New K-Ar ages for Pliocene mafic to intermediate volcanic rocks in the Reveille Range, Nevada

T.R. Naumann, E.I. Smith, M. Shafiqullah, and P.E. Damon

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NEW K-Ar AGES FOR PLIOCENE MAFIC TO INTERMEDIATE VOLCANIC ROCKS IN THE REVEILLE RANGE, NEVADA

TERRY R. NAUMANN
EUGENE I. SMITH
Center for Volcanic and Tectonic Studies, Department of Geoscience, University of Nevada, Las Vegas, NV 89154

MUHAMMAD SHAFIQULLAH
PAUL E. DAMON
Laboratory of Isotope Geochemistry, Department of Geosciences, University of Arizona, Tucson, AZ 85721

In this paper we report 16 new K-Ar ages for Pliocene mafic to intermediate volcanic rocks in the Reveille Range, Nevada and one K-Ar date of a Miocene-aged tristanite from the vicinity of the Reveille Range.

The Pliocene volcanic rocks of the Reveille Range represent the southern half of a 20 km wide by 100 km long north to N30°E trending belt that combined with the Lunar Crater Volcanic Field extends from 37°45′ to 38°45′ in the south-central Great Basin (fig. 1a). According to the classification of Irvine and Baragar (1971) volcanic rocks range in composition from picrite to trachyte and occur as shallow intrusions, domes, flows and dissected cinder cones. Based on field relations, petrology and K-Ar ages volcanic rocks of the Reveille Range are divided into three episodes (Naumann and Smith, 1988) (fig. 1b and 2). These are:

Episode 1 (5.9 to 5.0 Ma): Basalts of Episode 1 are porphyritic olivine basalts that contain plagioclase megacrysts (up to 40 modal %). They range in composition from alkali basalt to hawaiite (44 to 48% SiO_2). Fifty-two vents occur on both the east and west flanks and near the crest of the range (fig. 1b).

Episode 2 (4.6 to 3.0 Ma): Basalts of Episode 2 are porphyritic olivine basalts containing megacrysts of augite (up to 40 %), amphibole (up to 35 %) and plagioclase (< 5%) and coarse grained xenoliths of gabbro and dunite (up to 20 cm in length). They range in composition from picrite to trachybasalt (41 to 56% SiO_2). Fourteen Episode 2 vents occur on the northeast piedmont and flank of the range (fig. 1b).

Evolved volcanism (4.4 & 4.2 Ma): Eruptions of trachyte (60% SiO_2) and tristanite (58% SiO_2) containing ferrosillite, hedenburgite, anorthoclase, sanidine, and andesine produced two domes (volumes are < 0.01 km^3 and 0.26 km^3, respectively) on the northeast flank of the range (Naumann and others, 1990) (fig. 1b). The northernmost dome is associated with an apron of pyroclastic flow and surge deposits and volcaniclastic debris (fig. 1b).

The new K-Ar dates establish that two episodes of basaltic volcanism occurred in the Reveille Range between 5.9 and 3.00 Ma. Episodes of basaltic volcanism were separated by the eruption of trachytic lavas and pyroclastic units at 4.4 and 4.2 Ma (fig, 2).

Previously published K-Ar ages for the Reveille Range include a date of 5.7 ± 0.2 Ma on an Episode 1 basalt flow on the northwestern flank of the range (Marvin and others, 1973). Dates of 5.8 ± 0.3 and 5.6 ± 0.3 Ma were obtained for Episode 1 basalt flows in the western part of the range, and 3.9 ± 0.2 and 3.8 ± 0.3 Ma for Episode 2 basalt flows on the east flank of the range (Dohrenwend and others, 1985). The K-Ar dates reported in this paper indicate that the most recent activity in the Reveille Range occurred at 3.0 Ma rather than 3.8 Ma.

MIGRATION OF VOLCANISM

Foland and others (1987) reported that volcanism migrated to the north in the Reveille-Lunar Crater field. According to their model, volcanism initiated at about 9 Ma and migrated north to the Lunar Crater field at a rate of about 1 cm/year. Detailed dating of volcanic centers in the northeast Reveille range indicates that migration patterns are locally more complicated. For example, in the northeastern Reveille Range, Episode 1 activity migrated mainly to the south while Episode 2 volcanism migrated both north and south. The youngest Episode 2 volcano (3.0 Ma) formed in the south (fig. 3).

MISCELLANEOUS NYE COUNTY VOLCANIC ROCKS

A previously unmapped trachyte dome and flow complex located 20 km southeast of the Reveille Range in the White Blotch Springs quadrangle yielded a K/Ar date of 14.1 Ma. The dome is 1 km in diameter and 150 m high and was mapped on the Geologic Map of Southern Nye County as undifferentiated Pliocene welded Tuff (Cornwall, 1972).

ANALYTICAL TECHNIQUES

All dates were obtained from groundmass plagioclase separates. Feldspar phenocrysts and megacrysts were removed from samples prior to analysis. Analytical procedures discussed by Damon and others (1983) were used in this study (constants: $\lambda_\beta = 4.963 \times 10^{-10}$ yr^{-1}, $\lambda_\epsilon = 0.581 \times 10^{-10}$ yr^{-1}, $\lambda = 6.544 \times 10^{-10}$ yr^{-1}, $^{40}K/K = 1.167 \times 10^{-4}$ atom/atom).

ACKNOWLEDGEMENTS

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SAMPLE DESCRIPTIONS

Episode 1

1. *R8-1-17-LN* K-Ar
Porphyritic olivine basalt flow; contains large plagioclase megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°4′15″, 116°7′24″; Reveille Range, Nye County, NV). *Analytical data:* K = 0.846, 0.849, 0.823%; $*Ar^{40}$ = 7.335, 7.462, 7.651, 7.461 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 54.5, 55.2, 56.4, 55.3%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah. *Comment:* This sample was collected from the youngest Episode 1 flow.
(plagioclase) 5.13 ± 0.15 Ma

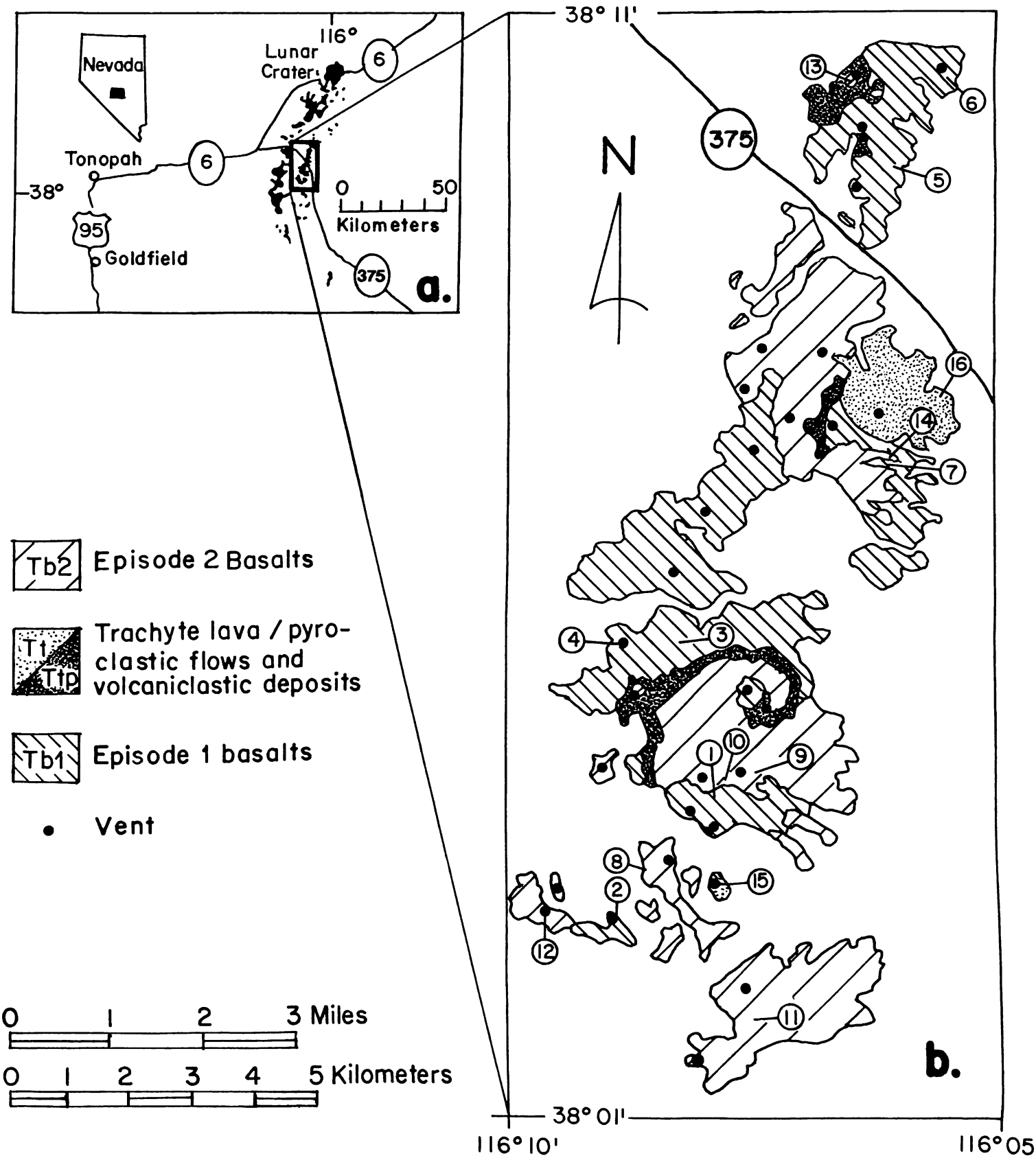

FIGURE 1. *a*—Location of Pliocene and younger volcanic rocks of the Reveille Range—Lunar Crater volcanic field. *b*—Generalized geologic map of the Pliocene volcanic rocks in the northeastern Reveille Range. Circled numbers are sample locations for K-Ar dates.

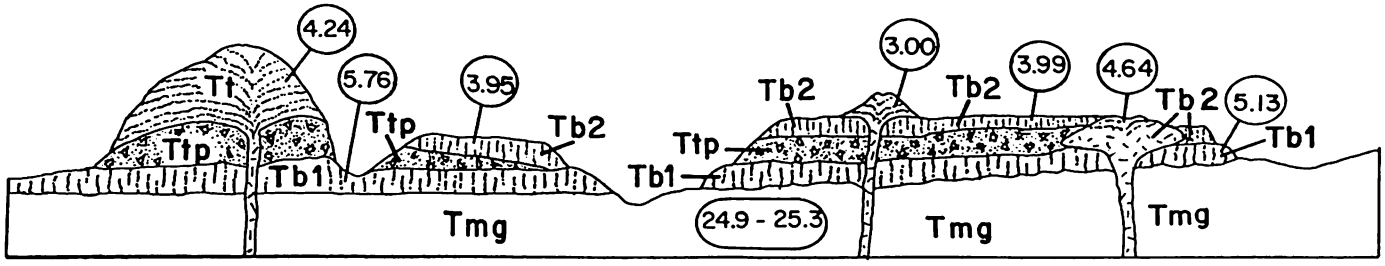

FIGURE 2. Cartoon cross-section showing the stratigraphic relationships among the dated volcanic units in the Reveille Range. Symbols are the same as in figure 1b. Tmg = Tuff of Goblin Knobs (Monotony Tuff) a densely welded, coarsely devitrified quartz latitic to rhyolitic welded tuff. Dates for Tmg were reported in Ekren and others (1973).

2. *R8-1-24-LN* K-Ar
Porphyritic olivine basalt dike; contains large plagioclase megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°3'18", 116°8'52"; Reveille Range, Nye County, NV). *Analytical data:* K = 0.871, 0.871, 0.891, 0.887%; $*Ar^{40}$ = 8.233, 8.390, 8.374, 8.254 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 78.4, 78.5, 76.4, 64.5%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 5.44 ± 0.14 Ma

3. *R8-1-28-LN* K-Ar
Porphyritic olivine basalt flow; contains large plagioclase megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°5'40", 116°8'5"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.693, 1.683, 1.652, 1.679, 1.683, 1.679%; $*Ar^{40}$ = 16.57, 16.78, 16.80 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 66.4, 68.1, 68.2%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah. *Comment:* This sample and R8-1-29-LN were collected from the same cinder cone-flow complex.
(plagioclase) 5.74 ± 0.10 Ma

4. *R8-1-29-LN* K-Ar
Porphyritic olivine basalt plug; contains large plagioclase megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°5'39", 116°8'40"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.116, 1.079, 1.067, 1.118, 1.095%; $*Ar^{40}$ = 10.92, 10.73, 10.55, 10.48 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 50.7, 49.7, 49.0, 48.6%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 5.61 ± 0.15 Ma

5. *R9-1-48-LN* K-Ar
Porphyritic olivine basalt flow; contains large plagioclase megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°9'48", 116°6'02"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.194, 1.176, 1.229, 1.185, 1.170%; $*Ar^{40}$ = 12.08, 12.04, 12.03, 11.80 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 75.7, 75.5, 75.7, 75.2%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 5.80 ± 0.13 Ma

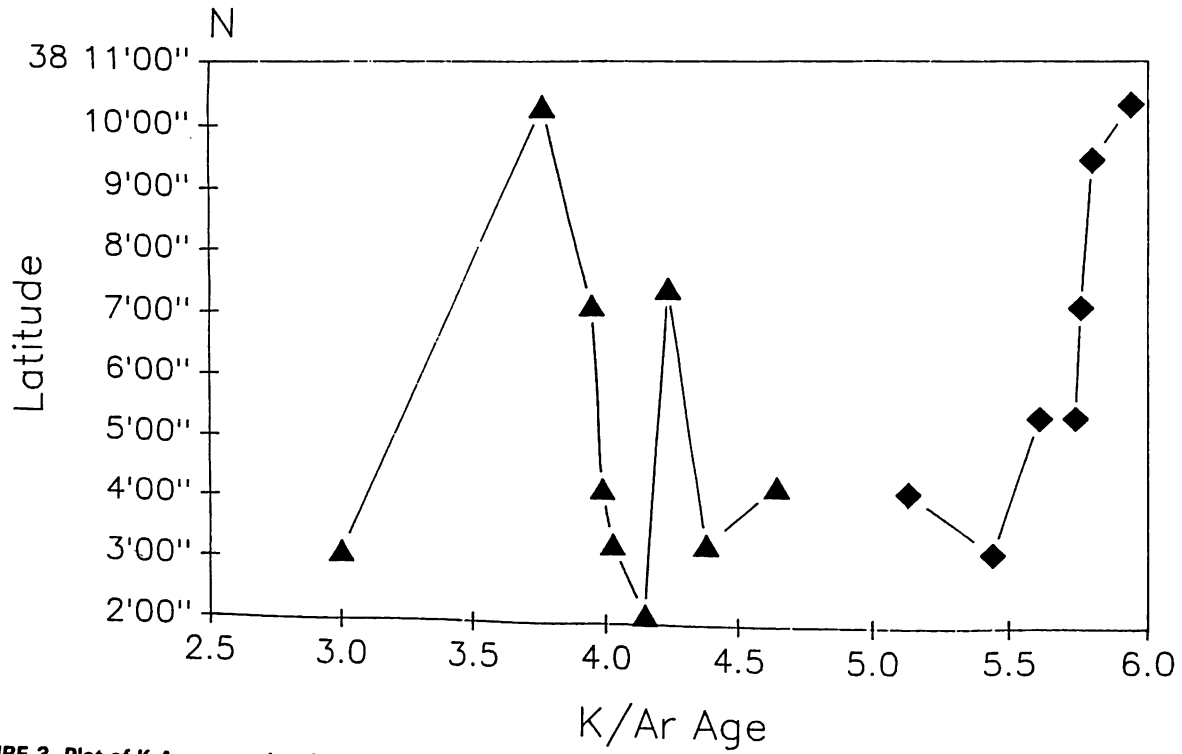

FIGURE 3. Plot of K-Ar age against latitude for dated volcanic centers in the northeast Reveille Range. Diamonds = Episode 1 basalts; Triangles = Episode 2 basalts and trachyte lavas.

6. *R9-1-56-LN* K-Ar
Porphyritic olivine basalt plug; contains large plagioclase megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°10'33", 116°5'30"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.257, 1.260, 1.225, 1.209%; $*Ar^{40}$ = 12.92, 12.67, 12.66, 12.82 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 67.2, 65.7, 65.8, 66.8%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah. *Comment:* This sample was collected from the stratigraphically lowest Episode 1 flow.
(plagioclase) 5.94 ± 0.14 Ma

7. *R9-1-57-LN* K-Ar
Porphyritic olivine basalt; contains large plagioclase megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°7'15", 116°5'45"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.365, 1.367, 1.384, 1.393, 1.360%; $*Ar^{40}$ = 13.73, 13.73, 13.77 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 68.0, 66.9, 66.9%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah. *Comment:* R9-1-57-LN is overlain by pyroclastic deposits from the adjacent trachyte dome.
(plagioclase) 5.76 ± 0.14 Ma

Episode 2

8. *R8-1-2-LN* K-Ar
Porphyritic olivine basalt flow; contains plagioclase and augite megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°3'30", 116°8'20"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.469, 1.468, 1.444, 1.469, 1.497%; $*Ar^{40}$ = 10.12, 10.24, 10.50, 10.33, 10.25, 10.29, 10.29, 10.20 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 71.2, 72.9, 74.0, 68.9, 68.6, 69.0, 68.5, 72.6%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 4.03 ± 0.12 Ma

9. *R8-1-13-LN* K-Ar
Porphyritic olivine basalt plug; contains large plagioclase and augite megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°4'23", 116°7'18"; Reveille Range, Nye County, NV). *Analytical data:* K = 0.805, 0.825, 0.839%; $*Ar^{40}$ = 6.730, 6.676, 6.607, 6.482 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 68.3, 67.8, 67.3, 67.5%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah. *Comment:* This sample was collected from the oldest Episode 2 basalt.
(plagioclase) 4.64 ± 0.14 Ma

10. *R8-1-18-LN* K-Ar
Porphyritic olivine basalt flow; contains large plagioclase and augite megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°4'20", 116°7'24"; Reveille Range, Nye County, NV). *Analytical data:* K = 0.999, 0.994, 0.987, 0.969, 0.972%; $*Ar^{40}$ = 6.757, 6.801, 6.867 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 73.7, 74.9, 75.4%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 3.99 ± 0.10 Ma

11. *R8-1-19-LN* K-Ar
Porphyritic olivine basalt flow; contains large plagioclase and augite megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°2'15", 116°7'10"; Reveille Range, Nye County, NV). *Analytical data:* K = 0.911, 0.875, 0.840, 0.905, 0.874, 0.872, 0.854%; $*Ar^{40}$ = 6.387, 6.627, 6.240, 6.327 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 68.1, 66.2, 66.1, 66.9%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 4.15 ± 0.13 Ma

12. *R8-1-27-LN* K-Ar
Porphyritic olivine basalt plug; contains large plagioclase and augite megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°3'10", 116°9'23"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.886, 1.809, 1.863, 1.833%; $*Ar^{40}$ = 9.939, 9.643, 9.594, 9.355 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 51.9, 50.5, 50.0, 48.6%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 3.00 ± 0.08 Ma

13. *R9-1-46-LN* K-Ar
Porphyritic olivine basalt flow; contains large augite and plagioclase megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide. (38°10'30", 116°6'30"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.621, 1.580, 1.584, 1.582, 1.630%; $*Ar^{40}$ = 10.47, 10.66, 10.36, 10.30 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 38.3, 39.0, 38.1, 38.0%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 3.76 ± 0.11 Ma

14. *R9-1-58-LN* K-Ar
Porphyritic olivine basalt flow; contains large plagioclase and augite megacrysts in a holocrystalline matrix of coarse plagioclase, augite and Fe-oxide (38°7'17", 116°5'45"; Reveille Range, Nye County, NV). *Analytical data:* K = 1.386, 1.343, 1.361, 1.371, 1.366%; $*Ar^{40}$ = 9.24, 9.51, 9.44, 9.22 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 57.2, 58.6, 58.3, 57.6%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah. *Comment:* This sample was collected from a flow that directly overlies pyroclastic deposits from the adjacent trachyte dome.
(plagioclase) 3.95 ± 0.12 Ma

Evolved Volcanic Rocks

15. *R8-1-16-LN* K-Ar
Tristanite dome containing plagioclase and sanidine (38°3'18", 116°8'52"; Reveille Range, Nye County, NV). *Analytical data:* K = 3.617, 3.517, 3.687, 3.757, 3.556, 3.567%; $*Ar^{40}$ = 27.79, 27.41, 27.55, 27.37 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 86.4, 86.0, 86.5, 86.0%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 4.39 ± 0.18 Ma

16. *R8-1-43-LN* K-Ar
Trachyte flow containing sanidine and plagioclase phenocrysts in a matrix of green glass (38°7'45", 116°5'20"; Reveille Range, Nye County, NV). *Analytical data:* K = 4.838, 4.841, 4.931%; $*Ar^{40}$ = 36.04, 35.79, 35.69, 35.96 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 65.2, 65.7, 65.4, 58.4%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.
(plagioclase) 4.24 ± 0.06 Ma

Miscellaneous Nye County Volcanic Rocks

17. *N9-SD-LN* K-Ar
Tristanite dome containing sanidine and plagioclase (37°41'30", 115°56'30"; Nellis Bombing and Gunnery Range, Nye County, NV). *Analytical data:* K = 1.724, 1.720, 1.738, 1.727, 1.719, 1.715, 1.701%; $*Ar^{40}$ = 41.96, 41.89, 42.47, 42.14 × 10^{-12} mol/gm; $*Ar^{40}/\Sigma Ar^{40}$ = 83.4, 82.9, 83.7, 83.2%. *Collected by:* T. R. Naumann; *dated by:* M. Shafiqullah.

(plagioclase) 14.1 ± 0.14 Ma

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