New Mexico Bureau of Geology and Mineral Resources
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^{40}Ar/^{39}Ar Geochronology Results from Peña Tank Rhyolite, Western San Luis Basin, North-Central New Mexico

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Table 1. ^{40}Ar/^{39}Ar analytical data for sanidines analyzed by single-crystal laser-fusion.

ID	^{40}Ar/^{39}Ar	^{37}Ar/^{39}Ar	^{36}Ar/^{39}Ar (x 10^{-3})	^{39}Ar$_K$ (x 10^{-15} mol)	K/Ca	^{40}Ar* (%)	Age (Ma)	±1σ (Ma)
GTM-528-djk, Sanidine, J=0.0007932±0.05%, D=1.004±0.001, NM-217C, Lab#=57802								
04	22.30	0.0054	23.24	3.776	94.1	69.2	22.27	0.14
10	18.13	0.0065	8.732	7.443	78.6	85.8	22.44	0.07
09	16.73	0.0047	3.990	1.144	108.9	93.0	22.44	0.26
07	26.84	0.0071	38.17	6.395	72.3	58.0	22.46	0.14
03	18.23	0.0070	8.870	10.061	72.7	85.6	22.52	0.06
08	16.35	0.0072	2.514	1.253	70.9	95.5	22.52	0.23
02	16.96	0.0067	4.440	5.071	76.4	92.3	22.58	0.08
06	18.80	0.0087	10.61	7.913	58.6	83.3	22.61	0.07
12	19.68	0.0063	13.59	9.743	80.6	79.6	22.61	0.07
14	18.21	0.0090	8.452	3.975	56.8	86.3	22.67	0.10
05	27.91	0.0074	41.09	9.158	68.8	56.5	22.75	0.13
15	19.32	0.0081	12.02	1.987	63.2	81.6	22.76	0.19
01	16.42	0.0070	2.174	6.533	72.8	96.1	22.77	0.07
13	18.13	0.0108	7.953	3.748	47.2	87.0	22.78	0.11
11	19.36	0.0162	12.01	7.541	31.5	81.7	22.82	0.08
Mean age ± 2σ	n=15		MSWD=2.35		70.2 ±36.6		22.62	0.08
GTM1018, Sanidine, J=0.001524±0.06%, D=1.005±0.001, NM-225K, Lab#=59091								
01	8.459	0.0083	1.438	6.423	61.6	95.0	22.25	0.08
04	8.628	0.0089	1.762	13.372	57.3	94.0	22.45	0.06
13	8.259	0.0105	0.4539	31.719	48.5	98.4	22.50	0.04
05	8.247	0.0086	0.3927	7.200	59.1	98.6	22.52	0.07
03	8.747	0.0131	2.074	2.994	38.9	93.0	22.53	0.15
15	8.170	0.0091	0.1104	7.442	56.2	99.6	22.54	0.06
06	8.243	0.0090	0.3441	14.187	56.8	98.8	22.55	0.05
12	8.209	0.0091	0.2140	3.484	56.2	99.2	22.56	0.12
08	8.178	0.0100	0.1058	24.205	51.3	99.6	22.56	0.04
14	8.166	0.0084	0.0192	20.109	60.4	99.9	22.60	0.04
09	8.218	0.0098	0.0621	3.202	52.2	99.8	22.71	0.13
x 02	10.92	1.063	9.472	1.126	0.48	75.1	22.74	0.39
x 11	9.274	2.271	4.019	0.227	0.22	89.2	22.95	1.47
x 07	10.79	2.226	7.739	0.234	0.23	80.5	24.09	1.43
x 10	11.37	1.874	8.864	0.514	0.27	78.3	24.69	0.75
Mean age ± 2σ	n=11		MSWD=2.13		54.4 ±12.9		22.53	0.06
GTM-439-djk, Sanidine, J=0.0007958±0.05%, D=1.004±0.001, NM-217C, Lab#=57800								
14	17.84	0.0140	4.840	0.267	36.4	92.0	23.75	1.02
07	17.38	0.0267	2.510	0.163	19.1	95.7	24.09	1.61
15	17.60	0.0083	2.809	0.402	61.7	95.3	24.27	0.70
02	17.62	0.0077	2.829	0.696	66.2	95.3	24.29	0.39
05	17.36	0.0017	0.6676	1.467	293.9	98.9	24.83	0.20
12	17.58	0.0040	1.376	0.715	127.8	97.7	24.85	0.41
09	17.59	0.0064	1.244	0.455	79.9	97.9	24.92	0.62
06	17.57	0.0009	1.130	1.067	563.0	98.1	24.94	0.27
04	17.58	0.0087	0.9847	0.455	58.3	98.3	25.01	0.61
11	17.46	0.0035	0.5549	0.653	146.4	99.1	25.02	0.43
13	17.64	0.0010	0.8796	0.918	534.6	98.5	25.14	0.30
08	17.97	0.0095	1.798	0.569	53.5	97.0	25.23	0.49
10	17.90	0.0012	0.9413	0.772	425.5	98.4	25.49	0.40
x 03	17.58	-0.0050	-0.5711	0.568	-	101.0	25.67	0.50

	ID								
	01	18.09	0.0059	0.7819	1.102	86.7	98.7	25.84	0.27
	Mean age ± 2σ	n=14	MSWD=1.44			182.4 ±381.3		25.04	0.24

GTM-536-djk, Sanidine, J=0.0007942±0.05%, D=1.004±0.001, NM-217C, Lab#=57801

	ID								
	06	18.73	0.0037	4.926	1.691	137.8	92.2	24.94	0.18
	14	17.54	0.0044	0.6575	3.333	116.4	98.9	25.05	0.10
	11	17.54	0.0045	0.5734	2.561	113.2	99.0	25.09	0.12
	03	17.98	0.0017	2.004	2.081	304.9	96.7	25.10	0.14
	01	17.61	0.0009	0.7394	2.750	545.9	98.8	25.11	0.12
	08	17.76	0.0062	1.173	1.541	81.7	98.1	25.15	0.19
	12	17.57	0.0052	0.5100	2.646	97.3	99.1	25.16	0.12
x	04	31.13	0.0041	46.35	4.433	124.1	56.0	25.18	0.19
	05	17.68	0.0065	0.8120	4.019	78.5	98.6	25.18	0.08
	10	17.57	0.0049	0.3305	1.978	103.2	99.4	25.23	0.15
	02	17.82	0.0064	1.054	1.822	79.1	98.3	25.28	0.17
	13	17.93	0.0019	1.379	2.346	274.4	97.7	25.29	0.13
	09	17.67	0.0026	0.4646	7.088	192.9	99.2	25.31	0.06
	07	18.24	0.0019	2.395	3.893	262.4	96.1	25.32	0.09
	15	17.92	0.0058	1.216	1.610	87.7	98.0	25.36	0.19
	Mean age ± 2σ	n=14	MSWD=1.05			176.8 ±264.2		25.21	0.07

GTM1043, Sanidine, J=0.0015222±0.07%, D=1.005±0.001, NM-225K, Lab#=59090

	ID								
x	07	9.818	0.2708	5.738	1.564	1.9	82.9	22.53	0.26
x	04	9.028	0.0140	0.9799	5.024	36.3	96.8	24.16	0.10
x	05	9.364	0.0112	1.588	4.592	45.4	95.0	24.59	0.11
x	03	14.41	0.1575	18.17	4.746	3.2	62.8	25.03	0.20
	02	9.277	0.0069	0.5578	6.678	74.1	98.2	25.19	0.07
	13	9.325	0.0105	0.6908	3.903	48.7	97.8	25.21	0.11
x	08	9.403	0.1364	0.9116	2.737	3.7	97.3	25.28	0.15
	10	9.493	0.0082	1.162	6.173	62.4	96.4	25.29	0.08
	06	9.302	0.0085	0.4471	5.286	60.3	98.6	25.35	0.09
	09	9.625	0.0127	1.527	5.057	40.2	95.3	25.36	0.10
	01	9.245	0.0078	0.2068	9.316	65.8	99.3	25.39	0.06
	11	10.19	0.0258	3.363	7.764	19.8	90.3	25.44	0.08
x	12	10.13	0.0749	2.877	5.313	6.8	91.7	25.67	0.11
x	14	9.328	0.0066	0.1268	5.761	77.1	99.6	25.68	0.08
x	15	9.707	0.0044	1.177	2.262	116.5	96.4	25.87	0.18
	Mean age ± 2σ	n=7	MSWD=1.31			53.0 ±36.9		25.33	0.08

Notes:
x symbol preceding sample ID denotes analyses excluded from weighted-mean age calculations.
Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interfering reactions.
Errors quoted for individual analyses include analytical error only, without interfering reaction or J uncertainties.

Age calculations:
Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard (28.201 Ma, Kuiper et al, 2008).
Mean age is weighted mean age of Taylor (1982). Mean age error is weighted error
   of the mean (Taylor, 1982), multiplied by the root of the MSWD where MSWD>1, and also
   incorporates uncertainty in J factors and irradiation correction uncertainties.
MSWD values are calculated for n-1 degrees of freedom for plateau age.
Decay constants and isotopic abundances after Min et al. (2000).
All errors reported at ±2σ, unless otherwise noted.

Sample preparation and irradiation:
Sanidine separates prepared using crushing, dilute HCl acid treatment, Franz magnetic separator, and hand-picking technique
Samples were loaded into machined Al discs and irradiated in 2 separate positions (NM-217C and NM-225K)
Neutron flux monitor Fish Canyon Tuff sanidine (FC-2).

Instrumentation:

Mass Analyzer Products 215-50 mass spectrometer on line with automated all-metal extraction system.

Samples were fused using a CO2 laser (heating duration 30 seconds).

Reactive gases removed during laser analysis by reaction with 2 SAES GP-50 getters, 1 operated
 at ~450°C and 1 at 20°C. Gas also exposed to a W filament operated at ~2000°C.

Analytical parameters:

Electron multiplier sensitivity averaged 5.02×10^{-17} moles /pA.

Total system blank and background for the laser averaged 350, 3.54, 0.00296,1.90, 6.42×10^{-18} moles at masses
40,39,38,37 and 36 respectively

J-factors determined to a precision of ± 0.1% by CO_2 laser-fusion of 6 single crystals from each of 10 radial positions
around the irradiation tray.

Correction factors for interfering nuclear reactions were determined using K-glass and CaF_2 and are as follows:

$(^{39}Ar/^{37}Ar)_{Ca} = 0.00068 \pm 2e\text{-}05$

Table 2. ^{40}Ar/^{39}Ar analytical data for biotite samples step heated by resistance furnace.

ID	Power (Watts)	^{40}Ar/^{39}Ar	^{37}Ar/^{39}Ar	^{36}Ar/^{39}Ar (x 10^{-3})	^{39}Ar$_K$ (x 10^{-15} mol)	K/Ca	^{40}Ar* (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
GTM-627, Biotite, 7.07 mg, J=0.0007932±0.06%, D=1.004±0.001, NM-217L, Lab#=57852-01										
A	650	632.2	0.0478	2100.4	0.425	10.7	1.8	0.5	16.72	5.40
B	750	74.61	0.0437	199.3	0.603	11.7	21.1	1.1	22.67	1.26
C	850	42.31	0.0274	88.64	1.81	18.6	38.1	3.0	23.26	0.46
D	920	27.88	0.0142	39.29	3.17	35.9	58.4	6.4	23.47	0.25
E	1000	21.05	0.0102	17.19	7.77	50.3	75.9	14.7	23.04	0.10
F	1075	20.11	0.0108	14.35	10.6	47.2	78.9	26.0	22.90	0.08
G	1110	20.35	0.0080	14.88	13.6	63.5	78.4	40.5	23.01	0.08
H	1180	19.24	0.0301	11.02	29.7	17.0	83.1	72.2	23.06	0.06
I	1210	19.11	0.0410	10.66	18.8	12.5	83.5	92.2	23.04	0.06
J	1250	20.19	0.0169	14.38	6.23	30.2	79.0	98.9	23.01	0.13
K	1300	28.63	0.0175	44.28	0.84	29.2	54.3	99.8	22.44	0.61
L	1680	507.0	0.1638	1675.3	0.232	3.1	2.4	100.0	17.27	5.81
Integrated age ± 2σ		n=12			93.8	21.1	K2O=6.43%		22.99	0.16
Plateau ± 2σ	steps A-L	n=12		MSWD=0.87	93.8	30.5 ±37.3		100.0	23.02	0.07
Isochron±2σ	steps A-L	n=12		MSWD=0.81		^{40}Ar/^{36}Ar=	294.1±2.6		23.05	0.08
GTM-1078, Biotite, 6.66 mg, J=0.0015417±0.10%, D=1.005±0.001, NM-225L, Lab#=59109-01										
X A	650	170.4	0.1218	554.8	3.16	4.2	3.8	1.8	18.01	2.48
Xi B	750	12.70	0.0724	12.70	5.06	7.0	70.5	4.7	25.08	0.23
Xi C	850	9.921	0.0612	4.659	8.10	8.3	86.2	9.4	23.94	0.12
Xi D	920	9.375	0.0540	3.159	8.68	9.5	90.1	14.4	23.66	0.11
E	1000	9.644	0.0428	4.701	14.8	11.9	85.6	22.9	23.13	0.09
F	1075	10.54	0.0450	7.759	21.9	11.3	78.3	35.5	23.11	0.09
G	1110	10.96	0.0434	8.860	22.0	11.8	76.1	48.2	23.37	0.09
H	1180	10.33	0.0385	7.063	33.5	13.3	79.8	67.5	23.09	0.08
I	1210	9.833	0.0249	5.259	23.4	20.5	84.2	80.9	23.20	0.08
J	1250	9.928	0.0065	5.456	24.4	78.4	83.8	95.0	23.29	0.07
K	1300	10.10	0.0040	6.003	7.58	128.5	82.4	99.4	23.33	0.12
L	1680	13.92	0.0098	18.90	1.11	52.1	59.9	100.0	23.34	0.63
Integrated age ± 2σ		n=12			173.8	13.9	K2O=6.50%		23.22	0.18
Plateau ± 2σ	steps E-L	n=8		MSWD=1.41	148.8	30.6 ±86.0		85.6	23.21	0.09
Isochron±2σ	steps A-L	n=9		MSWD=1.45		^{40}Ar/^{36}Ar=	292.4±3.2		23.26	0.10

Notes:

x (or i) symbol preceding sample ID denotes analyses excluded from plateau (or isochron) age calculations.

Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interfering reactions.

Errors quoted for individual analyses include analytical error only, without interfering reaction or J uncertainties.

Age calculations:

Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard (28.201 Ma, Kuiper et al, 2008).

Integrated age calculated by summing isotopic measurements of all steps.

Integrated age error calculated by quadratically combining errors of isotopic measurements of all steps.

Plateau age or preferred age calculated for the indicated steps by weighting each step by the inverse of the variance.

Plateau age error is inverse-variance-weighted mean error (Taylor, 1982) times root MSWD where MSWD>1.

MSWD values are calculated for n-1 degrees of freedom for plateau age.

Isochron ages, ^{40}Ar/^{36}Ar$_i$ and MSWD values calculated from regression results obtained by the methods of York (1969).

Decay constants and isotopic abundances after Min et al., (2000).

Weight percent K_2O calculated from ^{39}Ar signal, sample weight, and instrument sensitivity.

All errors reported at ±2σ, unless otherwise noted.

Sample preparation and irradiation:

Biotite separates prepared using crushing, dilute HCl acid treatment, Franz magnetic separator, and hand-picking tecl

Samples were loaded into machined Al discs and irradiated in 2 separate batches (NM-217 and NM-225)

Neutron flux monitor Fish Canyon Tuff sanidine (FC-2).

Instrumentation:

Mass Analyzer Products 215-50 mass spectrometer on line with automated all-metal extraction system.

Samples were step-heated using a Mo double-vacuum resistance furnace (heating duration 10 minutes).

Reactive gases removed during furnace (laser) analysis by reaction with 3 (2) SAES GP-50 getters, 2 (1) operated

at ~450°C and 1 at 20°C. Gas also exposed to a W filament operated at ~2000°C.

Analytical parameters:

Electron multiplier sensitivity averaged 9.2×10^{-17} moles /pA.

Total system blank and background for the furnace averaged 1280, 8.1, 0.73, 5.81, 24.7×10^{-18} moles.

J-factors determined to a precision of ± 0.1% by CO_2 laser-fusion of 6 single crystals from each of 10 radial positions

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