K/Ar AGES OF THE PYRAMID SEQUENCE IN THE VICINITY OF THE SAN EMIDIO GEOTHERMAL AREA, WASHOE COUNTY, NEVADA

STANLEY H. EVANS, JR. — *Department of Geology and Geophysics, University of Utah*

JOSEPH N. MOORE
MICHAEL C. ADAMS — *Earth Science Laboratory, University of Utah Research Institute*

As part of the Department of Energy's program to evaluate the geothermal potential of various areas in the western states, personnel of the University of Utah Research Institute, Earth Science Laboratory and the University of Utah Department of Geology and Geophysics undertook a joint geologic, geophysical, and geochronological study of the San Emidio geothermal system. The San Emidio thermal area lies adjacent to the northern end of the Lake Range, approximately 15 miles south of Gerlach, Nevada. Figure 1 presents a generalized geologic map of the area along with sample locations for material dated. Previous work in the area includes the thesis of Bonham (1962) and a report on the reconnaissance geology of Washoe County, also by Bonham (1969). Further reconnaissance mapping was conducted by one of the authors (Moore, 1980) under Department of Energy sponsorship. A detailed discussion of geology and geothermal potential of the area was presented by Mackelprang and others (1980).

The purpose of this paper is to present K-Ar ages of volcanic rocks which are exposed in the Lake Range and underlie the San Emidio Desert. Although the volcanic rocks are too old to be related to the heat source which drives the San Emidio geothermal system, the K-Ar ages nevertheless provide new insight into the timing of andesitic volcanism and Basin and Range faulting in northern Nevada.

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Constants Used:

$\lambda_\beta = 4.962 \times 10^{-10}\ yr^{-1}$
$\lambda_\epsilon = 0.581 \times 10^{-10}\ yr^{-1}$
$\lambda = 5.543 \times 10^{-10}\ yr^{-1}$
$^{40}K/K_{tot} = 1.167 \times 10^{-4}$ atom/atom.

DISCUSSION

The geology of the San Emidio area is dominated by a thick sequence of Tertiary volcanic and sedimentary rocks that accumulated on an irregular topographic surface eroded into Mesozoic metasediments. Bonham (1969) has assigned the Mesozoic rocks to the Nightingale Sequence of Triassic and Jurassic age.

The Nightingale Sequence of the Lake Range consists of a thick succession of metamorphosed and folded argillaceous rocks intercalated with carbonate, sandy and volcanic horizons. Low-grade regional metamorphism has converted these rocks to slates containing mixtures of chlorite, muscovite, biotite, quartz and plagioclase. No attempt was made to date this interval of metamorphism in the present study.

The Tertiary rocks overlying the Nightingale Sequence include an older volcanic and sedimentary assemblage assigned to the Pyramid Sequence and a younger largely sedimentary sequence that may be correlative with the Truckee and Coal Valley Formations of late Tertiary age (Bonham, 1969). The regional distribution of these Tertiary assemblages in the San Emidio area is not well understood at present. The dates reported here provide data on the age of the Pyramid Sequence which should aid in these correlations.

The lower portions of the Pyramid Sequence in the Lake Range and in the adjacent San Emidio Desert consists of a heterogeneous suite of interbedded tuffaceous sandstones, ash-flow tuffs, mud flows and intermediate composition lava flows. The upper part of the Pyramid Sequence consists of a thick succession of andesite to dacite lava flows. In the Lake Range, rocks of the Pyramid Sequence dip gently to the east at about 25°. Dixon (1977) mapped a similar suite of interbedded volcaniclastic and volcanic rocks in the Fox Range to the west which he also assigned to the Pyramid Sequence.

Three samples of poorly welded ash-flow tuffs, numbered 7c, 7d, and 34 were collected for age dating from two localities near the top of the lower portion of the Pyramid Sequence. K-Ar ages of 17.8 ± 0.7, 16.9 ± 1.2 and 16.2 ± 0.5 m.y. clearly establish the age of these rocks as mid-Miocene.

The voluminous outpourings of andesite and dacite which capped the ash-flow tuffs formed thin sparsely porphyritic flows. Phenocrysts include plagioclase and hypersthene accompanied, in places, by olivine. The flows have a total thickness of over 1000 feet (Moore, 1980, Mackelprang and others, 1980).

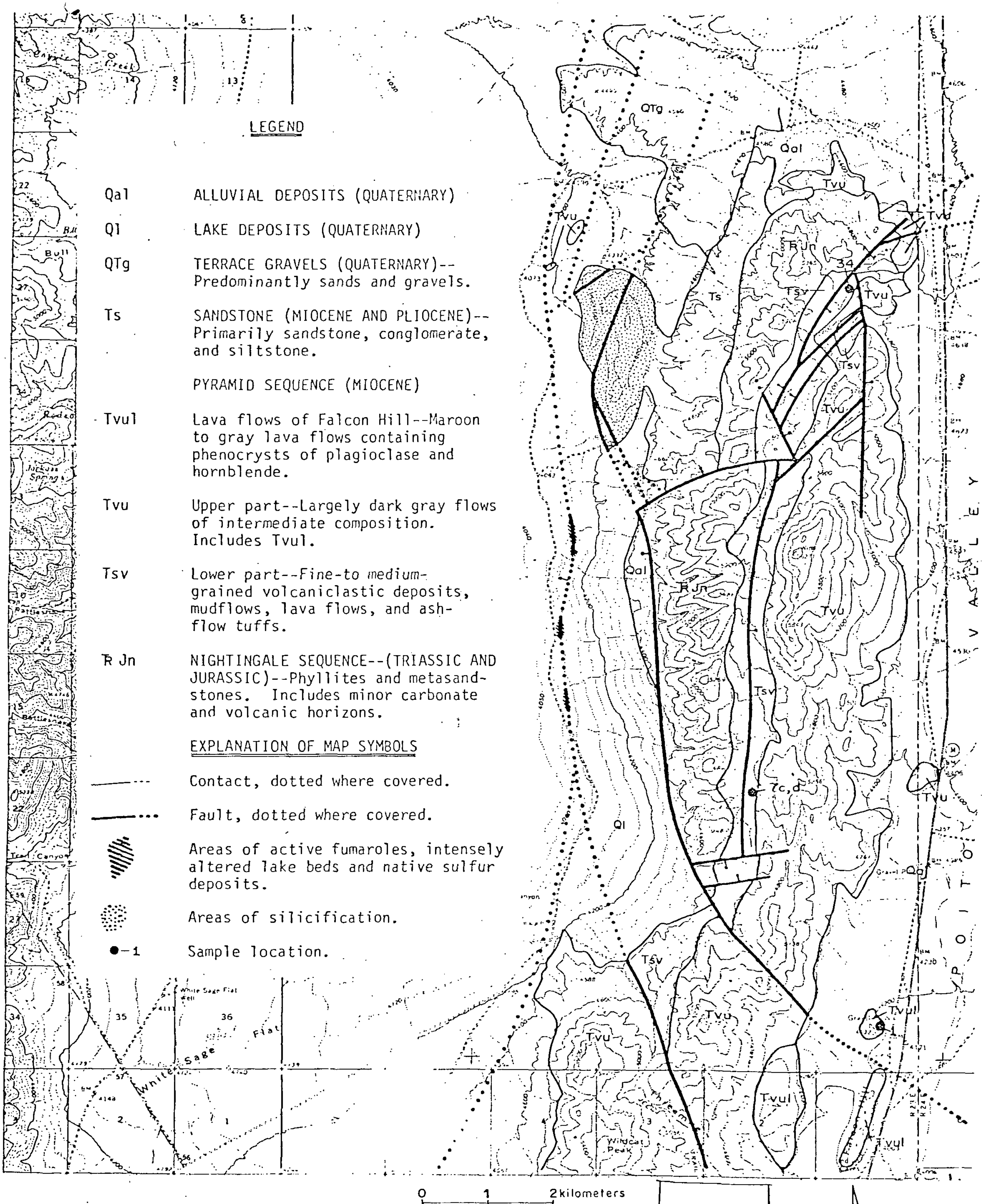
Porphyritic lava flows, containing phenocrysts of plagioclase and hornblende, were erupted from vents near Falcon Hill and locally cap the andesite flows on the east side of the Lake Range. Hornblende from the dacite flows yielded an age of 15.5 ± 0.7 m.y.

In summary deposition of the Pyramid Sequence spanned an interval of over 1.5 m.y. in the Lake Range. During the interval between about 15.5 and 17.0 m.y. ago volcanism was dominated by eruption of andesite lavas. Intense Basin and Range faulting began after deposition of the Pyramid Sequence, during the Miocene, and continued throughout the remainder of the Cenozoic.

SAMPLE DESCRIPTIONS

1. *1* K/Ar
Lava flows of Falcon Hill (40°20'N, 119°21'W; Washoe Co., NV). Unit consists of maroon to gray lava flows containing phenocrysts of plagioclase and hornblende. *Analytical data:* K = 2.41%, radiogenic $^{40}Ar = 6.53 \times 10^{-11}$ m/gm, atmospheric ^{40}Ar = 68%.
(hornblende) 15.5 ± 0.7 m.y.

2. *7C* K/Ar
Ash Flow of Northern Lake Range (40°22'N, 119°22'W; Washoe Co., NV). Pumice rich ash-



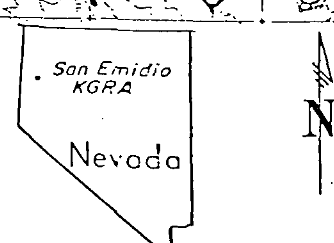


FIGURE 1. Generalized geologic map and sample locations for the San Emidio Geothermal Area, Washoe County, Nevada.

flow tuff containing approximately 7% phenocrysts of plagioclase, hypersthene, augite and hornblende. *Analytical data:* K = 0.55%, radiogenic ^{40}Ar = 1.71 x 10^{-11} m/gm, atmospheric ^{40}Ar = 51%.

(hornblende) 17.8 ± 0.7 m.y.

3. *7D* K/Ar

Ash Flow of Northern Lake Range (40°22'N, 119°22'W; Washoe County, NV). Same as sample 7C. *Analytical data:* K = 0.54%, radiogenic ^{40}Ar = 1.59 x 10^{-11} m/gm, atmospheric ^{40}Ar = 80%.

(hornblende) 16.9 ± 1.2 m.y.

4. *34* K/Ar

Ash Flow of Northern Lake Range (40°27'N, 119°21'W; Washoe Co., NV). Pumice rich ash-flow tuff similar to sample 7C but sampled from the northernmost outcrop of this unit. *Analytical data:* K = 0.66%, radiogenic ^{40}Ar = 1.88 x 10^{-11} m/gm, atomspheric ^{40}Ar = 28%.

(plagioclase) 16.2 ± 0.5 m.y.

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