

Table DR1. $^{40}\text{Ar}/^{39}\text{Ar}$ analytical data.

ID	$^{40}\text{Ar}/^{39}\text{Ar}$	$^{37}\text{Ar}/^{39}\text{Ar}$	$^{36}\text{Ar}/^{39}\text{Ar}$	$^{39}\text{Ar}_K$ ($\times 10^{-3}$)	K/Ca ($\times 10^{-15}$ mol)	$^{40}\text{Ar}^*$ (%)	Age (Ma)	$\pm 1\sigma$ (Ma)
6061402, Sanidine, J=0.0007728±0.05%, D=1.0006±0.001, NM-210E, Lab#=57279								
17	19.66	0.0201	5.221	0.452	25.3	92.2	25.053	0.096
12	18.89	0.0116	2.515	0.566	44.0	96.1	25.126	0.069
05	18.46	0.0040	0.9104	0.341	127.9	98.5	25.184	0.099
13	18.72	0.0137	1.759	0.571	37.3	97.2	25.201	0.075
02	18.79	0.0103	1.960	0.629	49.6	96.9	25.219	0.068
22	18.79	0.0206	1.858	0.450	24.8	97.1	25.219	0.083
27	18.59	0.0256	1.198	0.425	19.9	98.1	25.219	0.087
11	18.53	0.0148	1.056	0.603	34.5	98.3	25.222	0.067
09	18.54	0.0095	1.019	0.541	53.9	98.4	25.258	0.070
19	18.71	0.0165	1.462	0.999	30.8	97.7	25.272	0.049
08	18.79	-0.0156	1.793	0.453	-	97.2	25.279	0.083
23	18.68	0.0313	1.314	0.549	16.3	97.9	25.295	0.076
18	18.74	0.0257	1.508	0.307	19.9	97.6	25.30	0.11
14	18.36	0.0342	0.2951	0.340	14.9	99.5	25.307	0.095
15	19.02	0.0065	2.483	0.556	79.1	96.1	25.313	0.074
07	18.61	0.0086	1.078	0.480	59.2	98.3	25.332	0.072
30	18.60	0.0125	0.9297	0.783	40.7	98.5	25.337	0.060
29	18.74	0.0126	1.382	0.457	40.6	97.8	25.346	0.081
03	18.56	0.0114	0.8267	0.576	44.9	98.7	25.363	0.067
04	19.05	0.0032	2.470	0.464	157.4	96.2	25.369	0.083
10	18.45	0.0041	0.3385	0.387	123.7	99.5	25.408	0.087
28	18.70	0.0136	1.066	0.281	37.5	98.3	25.41	0.12
21	20.48	0.0125	7.067	0.490	40.7	89.8	25.426	0.095
24	18.73	0.0173	1.140	0.478	29.4	98.2	25.428	0.079
06	18.54	0.0070	0.5940	0.303	72.4	99.1	25.43	0.11
20	18.60	0.0040	0.6671	0.334	128.3	98.9	25.442	0.100
16	18.85	0.0148	1.523	0.195	34.4	97.6	25.44	0.17
25	18.66	0.0253	0.6594	0.299	20.1	99.0	25.53	0.11
01	18.85	0.0025	1.360	0.612	202.6	97.9	25.543	0.070
26	18.99	0.0173	1.181	0.166	29.4	98.2	25.77	0.18
Mean age ±								
2σ	n=25	MSWD=1.11				25.294	0.020	

BM27060601, Sanidine, J=0.000774±0.06%, D=1.0006±0.001, NM-210E, Lab#=57278

08	19.26	0.0120	3.746	0.472	42.6	94.3	25.170	0.082
03	20.38	0.0194	7.496	0.417	26.3	89.1	25.190	0.094
10	18.75	0.0067	1.880	0.359	75.6	97.0	25.224	0.090
05	18.31	0.0001	0.3794	0.403	5222.1	99.4	25.229	0.083
15	18.44	0.0148	0.8044	0.366	34.5	98.7	25.243	0.092
11	18.57	0.0215	1.219	0.373	23.7	98.1	25.25	0.10
04	18.78	0.0113	1.780	0.310	45.3	97.2	25.31	0.11
14	18.73	-0.0011	1.608	0.243	-	97.5	25.32	0.13
09	18.54	-0.0047	0.9187	0.316	-	98.5	25.33	0.10
02	18.39	0.0155	0.4202	0.348	32.8	99.3	25.330	0.099
01	18.49	0.0117	0.6247	0.761	43.8	99.0	25.381	0.054
07	18.43	0.0188	0.4118	0.260	27.2	99.3	25.38	0.12

12	18.82	0.0065	1.696	0.730	77.9	97.3	25.393	0.065
13	18.40	0.0185	0.2393	0.393	27.6	99.6	25.418	0.089
06	19.47	0.0246	3.521	0.238	20.7	94.7	25.56	0.14
Mean age ± 2σ	n=15	MSWD=1.11					25.314	0.028

BM28060601, Sanidine, J=0.0007745±0.06%, D=1.0006±0.001, NM-210E, Lab#=57276								
04	10.52	2.997	10.99	0.011	0.17	71.5	10.5	2.3
12	10.76	3.120	5.245	0.010	0.16	88.0	13.2	2.6
10	10.19	-0.0116	0.4726	0.217	-	98.6	13.98	0.13
07	10.15	0.0032	0.3000	0.339	160.7	99.1	13.997	0.090
13	10.16	0.0235	0.2565	0.206	21.7	99.3	14.04	0.14
14	10.15	0.0091	0.1757	0.260	56.2	99.5	14.06	0.11
06	10.22	0.0206	0.3862	0.237	24.8	98.9	14.06	0.13
15	10.21	0.0204	0.2397	0.301	25.0	99.3	14.109	0.099
11	10.16	0.0074	0.0304	0.268	69.1	99.9	14.13	0.11
02	10.20	0.0320	0.0632	0.212	16.0	99.8	14.17	0.13
08	10.27	0.0326	0.2150	0.200	15.7	99.4	14.20	0.14
05	10.25	0.0226	0.0638	0.195	22.6	99.8	14.25	0.15
09	10.31	0.0047	0.1607	0.165	108.0	99.5	14.28	0.19
01	10.17	0.0230	-0.3536	0.178	22.2	101.0	14.31	0.16
03	10.40	0.1436	-0.3115	0.220	3.6	101.0	14.62	0.13
Mean age ± 2σ	n=12	MSWD=0.62					14.106	0.037

BM29060601, Sanidine, J=0.0007745±0.06%, D=1.0006±0.001, NM-210E, Lab#=57277								
06	30.56	3.755	40.73	0.038	0.14	61.6	26.19	0.79
13	20.97	3.340	7.706	0.041	0.15	90.5	26.38	0.74
03	28.60	3.891	33.36	0.025	0.13	66.7	26.5	1.3
09	20.96	3.579	6.622	0.040	0.14	92.1	26.83	0.70
01	19.76	0.0167	0.7462	0.564	30.5	98.9	27.101	0.068
04	19.78	0.0131	0.3178	0.540	38.9	99.5	27.302	0.076
11	19.71	0.0069	-0.0005	1.356	74.5	100.0	27.333	0.054
12	19.73	0.0192	0.0745	0.315	26.5	99.9	27.34	0.10
02	19.75	0.0114	0.0680	1.440	44.8	99.9	27.366	0.055
07	24.21	0.0110	15.12	0.734	46.4	81.5	27.380	0.095
15	19.87	0.0031	0.2935	0.785	162.8	99.6	27.431	0.056
05	19.85	0.0099	0.2323	0.576	51.5	99.7	27.435	0.069
08	19.93	0.0080	0.4531	0.482	63.9	99.3	27.456	0.078
14	20.00	0.0097	0.4383	0.749	52.4	99.4	27.558	0.061
10	20.83	3.849	0.4307	0.023	0.13	100.9	29.2	1.2
Mean age ± 2σ	n=9	MSWD=1.48					27.405	0.031

BM29060602, Sanidine, J=0.0007711±0.04%, D=1.0006±0.001, NM-210E, Lab#=57272								
04	20.09	0.0156	1.113	0.288	32.8	98.4	27.28	0.12
06	20.00	0.0068	0.7862	0.332	75.2	98.8	27.29	0.10
10	20.22	0.0076	1.483	0.370	67.1	97.8	27.31	0.10
12	19.99	0.0153	0.6910	0.337	33.4	99.0	27.32	0.10
07	21.80	0.0424	6.803	0.254	12.0	90.8	27.33	0.15

13	20.00	-0.0007	0.6332	0.303	-	99.1	27.35	0.11
01	20.27	0.0190	1.540	0.258	26.9	97.8	27.36	0.13
09	20.06	0.0079	0.7497	0.307	64.3	98.9	27.39	0.11
11	20.20	0.0268	1.172	0.253	19.0	98.3	27.41	0.13
15	20.13	0.0038	0.9086	0.254	135.5	98.7	27.43	0.13
03	20.22	0.0098	1.047	0.537	52.1	98.5	27.488	0.075
05	20.08	0.0168	0.4977	0.332	30.3	99.3	27.52	0.11
08	20.56	0.0220	2.078	0.281	23.2	97.0	27.54	0.12
14	20.38	0.0346	1.245	0.334	14.8	98.2	27.63	0.10
02	20.41	0.0073	0.5029	0.213	70.0	99.3	27.98	0.15
Mean age ±								
2σ		n=14	MSWD=0.99				27.413	0.032

BM29060603, Sanidine, J=0.0007717±0.05%, D=1.0006±0.001, NM-210E, Lab#=57273								
04	22.21	3.863	13.08	0.018	0.13	84.0	25.9	1.6
12	20.26	0.1437	2.133	0.191	3.6	96.9	27.15	0.17
02	20.28	0.0202	1.930	0.412	25.2	97.2	27.233	0.098
06	19.82	0.0063	0.2693	0.514	80.7	99.6	27.280	0.074
07	19.91	0.0030	0.5045	0.373	171.6	99.3	27.30	0.10
05	19.94	0.0036	0.5831	0.353	141.9	99.1	27.306	0.095
09	19.96	0.0010	0.6525	0.336	515.5	99.0	27.32	0.10
03	22.29	3.809	9.638	0.014	0.13	88.6	27.4	1.9
15	20.14	0.0098	1.052	0.259	51.9	98.5	27.40	0.12
14	20.66	0.0080	2.698	0.349	63.5	96.1	27.45	0.10
08	21.45	0.0170	5.266	0.537	30.0	92.8	27.490	0.084
11	20.07	0.0072	0.1965	0.159	71.1	99.7	27.65	0.19
10	20.38	0.0215	1.206	0.327	23.7	98.3	27.67	0.11
13	29.68	3.587	19.21	0.006	0.14	81.9	33.6	5.0
01	41.05	-0.0438	27.05	0.015	-	80.5	45.4	1.8
Mean age ±								
2σ		n=9	MSWD=0.99				27.336	0.035

BM29060604, Sanidine, J=0.0007728±0.05%, D=1.0006±0.001, NM-210E, Lab#=57274								
01	19.90	0.0081	0.8578	0.621	63.3	98.7	27.183	0.073
07	20.03	0.0101	1.158	0.357	50.5	98.3	27.25	0.10
15	20.63	0.0090	3.178	0.326	56.5	95.5	27.25	0.11
08	20.54	0.0229	2.776	0.275	22.3	96.0	27.29	0.13
13	20.85	0.0180	3.674	0.232	28.4	94.8	27.35	0.14
02	20.13	0.0099	1.211	0.330	51.7	98.2	27.36	0.10
14	20.44	0.0159	2.224	0.576	32.1	96.8	27.373	0.074
04	20.50	0.0114	2.390	0.346	44.7	96.6	27.38	0.10
06	20.12	0.0072	1.100	0.452	71.2	98.4	27.394	0.085
09	21.72	0.0125	6.074	0.447	40.9	91.7	27.570	0.092
10	20.20	0.0104	0.5241	0.423	49.2	99.2	27.727	0.090
12	20.42	0.0085	1.097	0.265	59.9	98.4	27.80	0.12
05	20.92	0.0152	2.716	0.142	33.5	96.2	27.84	0.23
03	20.67	0.0217	1.802	0.347	23.5	97.4	27.860	0.099
11	20.53	0.0137	0.9149	0.406	37.2	98.7	28.028	0.094
Mean age ±								
2σ		n=9	MSWD=0.78				27.310	0.035

BM29060605, Sanidine, J=0.0007739±0.05%, D=1.0006±0.001, NM-210E, Lab#=57275								
08	21.27	0.0226	5.626	0.222	22.6	92.2	27.18	0.14
15	20.08	0.0140	1.447	0.344	36.3	97.9	27.23	0.10
04	19.85	0.0107	0.6085	0.263	47.9	99.1	27.25	0.12
01	20.00	0.0103	1.135	0.320	49.8	98.3	27.255	0.098
09	19.90	0.0106	0.5133	0.356	48.2	99.2	27.363	0.098
11	20.56	0.0048	2.677	0.261	107.3	96.2	27.39	0.13
14	20.09	0.0258	0.9977	0.222	19.7	98.5	27.43	0.14
12	19.91	0.0108	0.4002	0.392	47.2	99.4	27.429	0.096
03	20.47	0.0604	2.069	0.313	8.5	97.0	27.52	0.11
02	20.10	0.0144	0.7945	0.297	35.5	98.8	27.52	0.10
13	19.93	0.0147	0.2010	0.255	34.7	99.7	27.54	0.14
10	19.96	0.5750	0.4735	0.160	0.89	99.5	27.54	0.18
07	20.19	0.0150	0.9283	0.212	34.0	98.6	27.59	0.14
05	20.10	0.0335	0.5986	0.473	15.2	99.1	27.613	0.081
06	19.59	4.171	-2.1098	0.008	0.12	104.9	28.6	3.3
Mean age ±								
2σ		n=13	MSWD=1.77				27.416	0.043

Notes: Isotopic ratios are corrected for blank, radioactive decay, and mass discrimination, but not for interfering reactions. Errors quoted for individual analyses include analytical error only, without interfering reaction or J uncertainties. Weighted mean ages and errors (Taylor, 1982) incorporate uncertainties in J factors and irradiation corrections. Decay constants and isotopic abundances after Steiger and Jäger (1977). Data in italics denote analyses excluded from weighted mean age calculations. Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard at 28.02 Ma. Decay constant ($\lambda_{K(\text{total})}$) = 5.543e-10/a. Correction factors: ($^{39}\text{Ar}/^{37}\text{Ar}$)_{Ca} = 0.00068 ± 5e-05; ($^{36}\text{Ar}/^{37}\text{Ar}$)_{Ca} = 0.00028 ± 2e-05; ($^{40}\text{Ar}/^{39}\text{Ar}$)_K = 0 ± 0.0004.

References:

- Taylor, J.R., 1982, An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, University Science Books, Mill Valley, California, 270 p.
- Steiger, R.H., and Jäger, 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.

Table DR2. Recalculated modal point-count data for sandstones from the Peñas and Aranjuez Formations.

Sample	Level (m)	Q-F-L %			Qm-F-Lt %			Lm-Lv-Ls %		
		Q	F	L	Qm	F	Lt	Lm	Lv	Ls
A) Peñas N: 16°14.9'S, 68°30.1'W										
BM-05070602	11	94	0	6	88	0	12	90	0	10
BM-05070604	62	90	0	10	85	0	15	97	0	3
BM-05070605	104	89	2	9	86	2	12	90	3	7
BM-09070602	165	92	2	6	89	2	9	86	0	14
BM-06070602	210	92	0	8	87	0	13	100	0	0
BM-09070603	256	93	1	6	90	1	9	86	5	10
BM-09070604	312	94	1	5	90	1	9	94	0	6
BM-06070606	366	84	2	15	81	2	17	89	2	9
BM-07070601	395	93	1	5	91	1	8	89	0	11
BM-09070606	432	94	0	5	89	0	11	89	6	6
BM-07070604	473	90	3	7	89	3	8	92	4	4
BM-07070605	533	90	3	8	88	3	9	89	0	11
BM-07070606	599	92	0	8	89	0	10	100	0	0
BM-09070609	656	87	1	12	83	1	16	93	0	8
BM-07070608	715	93	2	5	93	2	5	80	13	7
BM-09070610	758	92	1	7	87	1	12	81	5	14
BM-08070602	804	87	3	10	83	3	14	65	0	35
BM-09070612	851	91	1	8	89	1	10	66	0	34
BM-08070603	896	95	1	5	87	1	13	47	0	53
B) Peñas S: 16°15.7'S, 68°29.5'W										
BM-23060602	18	88	1	11	85	1	15	91	0	9
BM-23060604	70	95	0	5	93	0	7	72	0	28
BM-23060606	130	90	1	10	89	1	10	91	3	6
BM-23060608	189	88	0	12	87	0	13	94	0	6
BM-23060610	243	94	0	6	90	0	9	95	0	5
BM-24060602	278	92	0	8	89	0	11	86	4	11
BM-24060604	336	93	1	7	89	1	10	86	5	9
BM-24060606	379	92	1	8	90	1	9	89	4	7
BM-24060608	423	96	0	4	95	0	5	85	0	15
BM-25060601	469	90	5	5	88	5	7	84	5	11
BM-25060603	520	91	1	9	87	1	12	93	3	3
BM-25060605	587	90	3	7	89	3	8	96	0	4
BM-25060607	648	88	0	12	86	0	14	98	0	2
BM-25060608	700	90	5	5	89	5	7	74	5	21
BM-25060610	770	93	1	6	92	1	7	70	5	25
C) Aranjuez: 16°33.1'S, 68°05.7'W										
BM-27060602	2	62	6	32	59	6	36	86	0	14
BM-27060603	73	67	2	31	65	2	33	90	4	6
BM-27060605	314.5	53	7	40	50	7	43	72	5	23
D) Pedregal: 16°33.3'S, 68°03.0'W										
BM-28060602	132	76	2	21	73	2	25	89	8	3
BM-28060604	193.5	62	4	34	60	4	36	96	1	2