Potassium-Argon ages of volcanic rocks from the Domeland, southern Sierra Nevada, California

J.R. Bergquist and M.F. Diggles

Isochron/West, Bulletin of Isotopic Geochronology, v. 46, pp. 6-8

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

POTASSIUM-ARGON AGES OF VOLCANIC ROCKS FROM THE DOMELAND, SOUTHERN SIERRA NEVADA, CALIFORNIA

JOEL R. BERGQUIST
MICHAEL F. DIGGLES
U.S. Geological Survey, Menlo Park, California 94025

Volcanic rocks from the Kern Plateau in the vicinity of the Domeland, about 80 km northeast of Bakersfield, California, were dated by the potassium-argon method (fig. 1). The volcanic rocks are erosional remnants of formerly extensive flows erupted onto a surface of relatively low relief. These remnants are now perched on the elevated, deeply dissected Kern Plateau. The samples were dated in order to correlate units and to provide a means to calculate rates of erosional downcutting.

The distribution of the volcanic rocks is shown on fig. 1, and on a geologic map (Bergquist and Nitkiewicz, 1982). The volcanic flows overlie a sequence of rocks that is typical of the Sierra Nevada. Pre-Middle Jurassic metasedimentary and metavolcanic rocks were intruded during the Mesozoic by a succession of platonic rocks of varying composition. The oldest intrusive unit is Jurassic and (or) Triassic mesocratic hornblende gabbro. Intruding the gabbro are a Jurassic mesocratic hornblende tonalite and a leucocratic hornblende-biotite granodiorite. The youngest plutonic rock is the Isabella Granodiorite of Miller (1931), a leucocratic, coarse-grained granite and granodiorite.

The volcanic rocks are mostly basalt flows that are dark gray to black, medium gray weathering, massive to blocky, and locally banded vesicular to scoriaceous. Near Trout Creek at the northern margin of the Domeland, and in Bartolas Country in the southern part of the Domeland, the flows are medium gray to purplish gray and platy weathering. The accumulation of volcanic flows is about 120 m thick at Trout Creek. The basalts locally contain xenoliths and quartz xenocrysts, derived from the underlying granitic rocks. Flow foliation, defined by flattened and elongated vesicles, is locally evident. Flow breccia, in part alloclastic, occurs locally along the contact with the granitic rocks.

The volcanic rocks typically contain euhedral to subhedral microphenocrysts of magnesian olivine; greenish, euhedral, zoned, titaniferous augite, often with hourglass structure; and variously resorbed fragments of zoned plagioclase. The olivine is sparsely rimmed or wholly altered to reddish-brown iddingsite. The texture is commonly trachytic; the groundmass is usually holocrystalline and consists of granular augite, plagioclase (labradorite?), chlorite, and abundant fine-grained, blocky, opaque minerals.

Nine samples were thin sectioned and examined with the petrographic microscope to determine suitability for dating. The samples were collected by Joel R. Bergquist in 1981, and Michael F. Diggles and Joel R. Bergquist in 1984. The age determinations were made in the laboratories of the U.S. Geological Survey, Menlo Park, Calif., using standard isotope-dilution procedures as described by Dalrymple and Lanphere (1969). The samples were crushed and sieved to 80- to 16-mesh and treated in hydrofluoric and nitric acids. The potassium content was determined using a lithium metaborate flux fusion-flame photometry technique with the lithium serving as an internal standard (Ingamells, 1970). The argon analyses were made using a 60° sector, 15.2 cm-radius, Neir-type mass spectrometer (Duckworth, 1958). The analytical uncertainties for the age data are reported at one standard deviation and are the combined analytical uncertainties in the measurement of radiogenic ^{40}Ar, the ^{38}Ar tracer, and the K_2O in the sample. The decay constants used are: $\lambda_\beta = 4.962 \times 10^{-10}$ yr^{-1}; $\lambda_{\epsilon+\epsilon'} = 0.581 \times 10^{-10}$ yr^{-1}; and $^{40}K/K_{total} = 1.167 \times 10^{-4}$ as adopted by the International Union of Geological Sciences Subcommission on Geochronology (Steiger and Jager, 1977).

The ages obtained for the volcanic flows cluster in two groups and indicate two distinct periods of volcanism. The younger ages range from 3.9 to 3.0 m.y. (Pliocene), and the older ages range from 12.8 to 10.6 m.y. (late Miocene). The younger flows are in the northern part of the Domeland in the vicinity of Trout Creek and Pine Mountain, whereas the older flows are to the south (fig. 1). Moore and Dodge (1980) found a similar bimodal age distribution of basalt flows in the San Joaquin-Kings volcanic field 50 to 150 km to the northwest. There, the younger ages clustered between 4.5 and 3.9 m.y., and the older ages between 12 and 9 m.y.

Diane E. Clemens prepared the samples, Paul R. Klock did the potassium analyses, and J. Donald Landells provided skilled helicopter support. Robert J. Miller and James E. Conrad reviewed the manuscript.

SAMPLE DESCRIPTIONS

1. *MO-84-8A* K-Ar
Basalt (36°00′22″N,118°12′31″W, 3 km SW of Pine Mountain, from top of 7,980 ft peak, Monache Mountain 15′ quad., Tulare Co., CA). *Analytical data:* K_2O = 0.700% and 0.671%; $^{40}Ar^* = 3.8191 \times 10^{-12}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar = 0.093$.
(whole rock) 3.9 ± 0.2 m.y.

2. *KV-84-7A* K-Ar
Basalt (35°59′20″N,118°17′06″W, 5 km SW of Bald Mountain on N side of Trout Creek, Kernville 15′ quad., Tulare Co., CA). *Analytical data:* K_2O = 2.727% and 2.727%; $^{40}Ar^* = 1.3297 \times 10^{-11}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar = 0.406$.
(whole rock) 3.4 ± 0.1 m.y.

3. *KV902* K-Ar
Basalt (35°58′31″N,118°17′29″W, 6 km SW of Bald Mountain on S side of Trout Creek, Kernville 15′ quad., Tulare Co., CA). *Analytical data:* K_2O = 2.582% and 2.588%; $^{40}Ar^* = 1.0977 \times 10^{-11}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar = 0.108$.
(whole rock) 3.0 ± 0.1 m.y.

4. *LP-81-1A* K-Ar
Basalt (35°51′24″N,118°14′54″W, N end Black Mountain, Lamont Peak 15′ quad., Tulare Co., CA). *Analytical data:* K_2O = 1.354%, 1.382%, 1.313%, and 1.390%; $^{40}Ar^* = 2.4 \times 10^{-11}$ mol/g; $^{40}Ar^*/\Sigma^{40}Ar = 0.550$ (Bergquist and Nitkiewicz, 1982).
(whole rock) 12.2 ± 0.4 m.y.

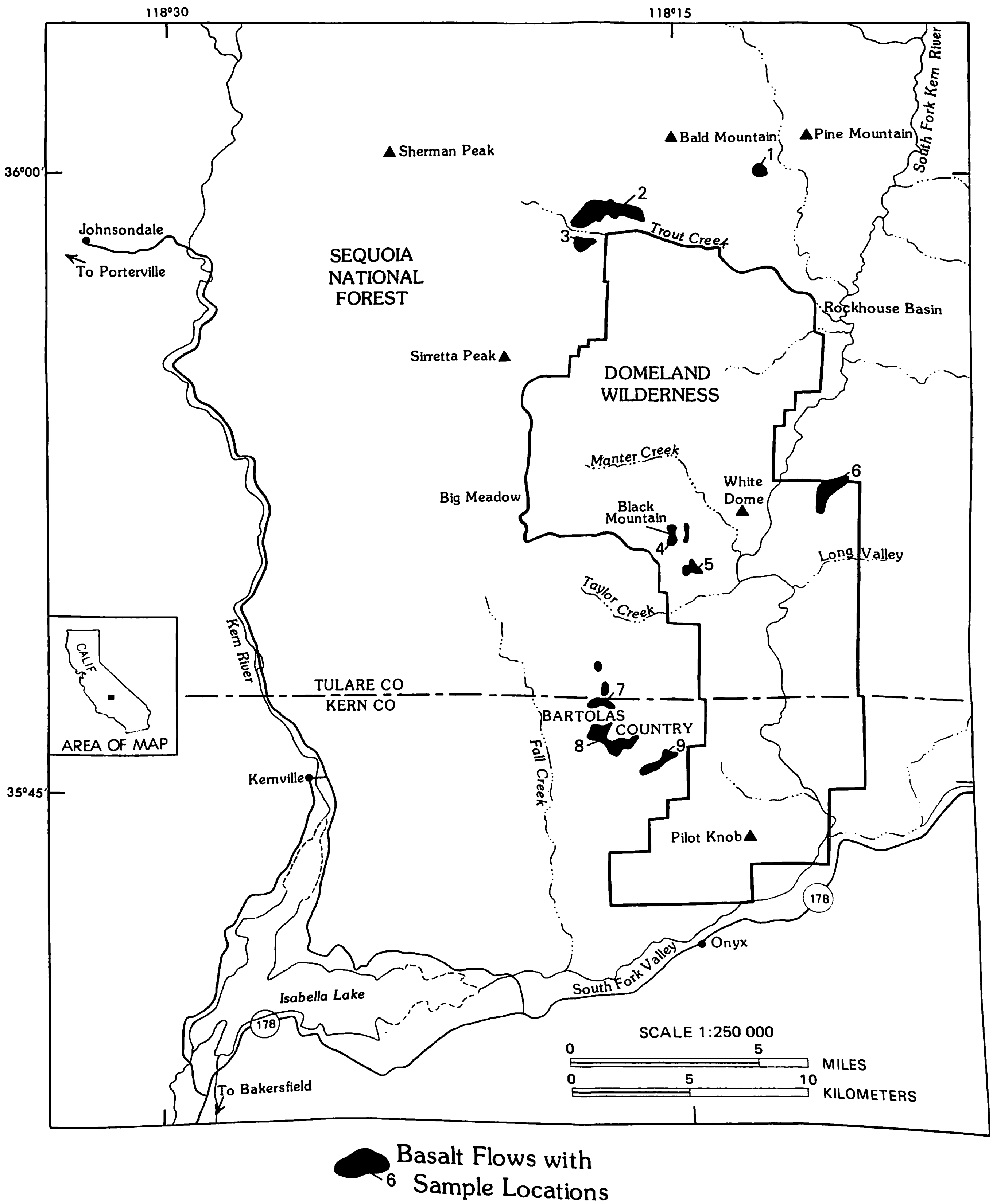

FIGURE 1. Location map showing areas of basalt flows and sample locations.

5. *KV-84-5A* K-Ar
Basalt (35°50′27″N,118°14′18″W, 1.5 km SE of Black Mountain, Kernville 15′ quad., Tulare Co., CA). *Analytical data:* K_2O = 1.719% and 1.693%; $^{40}Ar^*$ = 2.9166 × 10^{-11} mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 0.226.
(whole rock) 11.8 ± 0.2 m.y.

6. *LP-84-4A* K-Ar
Basalt (35°52′32″N,118°10′21″W, bottom of flows on top of flatiron ridge 3 km E of White Dome, Lamont Peak 15′ quad., Tulare Co., CA). *Analytical data:* K_2O = 0.575% and 0.538%; $^{40}Ar^*$ = 1.0326 × 10^{-11} mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 0.230.
(whole rock) 12.8 ± 0.7 m.y.

7. *KV-84-3A* K-Ar
Basalt (35°47′10″N,118°16′46″W, 0.5 km S of Tulare County-Kern County line, Kernville 15′ quad., Kern Co., CA). *Analytical data:* K_2O = 1.913% and 1.900%; $^{40}Ar^*$ = 3.1572 × 10^{-11} mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 0.395.
(whole rock) 11.5 ± 0.1 m.y.

8. *KV-84-1A* K-Ar
Basalt (35°46′17″N,118°16′55″W, 2 km SE of Cane Meadow, Kernville 15′ quad., Kern Co., CA). *Analytical data:* K_2O = 2.396% and 2.412%; $^{40}Ar^*$ = 3.6895 × 10^{-11} mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 0.284.
(whole rock) 10.6 ± 0.2 m.y.

9. *LP-84-2A* K-Ar
Basalt (35°45′48″N,118°14′52″W, Lamont Peak 15′ quad., Kern Co., CA). *Analytical data:* K_2O = 1.993% and 1.971%; $^{40}Ar^*$ = 3.3030 × 10^{-11} mol/g; $^{40}Ar^*/\Sigma^{40}Ar$ = 0.358.
(whole rock) 11.5 ± 1.0 m.y.

REFERENCES

Bergquist, J. R., and Nitkiewicz, A. M. (1982) Geologic map of the Domeland Wilderness and contiguous areas, Kern and Tulare Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1395-A.

Dalrymple, G. B., and Lanphere, M. A. (1969) Potassium-argon dating, principles, techniques, and applications to geochronology: W. H. Freeman Co., San Francisco.

Duckworth, H. E. (1958) Mass spectroscopy: Cambridge University Press.

Ingamells, C. O. (1970) Lithium metaborate flux in silicate analysis: Analytica Chimica Acta, v. 52, p. 323–334.

Miller, W. J. (1931) Geologic sections across the Southern Sierra Nevada of California: University of California Publications, Department of Geological Sciences Bulletin, v. 20, no. 9, p. 331–360.

Moore, J. G., and Dodge, F. C. W. (1980) Late Cenozoic volcanic rocks of the southern Sierra Nevada, California—geology and petrology: Geological Society of America Bulletin, v. 91, no. 9, p. 515–518.

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.