New K-Ar ages of volcanic and plutonic rocks from the Camp Douglas quadrangle, Mineral County, Nevada

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NEW K-AR AGES OF VOLCANIC AND PLUTONIC ROCKS FROM THE CAMP DOUGLAS QUADRANGLE, MINERAL COUNTY, NEVADA

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This report describes 12 new K-Ar age determinations on mineral separations from 7 rock samples of Mesozoic plutonic and Tertiary volcanic units exposed in the Camp Douglas quadrangle and summarizes previously published ages on other rocks and mineral deposits from the area. The K-Ar age determinations were done as part of a Nevada Bureau of Mines and Geology (NBMG)–U. S. Geological Survey (USGS) cooperative program. Mineral separates were prepared at NBMG or the USGS from samples collected by the authors. Argon analyses were performed by standard isotope dilution procedures. Mass analyses were made with a 60° sector, 15.2 cm radius Neir-type mass spectrometer operated in the static mode (Dalrymple and Lanphere, 1969). Potassium analyses were perfromed by a lithium metaborate flux fusion-flame photometry technique, the lithium serving as an internal standard (Ingamels, 1970). Overall analytical uncertainty of reported ages is approximately 3% unless otherwise specified, and is a combined estimate of the precision of the argon and potassium analyses at one standard deviation. Constants used in the calculation of ages are: $\lambda_\beta = 4.963 \times 10^{-10}\,yr^{-1}$, $\lambda_\epsilon = 0.572 \times 10^{-10}\,yr^{-1}$, $\lambda_\epsilon' = 8.78 \times 10^{-13}\,yr^{-1}$, $^{40}K/K$ total $= 1.167 \times 10^{-4}$ mole/mole. These constants, based on new data on abundance of ^{40}K (Garner and others, 1975) and its decay constants (Beckinsale and Gale, 1969) represent a change from those reported in previous articles. Consequently, the ages described in this article may differ by 1 to 2% from those of samples from Camp Douglas reported in previous references (Silberman and others,1975; Marvin and others, 1977). Where relevant, these changes are mentioned in the sample descriptions.

Sample locations are listed on the accompanying map (fig. 1). Where appropriate, short discussions of the significance of individual ages or groups of ages are included under comments in the sample description part of this report.

GEOLOGIC DISCUSSION

The Camp Douglas 7½ minute quadrangle is located in western Nevada a few miles southwest of the town of Mina. The rocks exposed in the quadrangle range in age from Permian(?) to Quaternary. Pre-Tertiary rocks of the Mina and Gold Range Formations (Speed, 1977) have been intruded by diorite (97 m.y.), granite (93 m.y.) and granite porphyry (90 m.y.). These rocks are unconformably overlain by a variety of Tertiary volcanic and sedimentary units and Quaternary alluvium. The oldest Tertiary rocks in the quadrangle are rhyolitic to rhyodacitic ash-flow tuffs which range in age from 27 m.y. (Marvin and others, 1977) to approximately 22 m.y. (samples CD–136, this report). These ash-flow tuffs are overlain by andesite flows. The youngest of these flows at Camp Douglas yielded concordant biotite and plagioclase ages of approximately 16 m.y. (Silberman and others, 1975); Marvin and others (1977) report ages of approximately 18 m.y. from a similar flow near Belleville, just south of the Camp Douglas quadrangle boundary. The lowermost andesite flows in the quadrangle have been cut by a latite hypabyssal intrusive approximately 19 m.y. old (sample CD–137 , this report). Tertiary sedimentary rocks near the mouth of Douglas Canyon contain pumiceous beds. Biotite from these beds gave a K-Ar age of 5.9 m.y. (sample D2466B, table 1; Marvin and others, 1977).

Adularia from a gold-bearing vein at the Camp Douglas mining district has been dated at 15 m.y. (Silberman and others, 1975) and adularia from the Silver Dyke vein gave an age of 17.3 m.y. (Morton and others, 1977). An older period of mineralization at Silver Dyke is documented by a K-Ar date of 76 m.y. on pink-colored potassium feldspar from a quartz-potassium feldspar-pyrite-molybdenite-chalcopyrite-bornite veinlet in the 97 m.y. diorite exposed in Silver Dyke Canyon.

Table 1 summarizes available K-Ar ages obtained on rocks and ore deposits from the Camp Douglas 7½ minute quadrangle. Relationships between volcanic activity and mineralization, and brief descriptions of the mineral deposits may be found in Silberman and others (1975), Morton and others (1977), and Ross (1961).

SAMPLE DESCRIPTIONS

1. *CD–137* **K-Ar**

Latite hypabyssal intrusive.(NW/4 SW/4 NE/4 S35,T6N, R34E; 38°20'12"(20.20')N, 118°09'36"(09.60')W; Mineral Co., NV). Fine-grained, biotite latite intrusion. *Analytical data:* (plagioclase) K_2O = 1.248%, $^*Ar^{40}$ = 3.412×10^{-11} mole/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 29%. *Collected by:* L. J. Garside, Nevada Bureau of Mines and Geology, and M. L. Silberman, U. S. Geological Survey; *dated by:* M. L. Silberman, U. S. Geological Survey. *Comment:* Intrudes older andesite flows of the Tertiary andesite sequence in the Camp Douglas quadrangle. Thus, andesite flows in this area range from approximately 16 m.y. (see CD–31, table 1) to over 19 m.y.

(plagioclase) 18.9 ± 0.8 m.y.

2. *CD–136* K-Ar

Rhyodacite vitric ash-flow tuff. (SE/4 SE/4 NE/4 S14, T6N,R34E; 38°22'45"(22.75')N, 118°09'07"(9.12')W; Mineral Co., NV). *Analytical data:* K_2O = 0.803%, $*Ar^{40}$ = 2.558 x 10^{-11} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 49%. *Collected by:* L. J. Garside, Nevada Bureau of Mines and Geology and M. L. Silberman, U. S. Geological Survey; *dated by:* M. L. Silberman, U. S. Geological Survey. *Comment:* Same unit as tuff of Belleville of Marvin and others (1977). Marvin and others (1977) report an age of 21.4 ± 0.9 m.y. (21.9 ± 1.4, new constants) for this tuff (sample D2436P1, table 1) which they believe is a minimum figure, due to stratigraphic relations seen to the S of Camp Douglas at Candelaria. The agreement of the two ages of this tuff at Camp Douglas, however, suggests the age may be close to the true age of emplacement of this unit.

(plagioclase) 22.0 ± 0.7 m.y.

3. *CD–261* K-Ar

Rhyolite crystal ash-flow tuff. (SE/4 SE/4 SE/4 S14, T6N,R34E; 38°22'13"(22.22')N, 118°09'08"(09.13') W; Mineral Co., NV). *Analytical data:* (biotite) K_2O = 8.57%, $*Ar^{40}$ = 3.007 x 10^{-10} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 51%; (plagioclase) K_2O = 0.575%, $*Ar^{40}$ = 2.064 x 10^{-11} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 23%. *Collected by:* L. J. Garside, Nevada Bureau of Mines and Geology; *dated by:* M. L. Silberman, U. S. Geological Survey. *Comment:* According to R. C. Speed (written commun., 1977) this unit correlates with the tuff of Metallic City. Marvin and others (1977) report an age of 24.2 ± 0.9 (24.8 ± 0.9, new constants) from this tuff at Candelaria, to the S of Camp Douglas.

(biotite) 24.2 ± 0.7 m.y.
(plagioclase) 24.8 ± 1.0 m.y.

FIGURE 1. Location of K-Ar age-date samples in the Camp Douglas quadrangle.

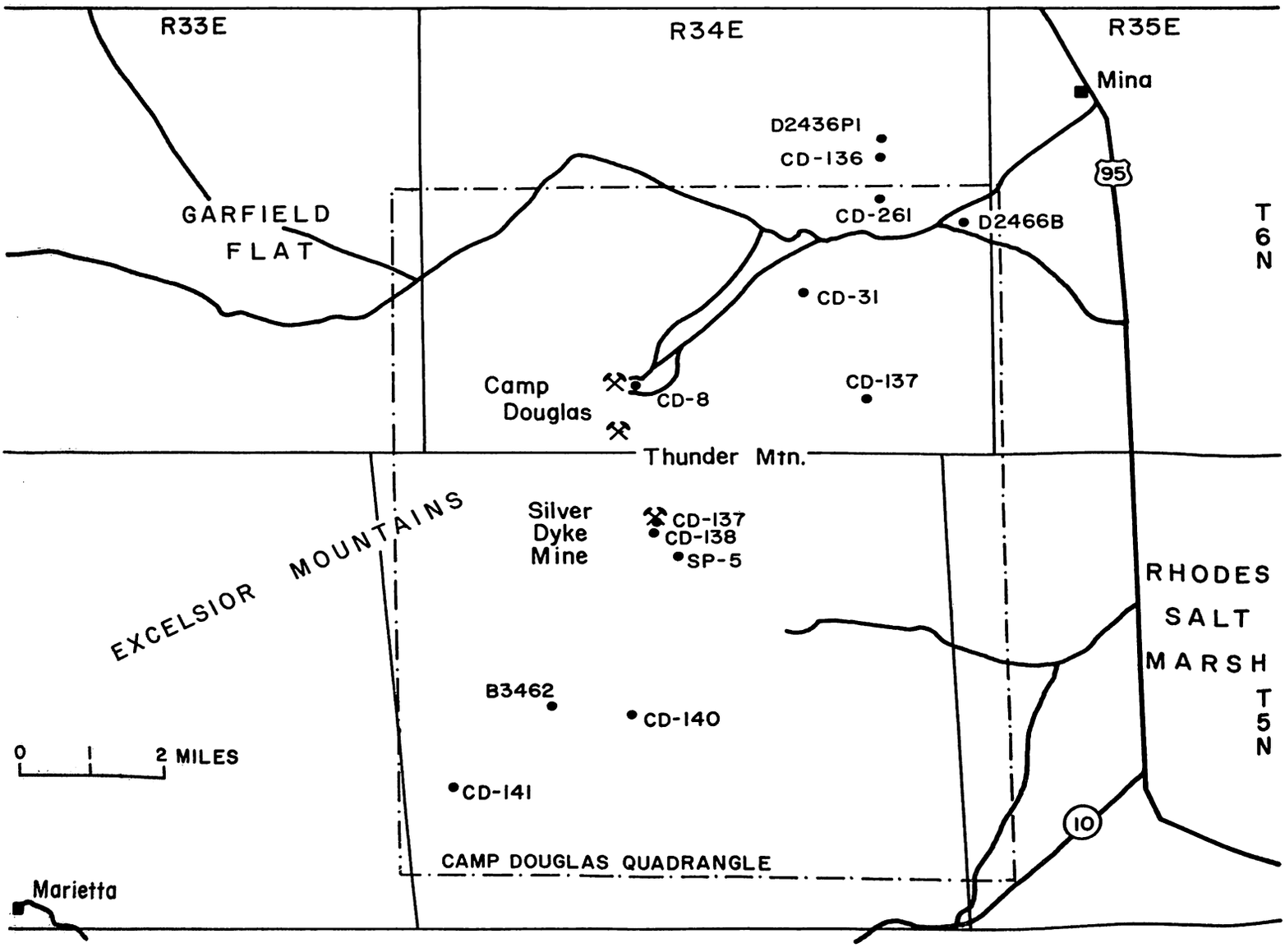

TABLE 1. Summary of K-Ar ages from igneous rocks and mineral deposits from the Camp Douglas quadrangle, Nevada.

SAMPLE	ROCK TYPE	MINERAL	AGE[1]	REFERENCE
		Tertiary Rocks		
D2466B	Tuffaceous sedimentary rock	Biotite	5.9 ± 0.2	Marvin and others (1977)
CD–31	Porphyritic andesite	Biotite Plagioclase	15.7 ± 0.5 16.1 ± 0.7	Silberman and others (1975)
CD–137	Latite intrusion	Plagioclase	18.9 ± 0.8	This report
CD–136	Rhyodacite ash-flow tuff	Plagioclase	22.0 ± 0.7	. .do. .
D2436P1	Crystal tuff	Plagioclase	21.9 ± 1.4	Marvin and others (1977)
CD–261	Rhyolite ash-flow tuff	Biotite Plagioclase	24.2 ± 0.7 24.8 ± 1.0	This report
B3462	Crystal tuff	Biotite	27.2 ± 1.5	Marvin and others (1977)
		Pre-Tertiary Rocks		
CD–141	"Quartz-eye" porphyry	Alkali feldspar Biotite	73.9 ± 2.2 89.5 ± 2.7	This report
CD–140	Granite	Alkali feldspar Plagioclase Biotite	78.5 ± 2.4 70.3 ± 2.1 92.8 ± 2.8	. .do. . . .do. . . .do. .
CD–139	Diorite	Biotite Hornblende concentrate	96.8 ± 2.9 91.5 ± 4.6	. .do. . . .do. .
SP–5	Diorite	Biotite	101 ± 4	. .do. .
		Alteration–Mineralization		
CD–8	Quartz-adularia vein–Camp Douglas	Hydrothermal K-feldspar	15.4 ± 0.5	Silberman and others (1975)
CD–138	Quartz-adularia vein–Silver Dyke	Hydrothermal K-feldspar	17.3 ± 0.2	Morton and others (1977)
CD–142	Quartz-adularia sulfide veinlet in diorite	Hydrothermal K-feldspar	75.9 ± 2.3	. .do. .

[1] Recalculated from previously published data to new constants

4. *CD–141* K-Ar
"Quartz-eye" granite porphyry dike. (NE/4 S30,T5N, R34E [unsurveyed]; 38°15'55"(15.92')N; 118°14'17" (14.28')W; Mineral Co., NV). Porphyritic granite with phenocrysts of quartz, biotite, K-feldspar, and plagioclase in fine-grained granular groundmass. *Analytical data:* (alkali feldspar) K_2O = 9.62%, $*Ar^{40}$ = 1.045 x 10^{-9} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 92%; (biotite) K_2O = 7.63%, $*Ar^{40}$ = 1.007 x 10^{-9} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 89%. *Collected by:* L. J. Garside, Nevada Bureau of Mines and Geology, and M. L. Silberman, U. S. Geological Survey; *dated by:* M. L. Silberman, U. S. Geological Survey. *Comment:* Alkali feldspar phenocrysts are microperthitic. Mixed phase feldspars are not in general retentive of argon (Evernden and Kistler, 1970). The biotite age is considered closer to the true

4. (continued)
crystallization age, and is close to the biotite age for the nearby granite pluton (see CD–140).

(alkali feldspar) 73.9 ± 2.2 m.y.
(biotite) 89.5 ± 2.7 m.y.

5. *CD 140* **K-Ar**

Granite. (NE/4 S21,T5N,R34E [unsurveyed]; 38° 16'37"(16.62')N, 118°12'04"(12.07')W; Mineral Co., NV). *Analytical data:* (alkali feldspar) K_2O = 10.49%, $*Ar^{40}$ = 1.211 x 10^{-9} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 79%; (biotite) K_2O = 3.98%, $*Ar^{40}$ = 5.454 x 10^{-10} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 80%; (plagioclase) K_2O = 0.323%, $*Ar^{40}$ = 3.336 x 10^{-11} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 47%. *Collected by:* L. J. Garside, Nevada Bureau of Mines and Geology and M. L. Silberman, U. S. Geological Survey; *dated by:* M. L. Silberman, U. S. Geological Survey. *Comment:* The ages of this sample are strongly discordant. The alkali feldspar is microcline, and the plagioclase has very fine twinning. According to Evernden and Kistler (1970) feldspars in plutonic rocks with those characteristics do not retain argon well. The biotite in the sample is highly chloritized as indicated by the low K_2O content. Chloritized biotites in the Sierra Nevada granitic rocks tend to give ages that are too young (Evernden and Kistler, 1970). However, in other areas, chloritized biotites and chlorites give ages concordant with minerals such as hornblende and muscovite (Silberman and others, 1977). In this sample, we consider the biotite age to be closest to the true age of crystallization.

(alkali feldspar) 78.5 ± 2.4 m.y.
(biotite) 92.8 ± 2.8 m.y.
(plagioclase) 70.3 ± 2.1 m.y.

6. *CD–139* **K-Ar**

Diorite. (in Silver Dyke Canyon; SW/4 S3,T5N,R34E [unsurveyed]; 38°18'55'(18.92')N; 118°11'52"(11.87') W; Mineral Co., NV). *Analytical data:* (biotite) K_2O = 7.30%, $*Ar^{40}$ = 1.045 x 10^{-9} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 89%; (hornblende) K_2O = 2.57%, $*Ar^{40}$ = 3.464 x 10^{-9} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 86%. *Collected by:* L. J. Garside, Nevada Bureau of Mines and Geology, and M. L. Silberman, U. S. Geological Survey; *dated by:* M. L. Silberman, U. S. Geological Survey. *Comment:* Hornblende concentrate was contaminated with biotite. The mafic minerals in this rock have magnetite inclusions, which makes mineral separation extremely difficult. The large uncertainty in the hornblende concentrate age reflects the problem with mineral concentration. This sample is from the same diorite pluton as sample SP–5.

(biotite) 96.8 ± 2.9 m.y.
(hornblende concentrate) 91.5 ± 4.6 m.y.

7. *SP–5* **K-Ar**

Peter Kerwin, Continental Oil Co., written commun., 1978.

Diorite. (in Silver Dyke Canyon; NW/4 NW/4 NW/4 S10, T5N,R34E [unsurveyed]; 38°18'44"(18.73')N, 118°11' 45"(11.75')W; Mineral Co., NV). *Analytical data:* (biotite) K_2O = 7.94%, $*Ar^{40}$ = 1.191 x 10^{-9} mole/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 75%. *Collected by:* W. A. Rehrig and O. J. Roman, Continental Oil Co.; *dated by:* Geochron Labs., Inc. *Comment:* The age reported by Geochron Labs. was 98.6 ± 3.6 m.y. using the old constants. This sample is from the same diorite pluton as sample CD–139.

(biotite) 101 ± 4

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