# *New radiometric ages of igneous and mineralized rocks, southern Toquima range, Nye county, Nevada*

D.R. Shawe, C.W. Naeser, R.F. Marvin, and H.H. Mehnert

Isochron/West, Bulletin of Isotopic Geochronology, v. 50, pp. 3-7

*Downloaded from:* https://geoinfo.nmt.edu/publications/periodicals/isochronwest/home.cfml?Issue=50

Isochron/West was published at irregular intervals from 1971 to 1996. The journal was patterned after the journal *Radiocarbon* and covered isotopic age-dating (except carbon-14) on rocks and minerals from the Western Hemisphere. Initially, the geographic scope of papers was restricted to the western half of the United States, but was later expanded. The journal was sponsored and staffed by the New Mexico Bureau of Mines *(now Geology)* & Mineral Resources and the Nevada Bureau of Mines & Geology.

ISOCHRON/WEST

*A Bulletin of Isotopic Geochronology*

*All back-issue papers are available for free:* *https://geoinfo.nmt.edu/publications/periodicals/isochronwest*

*This page is intentionally left blank to maintain order of facing pages.*

# NEW RADIOMETRIC AGES OF IGNEOUS AND MINERALIZED ROCKS, SOUTHERN TOQUIMA RANGE, NYE COUNTY, NEVADA

DANIEL R. SHAWE
CHARLES W. NAESER
RICHARD F. MARVIN
HARALD H. MEHNERT

*U.S. Geological Survey, P.O. Box 25046, Denver Federal Center, Denver, CO 80225*

## INTRODUCTION

Thirty-five new radiometric ages are presented here for igneous rocks and mineralized material from the southern Toquima Range, Nye County, Nevada, to provide additional information on the igneous and mineralization history of the area. Other radiometric ages for rocks of the area have been published by Krueger and Schilling (1971), Silberman and McKee (1971), Edwards and McLaughlin (1972), Marvin and others (1973), Silberman and others (1975), Marvin and Dobson (1979), Boden (1986), and Shawe and others (1986).

These earlier studies have established the following age framework for rocks of the area; the generalized geology is shown on figure 1. Emplacement of the Round Mountain lobe of the granite of Shoshone Mountain (Round Mountain pluton) into Paleozoic marine sedimentary rocks between Round Mountain and Belmont took place at about 95 Ma, and emplacement of the granite of Pipe Spring (Pipe Spring pluton) south of Manhattan occurred at about 80 Ma. Age of emplacement of the Belmont lobe of the granite of Shoshone Mountain (Belmont pluton) has not been established. Emplacement of aplite-pegmatite dikes and quartz veins into, and metamorphism of, the plutons took place at about 80 Ma for the Round Mountain and Belmont plutons and 75 Ma for the Pipe Spring pluton.

A granodiorite stock and an associated rhyolite dike swarm were emplaced into the Round Mountain pluton and adjacent Paleozoic rocks near Round Mountain at about 36 Ma. An episode of tourmalinization and metal mineralization was associated with emplacement of the stock. Geologic and geochronologic data suggest the possible presence of a buried stock and associated gold deposits of similar age in the east part of the Manhattan district (Shawe, 1986a).

The tuff of Mount Jefferson and related tuff of Round Mountain were erupted from the Mount Jefferson caldera at about 27–26 Ma. The Round Rock Formation (Shawe, 1986b; Shawe and Snyder, in press), a silicic ash-flow tuff sequence, was emplaced in the Manhattan caldera at about 25 Ma. Gold mineralization, possibly related to buried intrusives of the same igneous episode, also formed at 25 Ma.

A young episode of gold mineralization occurred at Manhattan at about 16 Ma. No igneous rocks have been correlated with this event, but coeval intrusive bodies are inferred to be present in the subsurface in or near the south margin of the Manhattan caldera.

## RESULTS

The K-Ar and fission-track ages reported here (see sample descriptions; sample localities shown on figure 1) add to our understanding of the aforementioned age framework.

Biotites from the Belmont pluton (samples DRS-81-89B and DRS-81-128) gave K-Ar ages of 81–80 Ma, which are in accord with previously published ages (recalculated, on the basis of the new decay constants—Steiger and Jager, 1977) of biotites from the Belmont lobe. These ages are inferred to be reduced ages and indicate that metamorphism occurred during the emplacement of aplite-pegmatite dikes and quartz veins in the pluton.

The 76-Ma biotite age of an aplite dike (sample DRS-81-54) in the Pipe Spring pluton and the 76-Ma biotite and feldspar ages of a granodiorite dike (sample DRS-81-58A) that is satellitic to the Pipe Spring pluton are probably primary ages and are concordant with ages of mineral deposits in association with the Pipe Spring pluton. The pluton itself has an age of 80 Ma.

The calc-silicate-mineralized limestone of the Lower Cambrian Gold Hill Formation in the Manhattan district appears to have been affected by at least three hydrothermal events. The first event was related to the mineralization that occurred about 76 Ma. A subsequent mineralization event at about 40–35 Ma reset coarse-grained K-feldspar (sample DRS-80-58A) so that it now gives an age of 45 Ma. A later Miocene event produced mineralizing solutions that deposited gold-bearing quartz-adularia veinlets in the calc-silicate-mineralized limestone about 17 Ma (sample DRS-80-58B, age data from Shawe and others, 1986).

A number of ages, which range from 28 to 25 Ma, indicate that volcanic activity related to the Big Ten Peak caldera occurred during the late Oligocene. The emplacement of ash tuff (sample DRS-81-166) and latite flows(?) and plugs (samples DRS-81-167, DRS-81-177, and DRS-81-182) was followed by intrusion of a rhyolite plug (sample DRS-81-196) and late ash flows. Detrital zircon and apatite from a black-sand layer (sample DRS-81-170) in conglomerate near the top of the early ash-tuff unit gives ages of 23 and 25 Ma, respectively, which are seemingly too young relative to the other determined ages.

Similar igneous activity occurred elsewhere in the region. The tuff of Round Mountain (sample DRS-79-85), which was probably derived from the Mount Jefferson caldera, was deposited about 27 Ma. A rhyolite plug (sample DRS-81-155) intruded the ring-fracture zone of the Manhattan caldera 25 Ma.

Andesite that intruded the Ordovician marine sedimentary rocks near the southeast margin of the Manhattan caldera gave an apatite fission-track age of 14 Ma (sample DRS-81-75A). The large age uncertainty (6 Ma) and the known age sensitivity of apatite to thermal resetting make an interpretation of this date uncertain. This age is a cooling age, but whether or not it is related to a late-phase thermal event is unknown.

Volcanic ash from a layer perhaps ten meters thick exposed about 3 km east of the Manhattan caldera consists of fresh colorless glass shards. Zircon from the ash (sample

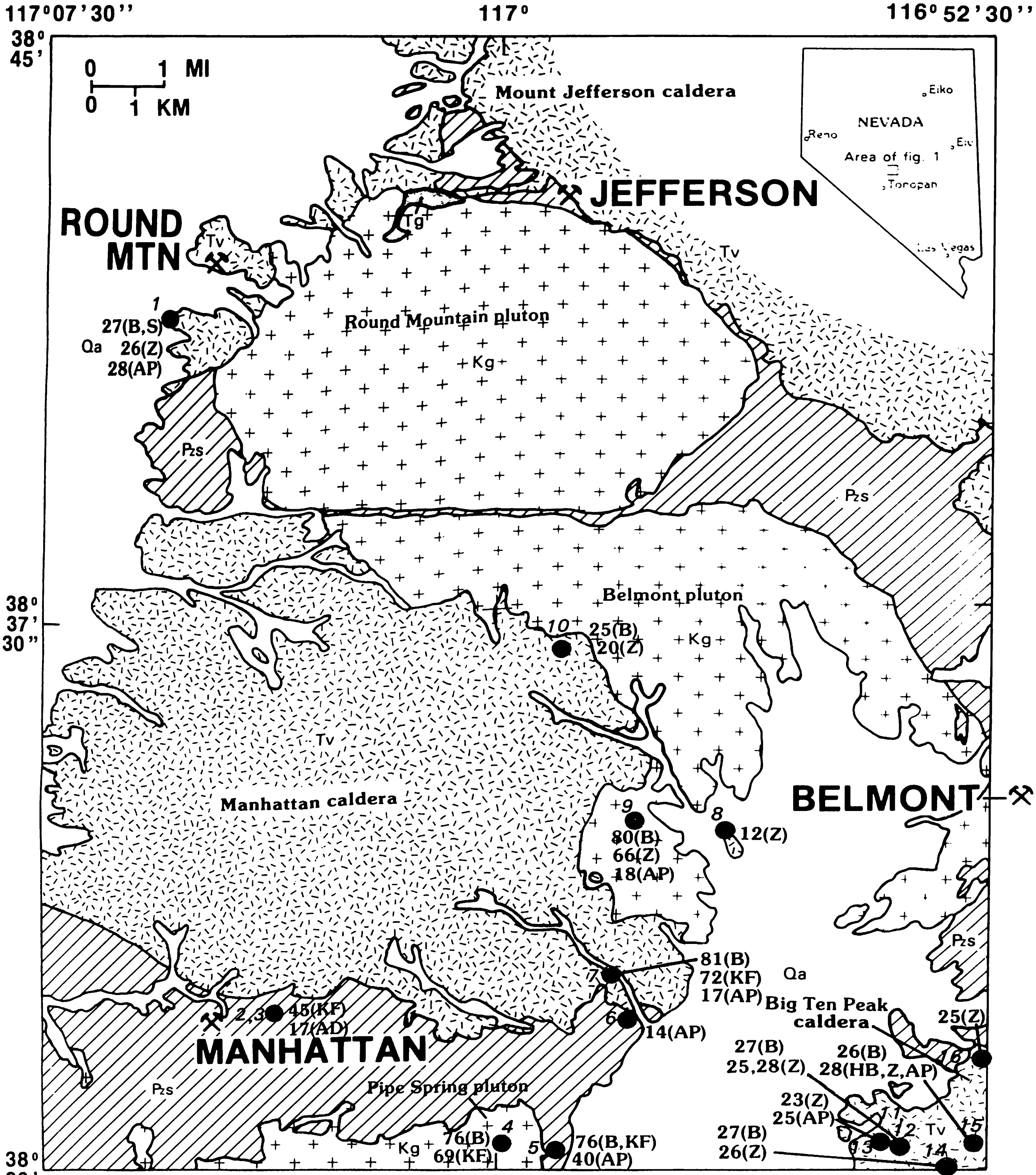


**FIGURE 1.** Simplified geologic map of part of the southern Toquima Range, Nevada, showing locations of the Round Mountain, Manhattan, Belmont, and Jefferson precious-metal districts, and sample localities. Pzs, Paleozoic sedimentary rocks; Kg, Cretaceous granite; Tg, Tertiary granodiorite stock; Tv, Tertiary volcanic rocks; Qa, Quaternary alluvium. Numbered dot, sample locality showing radiometric age in Ma (AD, adularia; AP, apatite; B, biotite; HB, hornblende; KF, K-feldspar; S, sanidine; Z, zircon).

DRS-81-126) gave a fission-track age of 12 Ma. The small analytical uncertainty (2.5 Ma), together with the fresh glassy character of the ash, indicate that this igneous rock is from an unknown source that is considerably younger than any source previously dated in the southern Toquima Range.

## ANALYTICAL INFORMATION

Radiometric ages reported in this paper were determined in the laboratories of the U.S. Geological Survey in Denver, Colorado. K-Ar ages were calculated with the following constants: $^{40}K\lambda_\epsilon = 0.581 \times 10^{-10}$/yr, $\lambda_\beta = 4.962 \times 10^{-10}$/yr, and $^{40}K/K = 1.167 \times 10^{-4}$ mol/mol. Potassium content was determined by flame photometry; argon content was determined by mass spectrometry. The decay constant for the spontaneous fission of $U^{238}$ that was used to calculate fission-track ages is $7.03 \times 10^{-17}$/yr. The thermal neutron dose (n/cm²) was determined by counting the induced fission tracks present in a piece of muscovite which covered a standard glass (SRM 962) during irradiation. The constants and the neutron dose calibration used in this study have yielded F-T ages concordant with K-Ar ages on unheated samples. The zircons were dated using the external detector method, and the apatites were dated using the population method (Naeser, 1976). The following abbreviations are used: Ps = fission-track density (tracks/cm²), number of tracks counted enclosed in parentheses; and Pi = induced track density (tracks/cm²), number of tracks counted enclosed in parentheses. The quoted uncertainties represent the estimated analytical error at two standard deviations (2w) for K-Ar and fission-track ages.

## SAMPLE DESCRIPTIONS

1. *USGS(D)-DRS-79-85* K-Ar, Fission-track
Silicic ash-flow tuff (38°41'26"N, 117°05'25"W; S30,T10N,R43E; 1.5 km SW of Round Mountain gold mine open pit; Round Mountain 7½' quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 8.15%, 7.90%; $^{40}Ar^*$ = $3.104 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 69%; (sanidine) $K_2O$ = 6.07%, 5.99%; $^{40}Ar^*$ = $2.345 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 81%. Fission-track—(zircon—6 grains) Ps = $3.11 \times 10^6$ tracks/cm² (749); Pi = $8.58 \times 10^6$ tracks/cm² (1033); d = $1.20 \times 10^{15}$ n/cm²; U = 230 ppm; (apatite—50 grains) Ps = $0.105 \times 10^6$ tracks/cm² (219); Pi = $0.154 \times 10^6$ tracks/cm² (321); d = $0.696 \times 10^{15}$ n/cm²; U = 7.0 ppm. *Comments:* Light-grayish-brown porphyritic rhyolite welded ash-flow tuff from Oligocene tuff of Round Mountain, now considered to be part of the Oligocene tuff of Mount Jefferson (Shawe and others, 1986; Boden, 1986).
**K-Ar (biotite) 26.7 ± 1.7 Ma**
**(sanidine) 27.0 ± 1.0 Ma**
**Fission-track (zircon) 26.0 ± 2.6 Ma**
**(apatite) 28.4 ± 7.8 Ma**

2. *USGS(D)-DRS-80-58A* K-Ar
Mineralized limestone (38°31'55"N, 117°03'03"W; S20,T8N,R44E; mine dump of the Union Amalgamated Mine, east part of the Manhattan gold district; Manhattan 7½' quad., Nye Co., NV). *Analytical data:* $K_2O$ = 13.64%, 13.44%; $^{40}Ar^*$ = $8.949 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 86%. *Comments:* Coarsely crystallized K-feldspar in sulfide-mineralized, calc-silicate-mineralized limestone of the Lower Cambrian Gold Hill Formation.
**(K-feldspar) 45.3 ± 1.0 Ma**

3. *USGS(D)-DRS-80-58B* K-Ar
Veinlet (38°31'55"N, 117°03'03"W; S20,T8N,R44E; mine dump of the Union Amalgamated Mine, east part of the Manhattan gold district; Manhattan 7½' quad., Nye Co., NV). *Analytical data:* $K_2O$ = 10.74%, 10.74%, 10.50%, 10.26%; $^{40}Ar^*$ = $2.578 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 84%. *Comments:* Gold-bearing quartz-adularia veinlet in calc-silicate-mineralized limestone of the Lower Cambrian Gold Hill Formation.
**(adularia) 16.9 ± 0.6 Ma**

4. *USGS(D)-DRS-81-54* K-Ar
Aplite dike (38°30'30"N, 116°59'54"W; S36,T8N,R44E; 2.5 km SW of mouth of East Manhattan Wash; Belmont West 7½' quad., Nye Co., NV). *Analytical data:* (biotite) $K_2O$ = 8.67%, 8.51%; $^{40}Ar^*$ = $9.609 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 89%; (K-feldspar) $K_2O$ = 14.60%, 14.58%; $^{40}Ar^*$ = $14.80 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 82%. *Comments:* Biotite-bearing aplite dike (30-m thick) emplaced in Cretaceous granite of Pipe Spring. The biotite age is probably the age of emplacement; the K-feldspar age is too young, probably as a result of diffusive loss of radiogenic argon from the K-feldspar crystals.
**(biotite) 76.1 ± 2.7 Ma**
**(K-feldspar) 69.2 ± 1.6 Ma**

5. *USGS(D)-DRS-81-58A* K-Ar, Fission-track
Granodiorite dike (38°30'11"N,116°59'07"W; S36,T8N,R44E; 2 km SSW of mouth of East Manhattan Wash; Belmont West 7½' quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 8.19%, 8.17%; $^{40}Ar^*$ = $9.160 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 89%; (K-feldspar) $K_2O$ = 9.21%, 9.13%; $^{40}Ar^*$ = $10.32 \times 10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 92%. Fission-track—(apatite—50 grains) Ps = $0.279 \times 10^6$ tracks/cm² (582); Pi = $0.288 \times 10^6$ tracks/cm² (599); d = $0.696 \times 10^{15}$ n/cm²; U = 13 ppm. *Comments:* Biotite-rich granodiorite dike satellitic to the Cretaceous granite of Pipe Spring in an area of small mineral deposits. The biotite and K-feldspar ages probably represent the age of the dike. The apatite age may reflect a 40-35-Ma thermal event that accompanied a postulated early Tertiary mineralization in the Manhattan district.
**K-Ar (biotite) 76.1 ± 2.7 Ma**
**(K-feldspar) 76.5 ± 2.8 Ma**
**Fission-track (apatite) 40.4 ± 6.8 Ma**

6. *USGS(D)-DRS-81-75A* Fission-track
Andesite (38°31'54"N, 116°57'56"W; S24,T8N,R44½E; 1.7 km NNE of mouth of East Manhattan Wash; Belmont West 7½' quad., Nye Co., NV). *Analytical data:* (apatite—50 grains) Ps = $0.016 \times 10^6$ tracks/cm² (34); Pi = $0.048 \times 10^6$ tracks/cm² (100); d = $0.696 \times 10^{15}$ n/cm²; U = 2.2 ppm. *Comments:* Olive-brown fine-grained andesite from an irregular body emplaced along bedding in the Ordovician Toquima(?) Formation.
**(apatite) 14.1 ± 6.3 Ma**

7. *USGS(D)-DRS-81-89B* K-Ar, Fission-track
Granite (38°32'37"N, 116°58'10"W;

S13,T8N,R44½E; adit dump 1.5 km NW of mouth of Bald Mountain Wash; Belmont West 7½′ quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 9.24%, 9.23%; $^{40}Ar^*$ = 10.97 × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 88%; (K-feldspar) $K_2O$ = 14.56%, 14.56%; $^{40}Ar^*$ = 15.39 × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 94%. Fission-track—(apatite—100 grains) Ps = 0.031 × $10^6$ tracks/cm² (130); Pi = 0.076 × $10^6$ tracks/cm² (317); d = 0.696 × $10^{15}$ n/cm²; U = 3.5 ppm. *Comments:* Light-gray, coarse-grained two-mica granite from an immense granite fragment of the Belmont lobe of the Cretaceous granite of Shoshone Mountain, embedded in ash tuff of the megabreccia of Sloppy Gulch (Shawe and Snyder, in press). The 81-Ma biotite age is a minimum age for the Belmont lobe. The K-feldspar age is too young and is probably due to loss of radiogenic argon by diffusion. The apatite fission-track age is a cooling age, perhaps related to a Miocene thermal event.

**K-Ar (biotite) 80.7 ± 2.9 Ma**
**(K-feldspar) 71.9 ± 1.7 Ma**
**Fission-track (apatite) 17.1 ± 3.9 Ma**

8. *USGS(D)-DRS-81-126* Fission-track
Volcanic ash (38°34′26″N,116°56′30″W; S30,T9N,R45E; 500 m east of Silver Creek on the north side of knob 7103; Belmont West 7½′ quad., Nye Co., NV). *Analytical data:* (zircon—4 grains) Ps = 0.969 × $10^6$ tracks/cm² (112); Pi = 5.81 × $10^6$ tracks/cm² (336); d = 1.20 × $10^{15}$ n/cm²; U = 150 ppm. *Comments:* Very light gray volcanic ash consisting of fresh colorless glass shards.

**(zircon) 12.0 ± 2.6 Ma**

9. *USGS(D)-DRS-81-128* K-Ar, Fission-track
Granite (38°34′34″N, 116°57′52″W; S31,T9N,R45E; 150 m south of hill 7167, 1.3 km west of Silver Creek; Belmont West 7½′ quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 8.02%, 7.99%; $^{40}Ar^*$ = 9.432 × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 89%. Fission-track—(zircon—5 grains) Ps = 6.05 × $10^6$ tracks/cm² (1,288); Pi = 6.56 × $10^6$ tracks/cm² (698); d = 1.20 × $10^{15}$ n/cm²; U = 170 ppm; (apatite—100 grains) Ps = 0.049 × $10^6$ tracks/cm² (206); Pi = 0.114 × $10^6$ tracks/cm² (475); d = 0.696 × $10^{15}$ n/cm²; U = 5.2 ppm. *Comments:* Light-gray, coarse-grained, nonporphyritic two-mica granite of the Belmont lobe of the Cretaceous granite of Shoshone Mountain. The 80-Ma biotite age is a minimum age for the Belmont lobe. The zircon and apatite ages are cooling ages, perhaps related to thermal events younger than 80 Ma.

**K-Ar (biotite) 80.0 ± 2.9 Ma**
**Fission-track (zircon) 65.9 ± 6.7 Ma**
**(apatite) 18.0 ± 3.6 Ma**

10. *USGS(D)-DRS-81-155* K-Ar, Fission-track
Rhyolite plug (38°36′54″N, 116°59′03″W; land net unsurveyed; on ridge 1.5 km north of the south fork of Silver Creek, 300 m east of pack trail in canyon; Belmont West 7½′ quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 7.57%, 7.49%; $^{40}Ar^*$ = 2.704 × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 71%. Fission-track—(zircon)—5 grains Ps = 2.11 × $10^6$ tracks/cm² (488); Pi = 7.53 × $10^6$ tracks/cm² (872); d = 1.20 × $10^{15}$ n/cm²; U = 200 ppm. *Comments:* Black glassy selvage of porphyritic rhyolite plug emplaced in the ring-fracture zone of the Oligocene Manhattan caldera. The zircon fission-track age appears slightly young.

**K-Ar (biotite) 24.8 ± 0.9 Ma**
**Fission-track (zircon) 20.1 ± 2.4 Ma**

11. *USGS(D)-DRS-81-166* K-Ar, Fission-track
Ash tuff (38°30′13″N, 116°53′52″W; S34,T8N,R45E; 1 km north of Hunts Canyon, 400 m south of hill 7428; Belmont West 7½′ quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 8.39%, 8.36%; $^{40}Ar^*$ = 3.279 × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 72%. Fission-track—(zircon)—6 grains) Ps = 2.64 × $10^6$ tracks/cm² (732); Pi = 7.61 × $10^6$ tracks/cm² (1,057); d = 1.20 × $10^{15}$ n/cm²; U = 200 ppm. *Comments:* Light-gray to whitish biotite-bearing ash tuff from the lowest exposed unit of the Oligocene Big Ten Peak caldera volcanic section.

**K-Ar (biotite) 27.0 ± 1.0 Ma**
**Fission-track (zircon) 24.8 ± 2.6 Ma**

12. *USGS(D)-DRS-81-167* K-Ar, Fission-track
Latite flow(?) (38°30′13″N, 116°53′52″W; S34,T8N,R45E; 1 km north of Hunts Canyon, 450 m south of hill 7428; Belmont West 7½′ quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 8.57%, 8.56%; $^{40}Ar^*$ = 3.325 × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 69%. Fission-track—(zircon—4 grains) Ps = 5.06 × $10^6$ tracks/cm² (749); Pi = 12.84 × $10^6$ tracks/cm² (951); d = 1.20 × $10^{15}$ n/cm²; U = 340 ppm. *Comments:* Light-lavender-gray porphyritic latite flow(?) that overlies the lowest exposed unit of the Oligocene Big Ten Peak caldera volcanic section.

**K-Ar (biotite) 26.8 ± 1.0 Ma**
**Fission-track (zircon) 28.2 ± 3.0 Ma**

13. *USGS(D)-DRS-81-170* Fission-track
Black-sand layer (38°30′19″N, 116°54′00″W; S34,T8N,R45E; 1 km north of Hunts Canyon, 300 m SSW of hill 7428; Belmont West 7½′ quad., Nye Co., NV). *Analytical data:* (zircon—6 grains) Ps = 2.95 × $10^6$ tracks/cm² (791); Pi = 9.29 × $10^6$ tracks/cm² (1,247); d = 1.20 × $10^{15}$ n/cm²; U = 250 pm; (apatite—50 grains) Ps = 0.060 × $10^6$ tracks/cm² (126); Pi = 0.099 × $10^6$ tracks/cm² (206); d = 0.696 × $10^{15}$ n/cm²; U = 4.5 ppm. *Comments:* Black-sand layer in fluvial conglomerate bed near top of ash-tuff unit that is the lowest exposed unit of the Oligocene Big Ten Peak caldera volcanic section. The zircon age appears slightly young.

**(zircon) 22.7 ± 2.2 Ma**
**(apatite) 25.4 ± 6.9 Ma**

14. *USGS(D)-DRS-81-177* K-Ar, Fission-track
Latite plug(?) (38°27′58″N, 116°53′12″W; S35,T8N,R45E; 500 m north of Hunts Canyon, 400 m SW of hill 6850; Belmont West 7½′ quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 8.15%, 8.12%; $^{40}Ar^*$ = 3.143 × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 81%. Fission-track—(zircon—6 grains) Ps = 2.86 × $10^6$ tracks/cm² (741); Pi = 8.04 × $10^6$ tracks/cm² (1,042); d = 1.20 × $10^{15}$ n/cm²; U = 210 ppm; (apatite—50 grains) Ps = 0.082 × $10^6$ tracks/cm² (171); Pi = 0.090 × $10^6$ tracks/cm² (188); d = 0.696 × $10^{15}$ n/cm²; U = 4.1 ppm. *Comments:* Light-gray porphyritic biotite-hornblende latite plug(?) emplaced in the ring-fracture

zone of the Oligocene Big Ten Peak caldera. The high crystal-defect density of the apatite grains severely limits the reliability of the apatite fission-track age.

**K-Ar (biotite) 26.6 ± 1.0 Ma**
**Fission-track (zircon) 25.5 ± 2.6 Ma**
**(apatite) 37.9 ± 11.3 Ma**

15. *USGS(D)-DRS-81-182* K-Ar, Fission-track
Latite plug(?) (38°30'24"N, 116°52'49"W; S35,T8N,R45E; 1.5 km north of Hunts Canyon, 500 m NNE of hill 6850; Belmont West 7½' quad., Nye Co., NV). *Analytical data:* K-Ar—(biotite) $K_2O$ = 8.43%, 8.42%; $^{40}Ar^*$ = 3.216 × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 74%; (hornblende) $K_2O$ = 2.48%, 2.40%, 2.41%; $^{40}Ar^*$ = 0.9806 × × $10^{-10}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 75%. Fission-track—(zircon—6 grains) Ps = 1.91 × $10^6$ tracks/cm² (513); Pi = 4.90 × $10^6$ tracks/cm² (658); d = 1.20 × $10^{15}$ n/cm²; U = 130 ppm; (apatite—50 grains) Ps = 0.079 × $10^6$ tracks/cm² (164); Pi = 0.117 × $10^6$ tracks/cm² (243); d = 0.696 × $10^{15}$ n/cm²; U = 5.3 ppm. *Comments:* Light-gray porphyritic biotite-hornblende latite plug(?) emplaced in the ring-fracture zone of the Oligocene Big Ten Peak caldera. The high crystal-defect density of the apatite grains severely limits the reliability of the apatite fission-track age.

**K-Ar (biotite) 26.3 ± 0.9 Ma**
**(hornblende) 27.8 ± 1.0 Ma**
**Fission-track (zircon) 27.9 ± 3.4 Ma**
**(apatite) 28.1 ± 8.5 Ma**

16. *USGS(D)-DRS-81-196* Fission-track
Rhyolite plug(?) (38°31'33"N, 116°52'32"W; S23,T8N,R45E; 800 m east of hill 7034; Belmont West 7½' quad., Nye Co., NV). *Analytical data:* (zircon—6 grains) Ps = 3.76 × $10^6$ tracks/cm² (1,010); Pi = 10.74 × $10^6$ tracks/cm² (1,442); d = 1.20 × $10^{15}$ n/cm²; U = 280 ppm. *Comments:* Buff porphyritic rhyolite plug(?) emplaced in ash-flow tuff of the Oligocene Big Ten Peak caldera volcanic section.

**(zircon) 25.1 ± 2.3 Ma**

## REFERENCES


Boden, D. R. (1986) Eruptive history and structural development of the Toquima caldera complex, central Nevada: Geological Society of America Bulletin, v. 97, p. 61–74.

Edwards, G., and McLaughlin, W. A. (1972) Shell list no. 1—K/Ar and Rb/Sr age determinations of California, Nevada, and Utah rocks and minerals: Isochron/West, no. 3, p. 1–7.

Krueger, H. W., and Schilling, J. H. (1971) Geochron/Nevada Bureau of Mines K/Ar age determinations—list 1: Isochron/West, no. 1, p. 9–14.

Marvin, R. F., and Dobson, S. W. (1979) Radiometric ages: Compilation B, U.S. Geological Survey: Isochron/West, no. 26, p. 3–32.

Marvin, R. F., Mehnert, H. H., and McKee, E. H. (1973) A summary of radiometric ages of Tertiary volcanic rocks in Nevada and eastern California, Part III—southeastern Nevada: Isochron/West, no. 6, p. 1–30.

Naeser, C. W. (1976) Fission track dating: U.S. Geological Survey Open-file Report 76-190, 58 p.

Shawe, D. R. (1986a) Complex history of precious metal deposits, southern Toquima Range, Nevada: U.S. Geological Survey Open-file Report 86-0459, 42 p.

_______ (1986b) Stratigraphic nomenclature of volcanic rocks near Manhattan, southern Toquima Range, Nye County, Nevada: U.S. Geological Survey Bulletin 1775-A, p. A1–A8 [1987].

Shawe, D. R., Marvin, R. F., Andriessen, P. A. M., Mehnert, H. H., and Merritt, V. M. (1986) Ages of igneous and hydrothermal events in the Round Mountain and Manhattan gold districts, Nye County, Nevada: Economic Geology, v. 81, p. 388–407.

Shawe, D. R., and Snyder, D. B. (in press) Ash-flow eruptive megabreccias of the Manhattan and Mount Jefferson calderas, Nye County, Nevada: U.S. Geological Survey Professional Paper 1471.

Silberman, M. L., and McKee, E. H. (1971) K-Ar ages of granite plutons in north-central Nevada: Isochron/West, no. 1, p. 15–32.

Silberman, M. L., Shawe, D. R., Koski, R. A., and Goddard, B. B. (1975) K-Ar ages of mineralization at Round Mountain and Manhattan, Nye County, Nevada: Isochron/West, no. 13, p. 1–2.

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