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NEW K-Ar AGES FOR MIOCENE VOLCANIC ROCKS FROM THE NORTHEASTERN JEMEZ MOUNTAINS AND TEJANA MESA, NEW MEXICO

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Fifteen basalts and one dacite from northern New Mexico were dated by the K-Ar method as part of stratigraphic and structural investigations of the northeastern Jemez Mountain and northwestern Española Basin (fig. 1). A basalt from Tejana Mesa, in west central New Mexico, was also radiometrically dated to constrain the age of the Fence Lake Formation. Ages obtained from the southern Chili and southeastern Vallecitos 7½′ quadrangles move back the initiation of NE Jemez volcanism, permit new age control for the lower Santa Fe Group, and provide evidence about Miocene faulting along the trace of the Jemez lineament.

The fifteen dates of basalts reported here are from flows and dikes that are interlayered with or intrude sedimentary rocks of the Santa Fe Group. Some of these rocks were mapped as Lobato basalt, whereas others were termed Santa Fe Group basalt (Smith and others, 1970). Ages, stratigraphic relations, and chemistry of the volcanic rocks (M. J. Aldrich, unpublished data) do not support the partitioning of Smith and others; and we group all of the dated basaltic rocks with the Lobato. Four of the K-Ar dates (11B-84-MJA, 33-84-MJA, 55-84-MJA, and 16A-85-MJA) demonstrate that basaltic volcanism in the Jemez Mountains had begun by 14 m.y., rather than 10 m.y., as previously reported (Smith and others, 1970). Lobato volcanism continued episodically until at least 9.56 m.y. in the Chili quadrangle. Dates reported here and elsewhere (Baldridge and others, 1980; Gardner and others, 1986) suggest that basaltic activity peaked between about 12 and 10 m.y.

Deposition of the alluvial fans that comprise the Chamita Formation of the Santa Fe Group began at about 14 m.y. and continued during and after Lobato volcanism in the

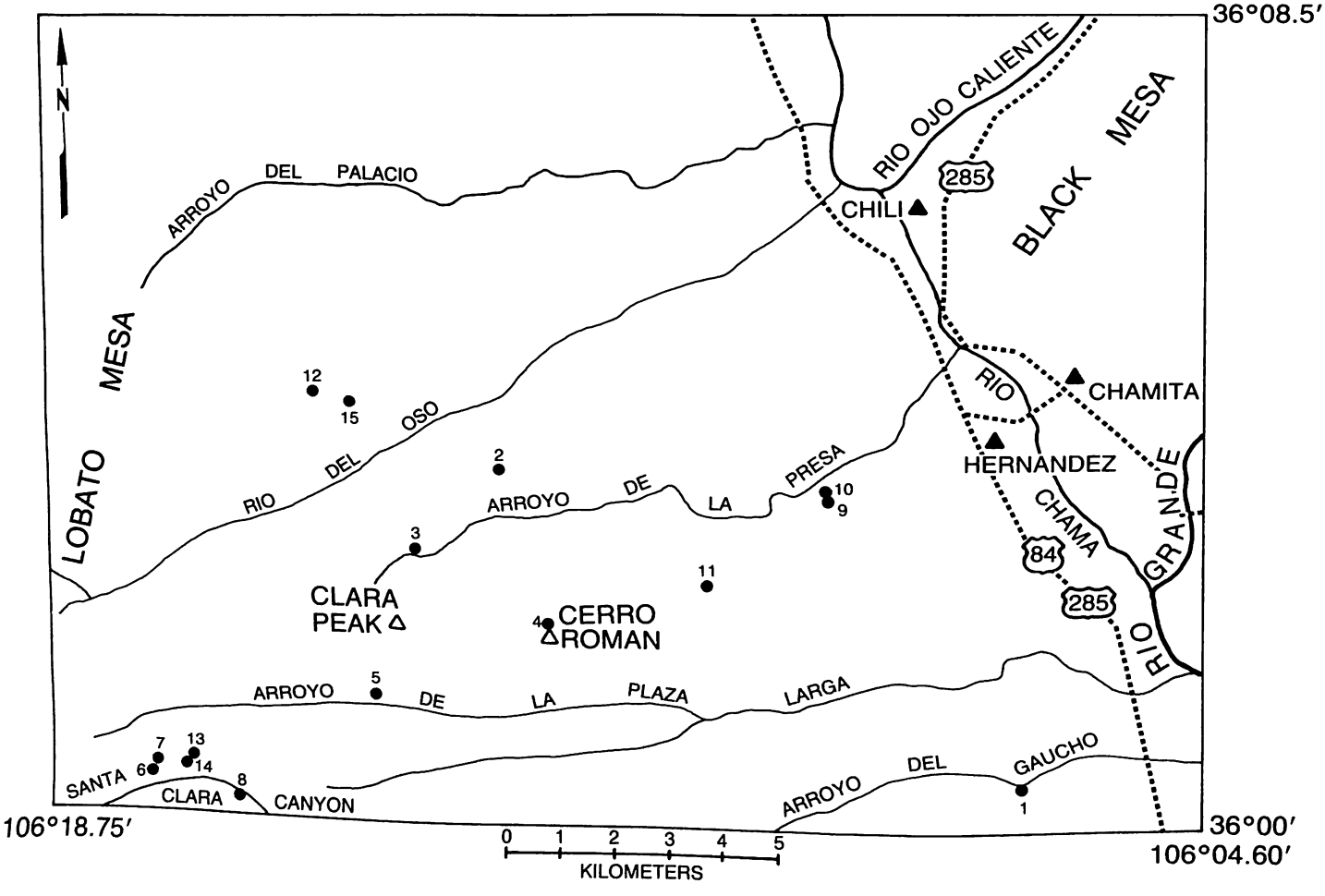

FIGURE 1. Map of sample locations in northeastern Jemez Mountains/northwestern Española Basin.

NE Jemez area. Dates from basalt demonstrate that the Tesuque Formation (lower Santa Fe Group) south of Clara Peak is older than 14 m.y. (33-84-MJA). The oldest Lobato flow there overlies sandy, arkosic alluvium derived from sources to the N and NE, and interbedded dunes deposited by winds from the SW. Correlation of this unit with the lower members of the Tesuque Formation (Chama-El Rito member and the Ojo Caliente Sandstone) is uncertain. Sedimentary rocks mapped as the Chamita Formation (upper Santa Fe Group) by Dethier and Manley (1985) are locally older than about 12.4 m.y. (11B-84-MJA).

Several K-Ar dates add to our knowledge about the complex stratigraphy of the Santa Fe Group in the northeast Jemez Mountains. Dethier and Martin (1984) correlated fine-grained alluvial fan deposits exposed in the western Chili and eastern Vallecitos quadrangles with the Chama-El Rito Member of the Tesuque Formation. A flow that fills a channel in the sedimentary sequence gave a date of 10.3 m.y. (D-83-44), and a dike which intrudes the rocks is 10.6 m.y. (P-7). Because the sedimentology and gravel lithologies of the undifferentiated unit are similar to those reported from the Chama-El Rito (Ekas and others, 1984; May, 1984), assignment of the fan deposits to the Chama-El Rito seems sound.

Several dates provide minimum limiting ages for the Ojo Caliente Sandstone, previously undated in the northeast Jemez region. Dikes dated at 10.6 m.y. (15-85-MJA) and 10.7 m.y. (D-83-21) intrude the sandstone. At locality 11B-84-MJA, the sandstone lies beneath a basalt flow dated at 12.4 m.y. Dates reported by May (1984) and Ekas and others (1984) show that the upper Chama-El Rito, which lies under the Ojo Caliente, is younger than about 15 m.y. some 20 km north of our study area. Construction of the dune field east of Lobato Mesa must have taken place between about 15 and 12 m.y.

Basalt flows dated at 12.4 m.y. (11B-84-MJA) and 11.9 m.y. (55-84-MJA) occur near the base of the Chamita Formation, demonstrating that deposition of these fan deposits began at least two million years earlier than previously reported.

Ages of basalt flows and dikes suggest that an episode of rapid extension began before 14 m.y. and lasted until about 9.6 m.y. in the NE Jemez Mountains. Although vents for the 14 m.y. Lobato volcanism are buried by the late Miocene Tschicoma Formation, field relations suggest they were located along Santa Clara Creek west of the area in figure 1. Flows dated at about 12.4 to 9.6 m.y. originated at Clara Peak, from a vent 1 km south of Clara Peak, from Cerro Roman, and from a maar some 3 km northeast of Cerro Roman. Aldrich (1986) showed that the volcanic centers lie along the Jemez lineament.

Sample TM-11-013-1 from Tejana Mesa was collected by John Hawley, David Love, and Robert Osburn of the New Mexico Bureau of Mines and Mineral Resources. This sample is from a basalt flow which overlies a soil that developed on the Fence Lake Formation. According to J. W. Hawley (written communication, 1986), the petrocalcic horizon of the buried soil took about 1 million years to form. The age of the basalt flow (6.73 ± 0.18 m.y.) and the soil together indicate the Fence Lake Formation was deposited prior to about 8 m.y. ago.

SAMPLE DESCRIPTIONS

1. *D-212 (UAKA 83-181)* K-Ar
Lobato Basalt flow within Chamita Formation of Santa Fe Group (0.5 km S of Forest Road 144 in Arroyo del Gaucho; 36°00'31"N,106°08'05"W; Rio Arriba Co., NM). *Analytical data:* K = 0.9338%, radiogenic $^{40}Ar = 15.51 \times 10^{-12}$ m/g, atmospheric ^{40}Ar = 37.4%.
(groundmass) 9.56 ± 0.24 m.y.

2. *D-209 (UAKA 83-182)* K-Ar
Lobato Basalt dike (1.5 km S of Rio Del Oso on N side of narrow mesa elongated ENE-WSW; 36°03'28"N, 106°13'24"W; Rio Arriba Co., NM). *Analytical data:* K = 0.3520%, radiogenic $^{40}Ar = 10.24 \times 10^{-12}$ m/g, atmospheric ^{40}Ar = 56.6%.
(groundmass) 10.67 ± 0.30 m.y.

3. *D-83-49 (UAKA 83-183)* K-Ar
Lobato Basalt flow (0.2 km N of Arroyo de la Presa; 36°02'50"N,106°14'04"W; Rio Arriba Co., NM). *Analytical data:* K = 0.9092%, radiogenic $^{40}Ar = 16.25 \times 10^{-12}$ m/g, atmospheric ^{40}Ar = 53.8%.
(groundmass) 10.3 ± 0.3 m.y.

4. *7-84-MJA (UAKA 84-102)* K-Ar
Lobato Basalt flow within a vent (top of Cerro Roman, 36°02'01"N,106°12'18"W; Rio Arriba Co., NM). Phenocrysts of zoned plagioclase and olivine rimmed by iddingsite in groundmass of plagioclase, pyroxene, olivine, and magnetite. *Analytical data:* K = 0.8000%, radiogenic $^{40}Ar = 14.32 \times 10^{-12}$ m/g, atmospheric ^{40}Ar = 55.4%.
(groundmass) 10.30 ± 0.30 m.y.

5. *15-84-MJA (UAKA 84-156)* K-Ar
Lobato Basalt flow within a vent (0.2 km N of Arroyo de la Plaza Larga; 36°01'06"N,106°14'54"W; Rio Arriba Co., NM). *Analytical data:* K = 1.799%, radiogenic $^{40}Ar = 31\ 82 \times 10^{-12}$ m/g, atmospheric ^{40}Ar = 19.3%.
(groundmass) 10.17 ± 0.24 m.y.

6. *33-84-MJA (UAKA 84-158)* K-Ar
Lobato Basalt flow interbedded with Santa Fe Group (0.3 km N of Santa Clara Creek on N side of Santa Clara Canyon; 36°00'27"N,106°17'31"W; Rio Arriba Co., NM). Phenocrysts of olivine largely altered to serpentine in groundmass of olivine, plagioclase, pyroxene, and magnetite. *Analytical data:* K = 1.003%, radiogenic $^{40}Ar = 24.53 \times 10^{-12}$ m/g, atmospheric ^{40}Ar = 25.9%.
(groundmass) 14.05 ± 0.33 m.y.

7. *30-84-MJA (UAKA 84-159)* K-Ar
Lobato Basalt flow at top of section exposed on N wall of Santa Clara Canyon (0.7 km N of Santa Clara Creek; 36°00'36"N, 106°17'16"W; Rio Arriba Co., NM). Phenocrysts of olivine rimmed by iddingsite and pyroxene in groundmass of plagioclase, pyroxene, olivine mostly altered to iddingsite and magnetite. *Analytical data:* K = 1.108%, radiogenic $^{40}Ar = 20.07 \times 10^{-12}$ m/g, atmospheric ^{40}Ar = 23.3%.
(plagioclase concentrate) 10.4 ± 0.30 m.y.

8. *16-84-MJA (UAKA 84-160)* K-Ar
Tschicoma dacite flow overlying Santa Fe Group on S wall of Santa Clara Canyon (0.1 km S of Santa Clara Creek; 36°00'08"N,106°17'12"W; Rio Arriba Co., NM). *Analytical data:* K = 6.124%, radiogenic $^{40}Ar = 42.3 \times 10^{-12}$ m/g, atmospheric ^{40}Ar = 76.8%.
(biotite concentrate) 3.98 ± 0.18 m.y.

9. *11A-84-MJA (UAKA 85-06)* K-Ar
Lobato Basalt flow within Chamita Formation of Santa Fe Group (0.5 km S of Arroyo de la Presa on N side of Hill 6268; 36°03'27"N,106°00'54"W; Rio Arriba Co., NM). Ophitic pyroxene, plagioclase, and olivine partly altered to iddingsite. Some plagioclase laths are partly altered to epidote. Significant amount of magnetite is present. *Analytical data:* K = 0.661%, radiogenic $^{40}Ar = 11.41 \times 10^{-12}$ m/g, atmospheric $^{40}Ar = 40.6\%$.
(plagioclase concentrate) 9.93 ± 0.20 m.y.

10. *11B-84-MJA (UAKA 85-07)* K-Ar
Vesicular Lobato Basalt flow within Chamita Formation of Santa Fe Group (0.5 km S of Arroyo de la Presa on N side of Hill 6268; 36°03'26"N,106°00'54"W; Rio Arriba Co., NM). Phenocrysts of plagioclase in groundmass of plagioclase, olivine largely altered to iddingsite(?), pyroxene, and magnetite. Vesicles are filled with carbonate. *Analytical data:* K = 0.161%, radiogenic $^{40}Ar = 3.468 \times 10^{-12}$ m/g, atmospheric $^{40}Ar = 46.2\%$.
(plagioclase concentrate) 12.4 ± 0.4 m.y.

11. *55-84-MJA (UAKA 85-09)* K-Ar
Lobato Basalt flow within Chamita Formation (1.3 km S of Arroyo de la Presa on N side of diatomaceous earth pit; 36°02'33"N,106°10'27"W; Rio Arriba Co., NM). Olivine phenocrysts rimmed by iddingsite in groundmass of euhedral plagioclase laths, pyroxene, olivine largely altered to iddingsite and magnetite. Vesicular; some vesicles filled with carbonate. *Analytical data:* K = 0.603%, radiogenic $^{40}Ar = 12.50 \times 10^{-12}$ m/g, atmospheric $^{40}Ar = 45.7\%$.
(plagioclase concentrate) 11.9 ± 0.3 m.y.

12. *P-7 (UAKA 85-423)* K-Ar
Lobato Basalt dike (1.6 km NE of La Utah peak in La Cañada del Almagre; 36°04'20"N,106°15'11"W; Rio Arriba Co., NM). Olivine partly altered to serpentine along fractures, pyroxene, plagioclase laths, and magnetite. *Analytical data:* K = 0.676%, radiogenic $^{40}Ar = 12.42 \times 10^{-12}$ m/g, atmospheric $^{40}Ar = 25.9\%$.
(groundmass) 10.57 ± 0.26 m.y.

13. *16A-85-MJA (UAKA 85-424)* K-Ar
Lobato Basalt flow interbedded with the Tesuque Formation of the Santa Fe Group (0.2 km N of Santa Clara Creek on N side of Santa Clara Canyon; 36°00'25"N,106°17'06"W; Rio Arriba Co., NM). Ophitic pyroxene grains, many of which are altered to chlorite; olivine altered to chlorophaeite; plagioclase laths; and magnetite. *Analytical data:* K = 0.543%, radiogenic $^{40}Ar = 13.11 \times 10^{-12}$ m/g, atmospheric $^{40}Ar = 55.4\%$.
(feldspar concentrate) 13.9 ± 0.40 m.y.

14. *16B-85-MJA (UAKA 84-425)* K-Ar
Lobato Basalt flow interbedded with the Tesuque Formation of the Santa Fe Group (0.3 km N of Santa Clara Creek on N side of Santa Clara Canyon; 36°00'27"N,106°17'05"W; Rio Arriba Co., NM). Olivine phenocrysts rimmed by iddingsite in groundmass of plagioclase laths, pyroxene partly altered to chlorite, olivine completely altered to iddingsite and magnetite. *Analytical data:* K = 0.726%, radiogenic $^{40}Ar = 13.79 \times 10^{-12}$ m/g, atmospheric $^{40}Ar = 44.4\%$.
(feldspar concentrate) 10.9 ± 0.3 m.y.

15. *15-85-MJA (UAKA 84-426)* K-Ar
Lobato Basalt dike (1.6 km N of Rio del Oso on E side of Hill 6742; 36°04'27"N,106°14'53"W; Rio Arriba Co., NM). Plagioclase, olivine partly altered along fractures to serpentine, and pyroxene extensively altered to uralite and leucoxene(?). *Analytical data:* K = 0.466%, radiogenic $^{40}Ar = 8.571 \times 10^{-12}$ m/g, atmospheric $^{40}Ar = 57.9\%$.
(groundmass feldspar) 10.59 ± 0.31 m.y.

16. *TM-11-13-1 (UAKA 85-10)* K-Ar
Basalt flow capping Tejana Mesa (S end of Tejana Mesa about 1.4 km N of New Mexico Route 32; 34°24'00"N,108°34'00"W; Catron Co., NM). *Analytical data:* K = 0.8104%, radiogenic $^{40}Ar = 9.48 \times 10^{-12}$ m/g, atmospheric $^{40}Ar = 44.2\%$.
(groundmass feldspar concentrate) 6.73 ± 0.18 m.y.

REFERENCES

Aldrich, M. J., Jr. (1986) Tectonics of the Jemez lineament in the Jemez Mountains and Rio Grande rift: Journal of Geophysical Research, v. 91, p. 1753–1762.

Baldridge, W. S., Damon, P. E., Shafiqullah, M., and Bridwell, R. J. (1980) Evolution of the central Rio Grande rift—New potassium-argon ages: Earth and Planetary Science Letters, v. 51, p. 309–321.

Dethier, D. P., and Martin, B. M. (1984) Geology and structure along part of the northeast Jemez Mountains, New Mexico: New Mexico Geological Society Guidebook 35, p. 145–150.

Dethier, D. P., and Manley, Kim (1985) Geologic map of the Chili quadrangle, Rio Arriba County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1814, scale 1:24,000.

Ekas, L. M., Ingersoll, R. V., Baldridge, W. S., and Shafiqullah, M. (1984) The Chama-El Rito Member of the Tesuque Formation, Española basin, New Mexico: New Mexico Geological Society Guidebook 35, p. 137–143.

Gardner, J. N., Goff, Fraser, Garcia, Sammy, and Hagan, R. C. (1986) Stratigraphic relations and lithologic variations in the Jemez volcanic field, New Mexico: Journal of Geophysical Research, v. 91, p. 1753–1762.

May, S. J. (1984) Miocene stratigraphic relations and problems between the Abiquiu, Los Piños, and Tesuque Formations near Ojo Caliente, northern Española basin: New Mexico Geological Society Guidebook 35, p. 129–135.

Smith, R. L., Bailey, R. A., and Ross, C. S. (1970) Geologic map of the Jemez Mountains, New Mexico: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-571, scale 1:125,000.