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K-AR AGES OF UPPER CENOZOIC VOLCANIC ROCKS, NORTHERN CALIFORNIA

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Geologic interest in the extensive volcanic region of northernmost California has recently been renewed after a lapse of about 40 years since the important studies by Peacock (1931), Powers (1932), and Anderson (1941). This interest, however, has been mainly in petrologic problems of the associated volcanic rocks in the Medicine Lake Highland. Radiometric data critical to a preliminary assessment of the geothermal potential have been lacking for most of the region. Several volcanic rock samples, therefore, were collected for radiometric dating in the Medicine Lake region (fig. 1). These supplement the samples recently dated (McKee and Duffield, 1979) in the Modoc region just to the east and provide a more comprehensive understanding of the region as part of our current geothermal studies of the western United States (Luedke and Smith, in press).

Five whole-rock potassium-argon ages were determined on volcanic flows that surround and underlie the geologically younger volcanic flows and tuffs composing the Medicine Lake Highland. The rocks collected are basalt and andesite from units formerly mapped as the Cedarville Series and Warner Basalt (Russell, 1928) and the "massive lava group" (Powers, 1932). Specific assignment of the dated units will be made during the detailed geologic mapping currently in progress by the U.S. Geological Survey.

Age assignments were done by isotope dilution, using equipment and techniques described by Dalrymple and Lanphere (1969). Potassium was measured by flame photometry, using a lithium internal standard. Potassium as determined by P. R. Klock and argon by B. M. Myers, S. E. Sims, and J. C. Von Essen (all of the U.S. Geological Survey). Constants used in the calculations are: $\lambda_e + \lambda'_e = 0.581 \times 10^{-10} \text{ yr}^{-1}$, $\lambda_\beta = 4.962 \times 10^{-10} \text{ yr}^{-1}$, and $^{40}\text{K}/\text{K total} = 1.167 \times 10^{-4} \text{ mol/mol}$. Errors are estimates of the standard deviation of analytical precision (Cox and Dalrymple, 1967). We thank J. G. Arth and B. C. Hearn, Jr., for their reviews of the manuscript.

SAMPLE DESCRIPTIONS

1. 78 C 11

K-Ar

Andesite or basaltic andesite. (SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ S25, T46N, R1W; 41°48'05"N, 121°50'35"W; Dorris 15' quad., Siskiyou Co., CA). Medium-gray slightly porphyritic rock containing small feldspar phenocrysts in a dense holocrystalline groundmass. *Analytical data:* K₂O = 1.13%, 1.13%, 1.13%, 1.13%; *Ar⁴⁰ = 1.956 x 10⁻¹² mol/gm; *Ar⁴⁰/ΣAr⁴⁰ = 17.2%. *Collected by:* R. G. Luedke, 1978. *Comment:* Collected within a road-metal quarry in faulted(?) flank flows on the west side of Sheep Mountain shield volcano.

(whole rock) 1.20 ± 0.07 m.y.

2. 78 C 9

K-Ar

Olivine basalt. (Center E $\frac{1}{2}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ S4, T45N, R2E; 41°46'25"N, 121°45'20"W; Dorris 15' quad., Siskiyou County, CA). Medium-gray dense interior of fine-grained vesicular flow. *Analytical data:* K₂O = 0.863%, 0.864%, 0.865%, 0.868%; *Ar⁴⁰ = 1.457 x 10⁻¹² mol/gm; *Ar⁴⁰/ΣAr⁴⁰ = 16.4%. *Collected by:* R. G. Luedke, 1978. *Comment:* This 10-m-thick, massive and blocky flow is near the base of about a 250-m-thick series of flows in the upfaulted block and thus indicates young northwest-trending basin-range faulting in the region.

(whole rock) 1.22 ± 0.07 m.y.

3. 78 C 14

K-Ar

Basalt. (SW cor SE $\frac{1}{4}$ SW $\frac{1}{4}$ S13, T43N, R4E, unsurveyed; 41°33'40"N, 121°27'45"W; Timber Mt. 15' quad., Siskiyou County, CA). Medium-gray dense to slightly porphyritic flow. *Analytical data:* K₂O = 0.674%, 0.676%, 0.679%, 0.679%; *Ar⁴⁰ = 1.253 x 10⁻¹³ mol/gm; *Ar⁴⁰/ΣAr⁴⁰ = 1.2%. *Collected by:* R. G. Luedke, 1978. *Comment:* Collected from a massive flow, not texturally like the younger Medicine Lake or Modoc lava flows, near the northeast base of Black Mountain. However, the young age suggests that this flow may be a part of the Medicine Lake shield volcano instead of representing the older basement volcanic rocks. Minimum or marginal age.

(whole rock) 0.13 ± 0.10 m.y.

4. 78 C 15

K-Ar

Basalt. (SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ S27, T43N, R7E; 41°31'55"N, 121°08'40"W; Hackamore 15' quad., Modoc County, CA). Light-gray slightly vesicular fine-grained flow. *Analytical data:* K₂O = 0.222%, 0.224%, 0.224%, 0.227%; *Ar⁴⁰ = 5.222 x 10⁻¹³ mol/gm; *Ar⁴⁰/ΣAr⁴⁰ = 10.0%. *Collected by:* R. G. Luedke, 1978. *Comment:* From flow on the southwest flank of the Spaulding Butte shield volcano.

(whole rock) 1.62 ± 0.15 m.y.

5. 78 C 8

K-Ar

Olivine basalt. (E-center SE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ S30, T40N, R2E; 41°16'47"N, 121°46'55"W; Bartle 15' quad., Siskiyou County, CA). Light- to medium-gray fine-grained flow. *Analytical data:* K₂O = 0.248%, 0.250%, 0.252%, 0.255%; *Ar⁴⁰ = 7.771 x 10⁻¹³ mol/gm; *Ar⁴⁰/ΣAr⁴⁰ = 15.8%. *Collected by:* R. G. Luedke, 1978. *Comment:* Stratigraphic relation of sampled flow is uncertain to or within the basalts of the Bear

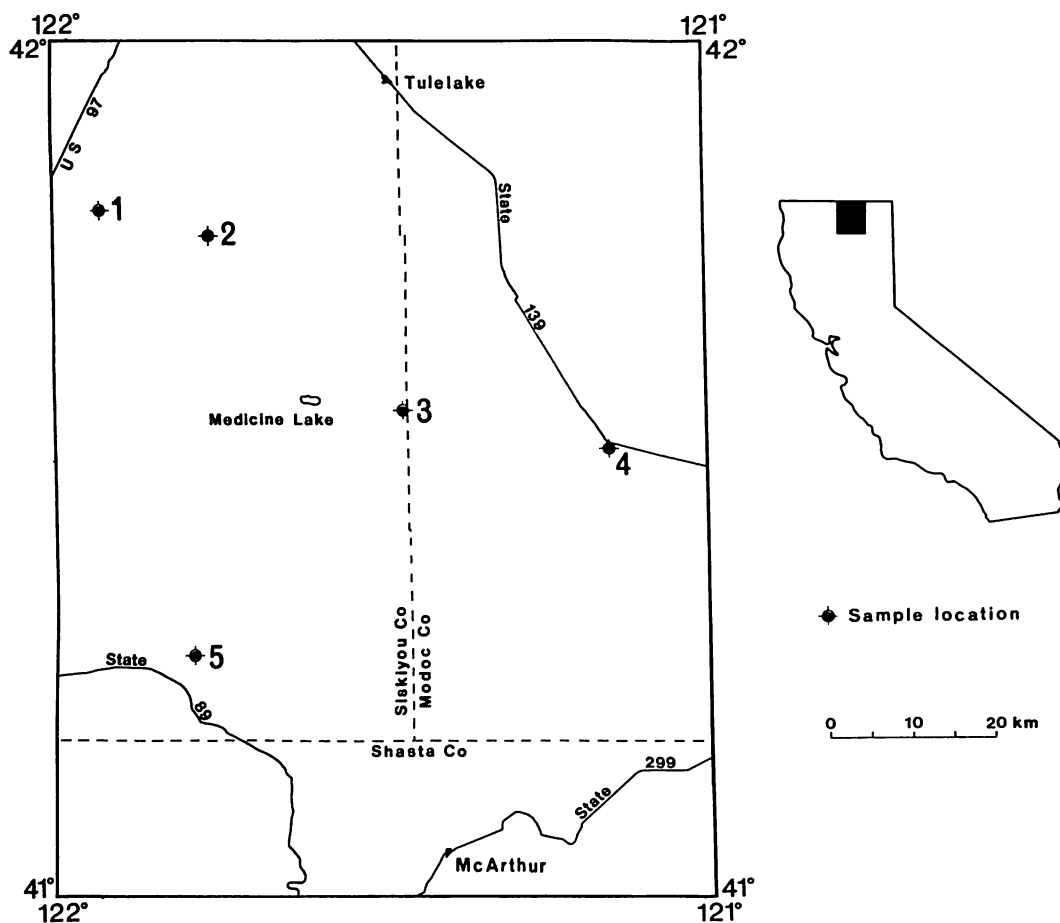


FIGURE 1. Map showing sample localities of dated rocks in northern California.

Mountain area (Powers, 1932) but indicates a younger age than expected for the volcanic rocks representing the basement in the region south of the Medicine Lake Highland.

(whole rock) 2.15 ± 0.13 m.y.

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