 | 220 | 35.0±1.7 |
| C | zircon | 7.17 (1295) | 6.50 (587) | 1.06 | 180 | 69.6±3.2 |
| Map No. | | | | | | |
| 1 | zircon | 8.74 (526) | 11.10 (334) | 1.17 | 270 | 54.9±2.7 |
| 2 | zircon | 5.69 (896) | 6.82 (537) | 1.06 | 190 | 52.7±2.7 |
| 4 | zircon | 7.73 (1467) | 9.38 (890) | 1.18 | 230 | 57.9±2.7 |
| 5 | zircon | 3.91 (452) | 3.66 (212) | 1.06 | 100 | 67.3±7.1 |
| 7 | zircon | 3.26 (709) | 6.84 (744) | 1.01 | 190 | 28.7±1.4 |
| 9 | zircon | 3.43 (540) | 6.65 (523) | 1.02 | 190 | 31.4±1.4 |
| 12 | zircon | 6.19 (1032) | 8.44 (703) | 1.02 | 230 | 44.7±2.7 |
| 13 | apatite | 0.084 (176) | 0.240 (501) | 1.31 | 5.3 | 27.5±4.8 |
| | zircon | 6.25 (955) | 11.77 (899) | 1.03 | 330 | 32.7±1.5 |
| 33 | zircon | 7.23 (971) | 17.70 (1188) | 1.17 | 440 | 28.6±1.2 |

$\lambda_F = 7.03 \times 10^{-17}$/yr.

Number within parentheses indicates the number of fission-tracks counted.


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