Table 1. Locations and descriptions of sampled tuff beds

Tuff	Location collected	Description	References
White Lignitic	N 42º 42' 54.3" W 108º 11' 11.8"	0.5 m thick, tan to white zeolitic tuff interbedded with carbonaceous shale and lignite. Unit 3 of Van Houten (1964). KA 1018 of Evernden et al. (1964).	(Sinclair and Granger, 1911; Evernden et al., 1964; Van Houten, 1964; Love, 1970)
Halfway Draw	N 42º 51' 51.0" W 108º 11' 58.1"	2 m thick, gray claystone containing white pumice clasts up to 5 cm in diameter within massive tan to orange silty mudstone. Matrix exhibits bentonite alteration. White tuff band in Big Sand Draw of Sinclair and Granger (1911). KA 1012 of Evernden et al. (1964).	(Sinclair and Granger, 1911; Hay, 1956; Evernden et al., 1964; Love, 1970)
Henrys Fork	N 41º 07' 25.3" W 110º 09' 27.7"	1 m thick, yellowish gray claystone that weathers to a dark gray band within massive white calcareous marlstone. Base is sharp and top is diffuse. Matrix exhibits bentonite alteration.	(Prothero, 1996; Evanoff et al., 1998; Murphey et al., 1999)
Church Buttes	N 41º 28' 34.5" W 110º 08' 04.3"	0.7 m thick, olive green claystone that weathers to a dark gray band within massive silty mudstone. Matrix exhibits bentonite alteration.	(Evanoff et al., 1998; Murphey et al., 1999)

Locations given according to NAD1927 datum.

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Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
Church Butte tuff ChBb biotite *J* = 0.014605 ± 0.16% μ = 1.0035									
Single crystal incremental heating experiments									
*# UW32B9ba: 1 crystal									
* 32B9ba1	0.19	2.053 ± 0.003	0.03517 ± 0.00024	0.001373 ± 0.000009	8.04	80.1	39.1	12	42.83 ± 0.18
* 32B9ba2	0.32	2.198 ± 0.003	0.02912 ± 0.00018	0.000169 ± 0.000007	10.39	97.6	47.3	15	55.67 ± 0.17
* 32B9ba3	0.45	2.009 ± 0.004	0.12148 ± 0.00079	0.000206 ± 0.000035	1.97	97.2	9.8	4	50.75 ± 0.57
* 32B9ba4	0.58	2.161 ± 0.008	0.06199 ± 0.00067	0.000288 ± 0.000096	0.66	96.1	3.1	7	53.90 ± 1.49
* 32B9ba5	0.84	2.181 ± 0.037	0.05079 ± 0.00103	0.000341 ± 0.000509	0.13	95.3	0.6	8	53.99 ± 7.93
* 32B9ba6	1.50	2.779 ± 0.153	0.06282 ± 0.00601	0.003579 ± 0.002241	0.04	62.0	0.1	7	44.81 ± 34.93
		no plateau or isochron					Total fusion age ± 2σ		50.09 ± 0.16
UW32B9bb: 1 crystal									
32B9bb1	0.19	1.972 ± 0.003	0.00826 ± 0.00010	0.000305 ± 0.000025	3.25	95.2	31.4	52	48.81 ± 0.40
32B9bb2	0.45	1.905 ± 0.003	0.04820 ± 0.00031	0.000056 ± 0.000010	6.71	99.1	67.0	9	49.07 ± 0.21
32B9bb3	0.71	1.958 ± 0.030	0.04007 ± 0.00089	0.000354 ± 0.000499	0.14	94.6	1.4	11	48.14 ± 7.72
32B9bb4	1.50	2.916 ± 0.160	0.05707 ± 0.00650	0.004027 ± 0.002111	0.04	59.2	0.2	8	44.90 ± 33.10
		Inverse isochron age ± 2σ	49.11 ± 0.25				Total fusion age ± 2σ		48.96 ± 0.24
		$^{40}Ar/^{39}Ar$ intercept ± 2σ	256.1 ± 59.9	MSWD 0.47			Weighted mean age ± 2σ		49.01 ± 0.20
UW32B9bc: 1 crystal									
32B9bc1	0.23	1.966 ± 0.003	0.01029 ± 0.00010	0.000256 ± 0.000026	3.06	95.9	40.7	42	49.02 ± 0.41
32B9bc2	0.39	1.914 ± 0.003	0.05601 ± 0.00037	0.000080 ± 0.000013	3.93	98.7	53.6	8	49.14 ± 0.24
32B9bc3	0.52	1.925 ± 0.015	0.02155 ± 0.00040	0.000138 ± 0.000168	0.29	97.7	3.9	20	48.90 ± 2.66
32B9bc4	0.84	1.971 ± 0.041	0.03483 ± 0.00175	0.000613 ± 0.000812	0.10	90.7	1.3	12	46.51 ± 12.51
32B9bc5	1.50	3.717 ± 0.124	0.14101 ± 0.00463	0.008431 ± 0.002235	0.06	33.2	0.5	3	32.18 ± 34.67
		Inverse isochron age ± 2σ	49.22 ± 0.30				Total fusion age ± 2σ		48.97 ± 0.33
		$^{40}Ar/^{39}Ar$ intercept ± 2σ	257.4 ± 75.3	MSWD 0.35			Weighted mean age ± 2σ		49.11 ± 0.22
* UW32B9bd: 1 crystal									
* 32B9bd1	0.19	2.042 ± 0.003	0.02107 ± 0.00015	0.000537 ± 0.000010	6.95	92.1	47.8	20	48.89 ± 0.20
* 32B9bd2	0.45	1.927 ± 0.002	0.08967 ± 0.00057	0.000088 ± 0.000007	7.08	98.8	51.7	5	49.48 ± 0.16
* 32B9bd3	1.50	2.051 ± 0.058	0.11223 ± 0.00295	0.002026 ± 0.001117	0.08	71.0	0.5	4	37.98 ± 17.28
		no plateau or isochron					Total fusion age ± 2σ		49.14 ± 0.17
*# UW32B9be: 1 crystal									
* 32B9be1	0.13	2.247 ± 0.004	0.05228 ± 0.00036	0.004167 ± 0.000036	2.25	45.2	8.3	8	26.56 ± 0.56
* 32B9be2	0.19	2.127 ± 0.003	0.02341 ± 0.00025	0.000422 ± 0.000022	2.16	94.0	8.4	18	51.94 ± 0.35
* 32B9be3	0.29	2.114 ± 0.003	0.02148 ± 0.00015	0.000195 ± 0.000014	3.81	97.1	15.0	20	53.32 ± 0.28
* 32B9be4	0.42	2.067 ± 0.003	0.03843 ± 0.00025	0.000124 ± 0.000008	6.13	98.2	24.7	11	52.68 ± 0.18
* 32B9be5	1.50	1.963 ± 0.002	0.09200 ± 0.00058	0.000121 ± 0.000004	10.31	98.3	43.6	5	50.16 ± 0.12
		no plateau or isochron					Total fusion age ± 2σ		49.46 ± 0.13
* UW32B9bf: 1 crystal									
* 32B9bf1	0.13	1.995 ± 0.026	0.03351 ± 0.00038	0.002933 ± 0.000122	0.82	56.5	15.5	13	29.43 ± 2.31
32B9bf2	0.19	2.138 ± 0.038	0.02184 ± 0.00043	0.000375 ± 0.000165	0.60	94.7	10.6	20	52.58 ± 3.16
32B9bf3	0.29	2.137 ± 0.020	0.02278 ± 0.00035	0.000181 ± 0.000102	1.15	97.4	20.4	19	54.01 ± 1.85
32B9bf4	0.39	2.124 ± 0.019	0.04050 ± 0.00038	0.000127 ± 0.000090	1.23	98.2	21.9	11	54.12 ± 1.66
32B9bf5	0.52	2.042 ± 0.024	0.14590 ± 0.00106	0.000240 ± 0.000114	0.89	96.9	16.6	3	51.38 ± 2.12
32B9bf6	1.50	2.117 ± 0.027	0.07124 ± 0.00064	0.000493 ± 0.000116	0.85	93.2	15.1	6	51.24 ± 2.22
		Inverse isochron age ± 2σ	45.28 ± 10.40				Total fusion age ± 2σ		49.25 ± 0.87
		$^{40}Ar/^{39}Ar$ intercept ± 2σ	1575.9 ± 11008.9	MSWD 1.98			Weighted mean age ± 2σ		52.95 ± 1.30

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
Church Butte tuff ChBb biotite continued									
UW32B9bg: 1 crystal									
32B9bg1	0.13	2.747 ± 0.173	0.08199 ± 0.00174	0.004437 ± 0.000841	0.17	52.3	1.2	5	37.49 ± 15.63
32B9bg2	0.19	2.133 ± 0.058	0.02435 ± 0.00040	0.000705 ± 0.000254	0.39	90.1	3.7	18	49.95 ± 4.85
32B9bg3	0.32	1.960 ± 0.010	0.01876 ± 0.00015	0.000146 ± 0.000049	2.09	97.6	21.5	23	49.74 ± 0.91
32B9bg4	0.48	1.931 ± 0.006	0.10872 ± 0.00070	0.000136 ± 0.000025	4.10	98.1	42.8	4	49.26 ± 0.48
32B9bg5	1.50	1.923 ± 0.007	0.10133 ± 0.00070	0.000132 ± 0.000032	2.94	98.1	30.8	4	49.07 ± 0.61
Inverse isochron age ± 2σ		49.38 ± 1.32					Total fusion age ± 2σ		49.18 ± 0.44
$^{40}Ar/^{39}Ar$ intercept ± 2σ		256.0 ± 131.3		MSWD 0.97			Weighted mean age ± 2σ		49.26 ± 0.36
UW32B9bh: 1 crystal									
32B9bh1	0.13	2.796 ± 0.084	0.03606 ± 0.00074	0.003621 ± 0.000391	0.35	61.7	2.2	12	44.86 ± 7.33
32B9bh2	0.19	2.016 ± 0.027	0.00935 ± 0.00042	0.000451 ± 0.000124	0.80	93.2	6.9	46	48.85 ± 2.32
32B9bh3	0.29	1.910 ± 0.009	0.00792 ± 0.00010	0.000062 ± 0.000045	2.48	98.8	22.6	54	49.08 ± 0.81
32B9bh4	0.45	1.895 ± 0.004	0.04967 ± 0.00032	0.000062 ± 0.000014	6.38	99.0	58.5	9	48.78 ± 0.29
32B9bh5	1.50	1.882 ± 0.019	0.02114 ± 0.00028	0.000054 ± 0.000082	1.06	99.0	9.8	20	48.45 ± 1.57
Inverse isochron age ± 2σ		48.85 ± 0.28					Total fusion age ± 2σ		48.73 ± 0.38
$^{40}Ar/^{39}Ar$ intercept ± 2σ		261.5 ± 249.1		MSWD 0.47			Weighted mean age ± 2σ		48.80 ± 0.28
*# UW32B9bi: 1 crystal									
* 32B9bi1	0.13	2.234 ± 0.007	0.04985 ± 0.00036	0.001685 ± 0.000023	5.82	77.7	21.4	9	45.17 ± 0.48
* 32B9bi2	0.19	2.105 ± 0.005	0.06870 ± 0.00046	0.000220 ± 0.000014	7.80	97.0	30.4	6	52.99 ± 0.34
* 32B9bi3	0.29	1.987 ± 0.004	0.13234 ± 0.00086	0.000157 ± 0.000014	6.64	98.0	27.4	3	50.59 ± 0.30
* 32B9bi4	0.39	1.959 ± 0.006	0.10979 ± 0.00072	0.000127 ± 0.000024	3.76	98.3	15.8	4	50.04 ± 0.48
* 32B9bi5	0.52	1.994 ± 0.019	0.12682 ± 0.00112	0.000216 ± 0.000089	1.13	97.1	4.7	3	50.30 ± 1.66
* 32B9bi6	1.50	2.058 ± 0.257	0.07297 ± 0.00215	0.000290 ± 0.001152	0.08	95.9	0.3	6	51.26 ± 21.84
no plateau or isochron							Total fusion age ± 2σ		50.06 ± 0.23
UW32B9bj: 1 crystal									
32B9bj1	0.14	7.481 ± 0.067	0.08426 ± 0.00758	0.020329 ± 0.000846	0.21	19.7	0.7	5	38.48 ± 13.01
32B9bj2	0.23	4.099 ± 0.022	0.06438 ± 0.00221	0.006893 ± 0.000317	0.36	50.3	2.3	7	53.54 ± 4.84
32B9bj3	0.31	2.175 ± 0.012	0.03475 ± 0.00093	0.000719 ± 0.000138	0.40	90.1	4.8	12	50.94 ± 2.16
32B9bj4	0.48	2.006 ± 0.003	0.02962 ± 0.00048	0.000358 ± 0.000027	2.47	94.6	31.9	15	49.33 ± 0.44
32B9bj5	1.50	1.927 ± 0.003	0.09167 ± 0.00133	0.000149 ± 0.000011	4.50	97.9	60.4	5	49.01 ± 0.23
Inverse isochron age ± 2σ		48.75 ± 0.47					Total fusion age ± 2σ		49.23 ± 0.28
$^{40}Ar/^{39}Ar$ intercept ± 2σ		371.1 ± 91.4		MSWD 2.32			Weighted mean age ± 2σ		49.09 ± 0.32
* UW32B9bk: 1 crystal									
* 32B9bk1	0.14	2.444 ± 0.035	0.06096 ± 0.00247	0.003149 ± 0.000478	0.18	61.9	2.1	7	39.46 ± 7.50
* 32B9bk2	0.23	2.142 ± 0.014	0.02799 ± 0.00102	0.000924 ± 0.000147	0.44	87.1	5.9	15	48.52 ± 2.34
* 32B9bk3	0.31	2.013 ± 0.007	0.02632 ± 0.00076	0.000183 ± 0.000067	0.83	97.2	11.7	16	50.82 ± 1.08
* 32B9bk4	0.48	1.947 ± 0.004	0.07351 ± 0.00110	0.000107 ± 0.000028	1.98	98.4	28.8	6	49.82 ± 0.47
* 32B9bk5	1.50	1.922 ± 0.003	0.07958 ± 0.00123	0.000110 ± 0.000017	3.49	98.4	51.5	5	49.16 ± 0.31
no plateau or isochron							Total fusion age ± 2σ		49.30 ± 0.33
*# UW32B9bl: 1 crystal									
* 32B9bl1	0.14	5.586 ± 0.024	0.04287 ± 0.00146	0.013306 ± 0.000207	0.77	29.6	1.6	10	43.04 ± 3.22
* 32B9bl2	0.23	2.145 ± 0.006	0.01637 ± 0.00052	0.000653 ± 0.000060	1.13	90.8	6.2	26	50.63 ± 0.95
* 32B9bl3	0.31	1.966 ± 0.004	0.01290 ± 0.00029	0.000088 ± 0.000027	2.24	98.5	13.4	33	50.31 ± 0.46
* 32B9bl4	0.48	1.938 ± 0.003	0.06781 ± 0.00100	0.000106 ± 0.000011	5.29	98.4	32.1	6	49.56 ± 0.23
* 32B9bl5	1.50	1.907 ± 0.003	0.05627 ± 0.00084	0.000074 ± 0.000009	7.59	98.8	46.7	8	49.00 ± 0.20
no plateau or isochron							Total fusion age ± 2σ		49.36 ± 0.17
Combined incremental heating ages									
Inverse isochron age ± 2σ		49.02 ± 0.17					Total fusion age ± 2σ		49.44 ± 0.11
$^{40}Ar/^{39}Ar$ intercept ± 2σ		304.7 ± 35.5		MSWD 1.20			Weighted mean: total fusion ages ± 2σ		49.09 ± 0.15
				MSWD 1.30			Weighted mean: plateau ages ± 2σ		49.04 ± 0.13

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
Henrys Fork tuff HeFb biotite *J* = 0.014648 ± 0.16% μ = 1.0035									
Single crystal incremental heating experiments									
UW32B7ba: 1 crystal									
32B7ba1	0.13	4.689 ± 0.050	0.69412 ± 0.01515	0.010702 ± 0.000707	0.18	33.6	1.2	1	41.23 ± 10.88
32B7ba2	0.23	2.080 ± 0.008	0.01689 ± 0.00054	0.000670 ± 0.000099	0.58	90.3	9.2	25	48.98 ± 1.55
32B7ba3	0.32	1.924 ± 0.004	0.00742 ± 0.00023	0.000166 ± 0.000046	1.12	97.2	19.0	58	48.79 ± 0.72
32B7ba4	0.42	1.916 ± 0.003	0.00756 ± 0.00018	0.000147 ± 0.000035	1.30	97.5	22.2	57	48.71 ± 0.56
32B7ba5	0.55	1.906 ± 0.004	0.01868 ± 0.00028	0.000124 ± 0.000045	1.30	97.9	22.3	23	48.65 ± 0.71
32B7ba6	1.50	1.878 ± 0.003	0.03555 ± 0.00048	0.000086 ± 0.000031	1.49	98.6	26.0	12	48.27 ± 0.49
Inverse isochron age ± 2σ		48.61 ± 0.32					Total fusion age ± 2σ		48.53 ± 0.35
$^{40}Ar/^{39}Ar$ intercept ± 2σ		282.2 ± 36.6		MSWD 0.85			Weighted mean age ± 2σ		48.56 ± 0.30
UW32B7bb: 1 crystal									
32B7bb1	0.15	2.606 ± 0.053	0.17333 ± 0.00732	0.002558 ± 0.002266	0.04	71.3	0.6	2	48.48 ± 34.54
32B7bb2	0.26	1.911 ± 0.008	0.00539 ± 0.00068	0.000228 ± 0.000142	0.40	96.3	9.1	80	47.97 ± 2.19
32B7bb3	0.36	1.891 ± 0.004	0.00317 ± 0.00025	0.000052 ± 0.000061	0.96	99.0	22.0	136	48.78 ± 0.95
32B7bb4	0.52	1.875 ± 0.003	0.01152 ± 0.00026	0.000092 ± 0.000040	1.63	98.4	37.9	37	48.10 ± 0.62
32B7bb5	1.50	1.882 ± 0.003	0.02579 ± 0.00040	0.000076 ± 0.000049	1.31	98.7	30.3	17	48.41 ± 0.77
Inverse isochron age ± 2σ		48.09 ± 1.21					Total fusion age ± 2σ		48.33 ± 0.49
$^{40}Ar/^{39}Ar$ intercept ± 2σ		410.4 ± 770.6		MSWD 0.40			Weighted mean age ± 2σ		48.32 ± 0.43
UW32B7bc: 1 crystal									
32B7bc1	0.16	3.069 ± 0.041	0.05296 ± 0.00382	0.003385 ± 0.001058	0.09	67.4	1.0	8	53.85 ± 16.16
32B7bc2	0.26	1.979 ± 0.011	0.01722 ± 0.00089	0.000395 ± 0.000198	0.34	93.9	5.8	25	48.46 ± 3.06
32B7bc3	0.36	1.889 ± 0.005	0.01083 ± 0.00040	0.000088 ± 0.000082	0.71	98.4	12.7	40	48.47 ± 1.27
32B7bc4	0.45	1.893 ± 0.004	0.01370 ± 0.00039	0.000081 ± 0.000063	1.19	98.6	21.1	31	48.64 ± 0.97
32B7bc5	0.58	1.878 ± 0.003	0.04414 ± 0.00059	0.000081 ± 0.000036	1.50	98.7	26.9	10	48.32 ± 0.56
32B7bc6	1.50	1.883 ± 0.004	0.06374 ± 0.00081	0.000068 ± 0.000036	1.82	99.0	32.5	7	48.57 ± 0.57
Inverse isochron age ± 2σ		48.37 ± 0.56					Total fusion age ± 2σ		48.55 ± 0.44
$^{40}Ar/^{39}Ar$ intercept ± 2σ		354.8 ± 204.5		MSWD 0.20			Weighted mean age ± 2σ		48.47 ± 0.36
UW32B7bd: 1 crystal									
32B7bd1	0.16	3.656 ± 0.147	0.10449 ± 0.01858	0.008234 ± 0.003397	0.03	33.6	0.3	4	32.14 ± 52.64
32B7bd2	0.26	2.159 ± 0.024	0.01271 ± 0.00223	0.000812 ± 0.000533	0.12	88.7	2.3	34	49.92 ± 8.19
32B7bd3	0.36	1.922 ± 0.010	0.00627 ± 0.00052	0.000250 ± 0.000118	0.42	95.9	9.3	69	48.07 ± 1.86
32B7bd4	0.45	1.858 ± 0.004	0.00533 ± 0.00037	0.000068 ± 0.000059	0.88	98.7	20.2	81	47.82 ± 0.91
32B7bd5	0.58	1.867 ± 0.003	0.01092 ± 0.00020	0.000088 ± 0.000042	1.23	98.4	28.0	39	47.91 ± 0.65
32B7bd6	1.50	1.875 ± 0.003	0.04935 ± 0.00062	0.000112 ± 0.000025	1.75	98.2	39.8	9	48.01 ± 0.41
Inverse isochron age ± 2σ		47.94 ± 0.61					Total fusion age ± 2σ		47.95 ± 0.44
$^{40}Ar/^{39}Ar$ intercept ± 2σ		307.8 ± 212.0		MSWD 0.16			Weighted mean age ± 2σ		47.97 ± 0.33
UW32B7be: 1 crystal									
32B7be1	0.19	2.873 ± 0.026	0.06358 ± 0.00207	0.003495 ± 0.000328	0.20	64.1	2.1	7	48.00 ± 5.11
32B7be2	0.29	1.935 ± 0.005	0.01125 ± 0.00050	0.000147 ± 0.000086	0.67	97.6	10.6	38	49.21 ± 1.32
32B7be3	0.39	1.885 ± 0.004	0.00947 ± 0.00019	0.000101 ± 0.000047	1.39	98.2	22.5	45	48.27 ± 0.75
32B7be4	0.52	1.883 ± 0.003	0.02224 ± 0.00039	0.000092 ± 0.000034	1.50	98.4	24.3	19	48.32 ± 0.53
32B7be5	0.65	1.871 ± 0.003	0.08705 ± 0.00114	0.000082 ± 0.000043	1.68	98.8	27.5	5	48.22 ± 0.67
32B7be6	1.50	1.881 ± 0.005	0.18124 ± 0.00239	0.000172 ± 0.000048	0.81	97.8	13.1	2	47.99 ± 0.76
Inverse isochron age ± 2σ		48.27 ± 0.37					Total fusion age ± 2σ		48.32 ± 0.35
$^{40}Ar/^{39}Ar$ intercept ± 2σ		300.9 ± 60.1		MSWD 0.52			Weighted mean age ± 2σ		48.28 ± 0.33

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
Henrys Fork tuff HeFb biotite continued									
UW32B7bf: 1 crystal									
32B7bf1	0.16	2.685 ± 0.033	0.31416 ± 0.00715	0.002666 ± 0.000941	0.07	71.4	1.1	1	49.99 ± 14.39
32B7bf2	0.24	2.050 ± 0.015	0.04674 ± 0.00138	0.000315 ± 0.000374	0.15	95.4	3.2	9	50.96 ± 5.73
32B7bf3	0.32	1.924 ± 0.008	0.01713 ± 0.00057	0.000175 ± 0.000078	0.51	97.1	11.1	25	48.73 ± 1.25
32B7bf4	0.42	1.877 ± 0.004	0.02672 ± 0.00043	0.000061 ± 0.000069	0.97	98.9	21.7	16	48.40 ± 1.06
32B7bf5	0.58	1.870 ± 0.003	0.10536 ± 0.00128	0.000077 ± 0.000037	1.72	99.0	38.4	4	48.26 ± 0.58
32B7bf6	1.50	1.883 ± 0.003	0.07343 ± 0.00092	0.000100 ± 0.000050	1.11	98.5	24.5	6	48.36 ± 0.77
Inverse isochron age ± 2σ		48.20 ± 0.70					Total fusion age ± 2σ		48.47 ± 0.47
$^{40}Ar/^{39}Ar$ intercept ± 2σ		384.3 ± 258.5		MSWD 0.27			Weighted mean age ± 2σ		48.37 ± 0.41
UW32B7bg: 1 crystal									
32B7bg1	0.26	2.081 ± 0.008	0.00859 ± 0.00054	0.000596 ± 0.000207	0.32	91.3	7.2	50	49.54 ± 3.17
32B7bg2	0.39	1.889 ± 0.003	0.00403 ± 0.00018	0.000045 ± 0.000037	1.09	99.1	27.3	107	48.78 ± 0.59
32B7bg3	0.48	1.885 ± 0.004	0.00664 ± 0.00032	0.000071 ± 0.000066	0.75	98.7	18.8	65	48.48 ± 1.03
32B7bg4	0.61	1.882 ± 0.006	0.01450 ± 0.00042	0.000065 ± 0.000085	0.63	98.8	15.7	30	48.49 ± 1.32
32B7bg5	1.50	1.991 ± 0.003	0.01637 ± 0.00040	0.000426 ± 0.000032	1.31	93.5	31.0	26	48.53 ± 0.52
Inverse isochron age ± 2σ		48.67 ± 0.54					Total fusion age ± 2σ		48.66 ± 0.44
$^{40}Ar/^{39}Ar$ intercept ± 2σ		287.7 ± 70.6		MSWD 0.22			Weighted mean age ± 2σ		48.62 ± 0.36
UW32B7bh: 1 crystal									
32B7bh1	0.26	1.903 ± 0.005	0.00820 ± 0.00022	0.000100 ± 0.000041	1.32	98.2	34.3	52	48.74 ± 0.67
32B7bh2	0.37	1.871 ± 0.004	0.03484 ± 0.00048	0.000043 ± 0.000036	1.40	99.2	37.1	12	48.42 ± 0.58
32B7bh3	0.48	1.871 ± 0.006	0.09861 ± 0.00134	0.000059 ± 0.000062	0.87	99.2	22.9	4	48.42 ± 0.99
32B7bh4	0.66	1.872 ± 0.020	0.04724 ± 0.00126	0.000095 ± 0.000217	0.18	98.5	4.9	9	48.07 ± 3.45
32B7bh5	1.50	2.059 ± 0.106	0.09367 ± 0.00638	0.000227 ± 0.001499	0.03	96.9	0.8	5	51.95 ± 23.38
Inverse isochron age ± 2σ		48.22 ± 1.38					Total fusion age ± 2σ		48.54 ± 0.47
$^{40}Ar/^{39}Ar$ intercept ± 2σ		505.9 ± 838.6		MSWD 0.18			Weighted mean age ± 2σ		48.53 ± 0.41
UW32B7bi: 1 crystal									
32B7bi1	0.26	1.900 ± 0.004	0.00817 ± 0.00021	0.000146 ± 0.000041	1.58	97.5	48.8	53	48.31 ± 0.64
32B7bi2	0.37	1.888 ± 0.005	0.05849 ± 0.00077	0.000086 ± 0.000048	0.91	98.7	28.2	7	48.57 ± 0.77
32B7bi3	0.48	1.869 ± 0.008	0.06183 ± 0.00089	0.000099 ± 0.000071	0.63	98.5	19.8	7	48.00 ± 1.15
32B7bi4	0.66	1.844 ± 0.047	0.08542 ± 0.00310	0.000378 ± 0.000628	0.07	94.1	2.3	5	45.26 ± 9.87
32B7bi5	1.50	1.842 ± 0.119	0.12584 ± 0.00717	0.000310 ± 0.001241	0.03	95.3	0.9	3	45.81 ± 19.87
Inverse isochron age ± 2σ		47.90 ± 2.06					Total fusion age ± 2σ		48.22 ± 0.48
$^{40}Ar/^{39}Ar$ intercept ± 2σ		451.2 ± 1074.1		MSWD 0.30			Weighted mean age ± 2σ		48.31 ± 0.46
UW32B7bj: 1 crystal									
32B7bj1	0.26	1.958 ± 0.005	0.03762 ± 0.00054	0.000348 ± 0.000068	0.94	94.7	11.3	11	48.33 ± 1.06
32B7bj2	0.37	1.875 ± 0.003	0.00673 ± 0.00022	0.000058 ± 0.000026	2.24	98.9	28.3	64	48.32 ± 0.43
32B7bj3	0.48	1.866 ± 0.003	0.02073 ± 0.00039	0.000036 ± 0.000030	1.94	99.3	24.7	21	48.30 ± 0.49
32B7bj4	0.66	1.870 ± 0.003	0.10477 ± 0.00136	0.000088 ± 0.000019	2.38	98.8	30.2	4	48.18 ± 0.32
32B7bj5	1.50	1.905 ± 0.014	0.12571 ± 0.00174	0.000222 ± 0.000140	0.45	96.8	5.6	3	48.11 ± 2.25
Inverse isochron age ± 2σ		48.23 ± 0.35					Total fusion age ± 2σ		48.26 ± 0.27
$^{40}Ar/^{39}Ar$ intercept ± 2σ		305.8 ± 147.7		MSWD 0.09			Weighted mean age ± 2σ		48.25 ± 0.23
UW32B7bk: 1 crystal									
32B7bk1	0.26	1.974 ± 0.020	0.02540 ± 0.00148	0.000540 ± 0.000366	0.12	91.8	5.2	17	47.24 ± 5.67
32B7bk2	0.37	1.904 ± 0.013	0.00939 ± 0.00079	0.000033 ± 0.000189	0.29	99.3	13.3	46	49.28 ± 2.95
32B7bk3	0.48	1.881 ± 0.010	0.00527 ± 0.00041	0.000151 ± 0.000116	0.48	97.4	22.0	82	47.78 ± 1.83
32B7bk4	0.66	1.871 ± 0.004	0.03062 ± 0.00054	0.000050 ± 0.000073	0.89	99.1	40.7	14	48.34 ± 1.12
32B7bk5	1.50	1.877 ± 0.011	0.01555 ± 0.00055	0.000008 ± 0.000143	0.41	99.7	18.8	28	48.79 ± 2.26
Inverse isochron age ± 2σ		48.41 ± 0.93					Total fusion age ± 2σ		48.37 ± 0.89
$^{40}Ar/^{39}Ar$ intercept ± 2σ		254.6 ± 426.0		MSWD 0.27			Weighted mean age ± 2σ		48.34 ± 0.84

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
Henrys Fork tuff HeFb biotite continued									
UW32B7bl: 1 crystal									
32B7bl1	0.26	2.122 ± 0.016	0.02592 ± 0.00106	0.000517 ± 0.000292	0.21	92.7	3.0	17	51.23 ± 4.51
32B7bl2	0.37	1.878 ± 0.006	0.00999 ± 0.00033	0.000094 ± 0.000086	0.73	98.3	11.8	43	48.15 ± 1.34
32B7bl3	0.48	1.869 ± 0.003	0.01035 ± 0.00022	0.000047 ± 0.000029	1.50	99.0	24.3	42	48.26 ± 0.48
32B7bl4	0.66	1.864 ± 0.002	0.05995 ± 0.00094	0.000044 ± 0.000022	2.07	99.3	33.7	7	48.26 ± 0.35
32B7bl5	1.50	1.862 ± 0.004	0.10239 ± 0.00125	0.000072 ± 0.000031	1.67	99.0	27.2	4	48.08 ± 0.52
Inverse isochron age ± 2σ		47.98 ± 0.74					Total fusion age ± 2σ		48.29 ± 0.31
$^{40}Ar/^{39}Ar$ intercept ± 2σ		531.1 ± 625.1		MSWD 0.54			Weighted mean age ± 2σ		48.22 ± 0.26
UW32B7bm: 1 crystal									
32B7bm1	0.26	1.956 ± 0.009	0.01473 ± 0.00081	0.000488 ± 0.000144	0.41	92.5	8.1	29	47.17 ± 2.23
32B7bm2	0.37	1.886 ± 0.004	0.00988 ± 0.00037	0.000148 ± 0.000042	0.92	97.5	19.0	44	47.92 ± 0.66
32B7bm3	0.48	1.877 ± 0.004	0.01678 ± 0.00034	0.000091 ± 0.000045	1.01	98.4	20.8	26	48.16 ± 0.72
32B7bm4	0.66	1.873 ± 0.004	0.07151 ± 0.00089	0.000077 ± 0.000020	2.00	98.8	41.4	6	48.26 ± 0.36
32B7bm5	1.50	1.894 ± 0.009	0.21772 ± 0.00275	0.000150 ± 0.000073	0.52	98.3	10.7	2	48.57 ± 1.21
Inverse isochron age ± 2σ		48.39 ± 0.37					Total fusion age ± 2σ		48.12 ± 0.34
$^{40}Ar/^{39}Ar$ intercept ± 2σ		201.3 ± 132.1		MSWD 0.51			Weighted mean age ± 2σ		48.18 ± 0.29
UW32B7bn: 1 crystal									
32B7bn1	0.26	2.041 ± 0.007	0.02598 ± 0.00054	0.000660 ± 0.000090	0.50	90.3	10.9	17	48.07 ± 1.41
32B7bn2	0.37	1.894 ± 0.003	0.00711 ± 0.00031	0.000183 ± 0.000053	0.94	96.9	21.9	60	47.86 ± 0.82
32B7bn3	0.48	1.897 ± 0.003	0.01888 ± 0.00033	0.000159 ± 0.000039	1.15	97.4	26.8	23	48.17 ± 0.61
32B7bn4	0.66	1.880 ± 0.003	0.10617 ± 0.00130	0.000097 ± 0.000031	1.53	98.7	36.1	4	48.37 ± 0.50
32B7bn5	1.50	1.917 ± 0.017	0.15860 ± 0.00306	0.000166 ± 0.000210	0.18	97.9	4.2	3	48.91 ± 3.31
Inverse isochron age ± 2σ		48.28 ± 0.48					Total fusion age ± 2σ		48.20 ± 0.38
$^{40}Ar/^{39}Ar$ intercept ± 2σ		277.6 ± 94.6		MSWD 0.34			Weighted mean age ± 2σ		48.21 ± 0.35
Combined single crystal incremental heating ages									
Inverse isochron age ± 2σ		48.28 ± 0.13					Total fusion age ± 2σ		48.34 ± 0.13
$^{40}Ar/^{39}Ar$ intercept ± 2σ		309.7 ± 26.3		MSWD 0.86			Weighted mean: total fusion ages ± 2σ		48.32 ± 0.13
				MSWD 1.07			Weighted mean: plateau ages ± 2σ		48.31 ± 0.12
Halfway Draw tuff HD-1b biotite J = 0.014499 ± 0.10% μ = 1.0035									
Single crystal incremental heating experiments									
*# UW32C1ba: 1 crystal									
* 32C1ba1	0.16	19.570 ± 0.056	0.05832 ± 0.00176	0.062637 ± 0.000551	1.85	5.4	19.0	7	27.54 ± 8.07
* 32C1ba2	0.23	5.940 ± 0.048	0.05346 ± 0.00207	0.015208 ± 0.000509	0.30	24.3	10.1	8	37.42 ± 7.84
32C1ba3	0.36	8.649 ± 0.067	0.05404 ± 0.00325	0.022520 ± 0.000834	0.29	23.1	6.9	8	51.41 ± 12.63
32C1ba4	0.39	5.739 ± 0.099	0.05901 ± 0.00813	0.013506 ± 0.001775	0.10	30.5	3.4	7	45.15 ± 27.05
32C1ba5	1.50	6.108 ± 0.010	0.13125 ± 0.00182	0.014354 ± 0.000194	1.84	30.7	60.7	3	48.33 ± 2.91
Inverse isochron age ± 2σ		42.68 ± 24.63					Total fusion age ± 2σ		43.40 ± 2.77
$^{40}Ar/^{39}Ar$ intercept ± 2σ		310.9 ± 65.2		MSWD 0.14			Weighted mean age ± 2σ		48.45 ± 2.82
UW32C1bb: 1 crystal									
32C1bb1	0.15	2.659 ± 0.017	0.00234 ± 0.00075	0.002569 ± 0.000315	0.29	71.3	22.9	184	48.91 ± 4.80
32C1bb2	0.23	2.164 ± 0.017	0.00317 ± 0.00099	0.000277 ± 0.000211	0.23	96.0	22.4	136	53.56 ± 3.28
32C1bb3	0.39	2.195 ± 0.014	0.00057 ± 0.00057	0.000237 ± 0.000223	0.34	96.6	33.1	755	54.63 ± 3.42
32C1bb4	0.52	2.149 ± 0.024	0.00169 ± 0.00185	0.000200 ± 0.000502	0.14	97.0	13.7	255	53.74 ± 7.63
32C1bb5	1.50	4.078 ± 0.043	0.00246 ± 0.00268	0.006294 ± 0.000809	0.15	54.3	7.9	175	57.00 ± 12.28
Inverse isochron age ± 2σ		53.55 ± 2.66					Total fusion age ± 2σ		53.15 ± 2.25
$^{40}Ar/^{39}Ar$ intercept ± 2σ		279.9 ± 71.2		MSWD 1.09			Weighted mean age ± 2σ		53.21 ± 2.10

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
Halfway Draw tuff HD-1b biotite continued									
UW32C1bc: 1 crystal									
* 32C1bc1	0.16	7.345 ± 0.034	0.01625 ± 0.00140	0.021373 ± 0.000449	0.52	14.0	20.5	26	26.64 ± 6.81
32C1bc2	0.32	3.995 ± 0.033	0.01580 ± 0.00174	0.006338 ± 0.000455	0.21	53.0	15.4	27	54.58 ± 6.92
32C1bc3	1.50	6.107 ± 0.009	0.04879 ± 0.00098	0.013247 ± 0.000202	1.35	35.9	64.1	9	56.43 ± 3.04
	No isochron						Total fusion age ± 2σ		50.08 ± 2.62
				MSWD 0.24			Weighted mean age ± 2σ		56.13 ± 2.78
UW32C1bd: 1 crystal									
* 32C1bd1	0.16	10.380 ± 0.050	0.02853 ± 0.00108	0.030174 ± 0.000397	1.16	14.1	26.6	15	37.82 ± 5.66
32C1bd2	0.32	5.226 ± 0.036	0.03013 ± 0.00207	0.010296 ± 0.000585	0.31	41.7	14.2	14	56.18 ± 8.85
32C1bd3	1.50	6.139 ± 0.010	0.08080 ± 0.00130	0.013507 ± 0.000148	1.53	35.0	59.2	5	55.36 ± 2.21
	No isochron						Total fusion age ± 2σ		50.82 ± 2.35
				MSWD 0.03			Weighted mean age ± 2σ		55.41 ± 2.14
* UW32C1be: 1 crystal									
* 32C1be1	0.16	5.335 ± 0.019	0.02803 ± 0.00065	0.012727 ± 0.000250	0.92	29.5	40.5	15	40.64 ± 3.76
32C1be2	0.32	4.927 ± 0.013	0.03922 ± 0.00077	0.009044 ± 0.000135	0.80	45.7	38.3	11	58.00 ± 2.06
32C1be3	1.50	12.680 ± 0.047	0.08003 ± 0.00153	0.035375 ± 0.000420	1.15	17.6	21.2	5	57.38 ± 6.06
	no isochron						Total fusion age ± 2σ		50.85 ± 2.14
				MSWD 0.04			Weighted mean age ± 2σ		57.93 ± 1.96
*# UW32C1bf: 1 crystal									
* 32C1bf1	0.16	20.845 ± 0.054	0.03105 ± 0.00078	0.067841 ± 0.000454	3.00	3.8	24.3	14	20.69 ± 6.47
* 32C1bf2	0.32	5.708 ± 0.016	0.03379 ± 0.00081	0.013962 ± 0.000248	0.71	27.7	21.1	13	40.87 ± 3.74
* 32C1bf3	1.50	5.899 ± 0.009	0.05683 ± 0.00080	0.012765 ± 0.000093	1.91	36.1	54.6	8	54.79 ± 1.41
	no plateau or isochron						Total fusion age ± 2σ		43.62 ± 1.91
Combined single crystal incremental heating experiments									
Inverse isochron age ± 2σ		53.16 ± 2.16					Total fusion age ± 2σ		48.24 ± 0.96
$^{40}Ar/^{39}Ar$ intercept ± 2σ		303.0 ± 8.6		MSWD 1.04			Weighted mean: plateau ages ± 2σ		54.65 ± 1.32
Multi-crystal incremental heating experiments									
*# UW32C1bg: 3 crystals									
* 32C1bg1	0.15	8.385 ± 0.012	0.02335 ± 0.00069	0.023621 ± 0.000202	2.51	16.7	22.6	18	36.31 ± 3.05
* 32C1bg2	0.23	3.476 ± 0.012	0.01166 ± 0.00074	0.004457 ± 0.000133	0.74	62.0	16.0	37	55.52 ± 2.05
32C1bg3	0.39	4.116 ± 0.008	0.02814 ± 0.00041	0.007072 ± 0.000069	1.86	49.2	34.1	15	52.17 ± 1.06
32C1bg4	0.52	3.822 ± 0.010	0.04931 ± 0.00095	0.005680 ± 0.000150	1.02	56.1	20.1	9	55.21 ± 2.29
32C1bg5	1.50	7.509 ± 0.036	0.14617 ± 0.00219	0.018395 ± 0.000335	0.73	27.7	7.3	3	53.61 ± 5.14
Inverse isochron age ± 2σ		52.88 ± 7.95					Total fusion age ± 2σ		49.86 ± 1.03
$^{40}Ar/^{39}Ar$ intercept ± 2σ		294.7 ± 42.0		MSWD 2.95			Weighted mean age ± 2σ		52.73 ± 1.62
UW32C1bh: 3 crystals									
* 32C1bh1	0.15	5.007 ± 0.011	0.01703 ± 0.00046	0.011694 ± 0.000155	1.31	30.9	33.3	25	40.04 ± 2.35
32C1bh2	0.23	3.190 ± 0.016	0.01219 ± 0.00080	0.003580 ± 0.000213	0.40	66.7	16.1	35	54.83 ± 3.28
32C1bh3	0.39	3.660 ± 0.009	0.02425 ± 0.00069	0.005073 ± 0.000110	0.97	59.0	33.9	18	55.58 ± 1.69
32C1bh4	0.52	3.082 ± 0.025	0.03486 ± 0.00149	0.002875 ± 0.000331	0.24	72.4	10.0	12	57.42 ± 5.09
32C1bh5	1.50	9.767 ± 0.064	0.09811 ± 0.00239	0.025785 ± 0.000619	0.51	22.0	6.7	4	55.41 ± 9.34
Inverse isochron age ± 2σ		55.65 ± 2.62					Total fusion age ± 2σ		50.47 ± 1.37
$^{40}Ar/^{39}Ar$ intercept ± 2σ		295.0 ± 17.1		MSWD 0.24			Weighted mean age ± 2σ		55.58 ± 1.42

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
Halfway Draw tuff HD-1b biotite continued									
* UW32C1bi: 3 crystals									
* 32C1bi1	0.15	4.583 ± 0.007	0.01349 ± 0.00031	0.009989 ± 0.000099	1.86	35.5	30.3	32	42.07 ± 1.51
32C1bi2	0.23	3.079 ± 0.008	0.01046 ± 0.00036	0.003044 ± 0.000115	0.90	70.7	22.0	41	56.04 ± 1.76
32C1bi3	0.39	3.124 ± 0.006	0.01959 ± 0.00029	0.003098 ± 0.000079	1.55	70.6	37.1	22	56.80 ± 1.21
32C1bi4	0.52	2.889 ± 0.030	0.04748 ± 0.00274	0.002165 ± 0.000458	0.16	77.8	4.1	9	57.88 ± 7.02
* 32C1bi5	1.50	12.974 ± 0.035	0.02760 ± 0.00138	0.038704 ± 0.000310	1.13	11.8	6.5	16	39.69 ± 4.60
Inverse isochron age ± 2σ		55.68 ± 22.23					Total fusion age ± 2σ		51.11 ± 0.86
$^{40}Ar/^{39}Ar$ intercept ± 2σ		307.2 ± 334.5		MSWD 0.32			Weighted mean age ± 2σ		56.58 ± 0.99
* UW32C1bj: 3 crystals									
* 32C1bj1	0.15	4.129 ± 0.009	0.00974 ± 0.00046	0.009210 ± 0.000118	1.16	34.0	27.6	44	36.35 ± 1.81
* 32C1bj2	0.23	2.836 ± 0.018	0.00606 ± 0.00093	0.002568 ± 0.000190	0.36	73.1	12.5	71	53.41 ± 2.97
32C1bj3	0.39	3.423 ± 0.007	0.01067 ± 0.00041	0.003865 ± 0.000070	1.34	66.5	38.5	40	58.61 ± 1.09
32C1bj4	0.52	3.332 ± 0.018	0.02231 ± 0.00087	0.003937 ± 0.000251	0.43	65.0	12.8	19	55.77 ± 3.86
32C1bj5	1.50	3.813 ± 0.026	0.06048 ± 0.00138	0.004822 ± 0.000265	0.33	62.6	8.6	7	61.42 ± 4.12
Inverse isochron age ± 2σ		42.70 ± 24.68					Total fusion age ± 2σ		51.73 ± 0.97
$^{40}Ar/^{39}Ar$ intercept ± 2σ		454.7 ± 295.7		MSWD 2.01			Weighted mean age ± 2σ		58.58 ± 1.45
* UW32C1bk: 3 crystals									
* 32C1bk1	0.15	7.748 ± 0.020	0.02632 ± 0.00049	0.021177 ± 0.000185	2.26	19.2	33.4	16	38.51 ± 2.72
* 32C1bk2	0.23	4.131 ± 0.020	0.02320 ± 0.00088	0.006308 ± 0.000261	0.55	54.8	15.3	19	58.27 ± 3.98
* 32C1bk3	0.39	4.492 ± 0.009	0.04104 ± 0.00071	0.007315 ± 0.000108	1.36	51.9	34.6	10	59.93 ± 1.65
* 32C1bk4	0.52	4.472 ± 0.026	0.07473 ± 0.00193	0.008113 ± 0.000229	0.43	46.4	10.9	6	53.49 ± 3.60
* 32C1bk5	1.50	5.412 ± 0.046	0.19704 ± 0.00349	0.009008 ± 0.000655	0.28	51.0	5.9	2	70.83 ± 9.95
no plateau or isochron							Total fusion age ± 2σ		52.50 ± 1.42
* UW32C1bl: 3 crystals									
* 32C1bl1	0.15	6.105 ± 0.009	0.01501 ± 0.00041	0.015323 ± 0.000105	2.13	25.8	30.5	29	40.69 ± 1.60
* 32C1bl2	0.23	3.643 ± 0.015	0.01676 ± 0.00057	0.005024 ± 0.000125	0.72	59.2	17.2	26	55.50 ± 1.95
* 32C1bl3	0.39	3.649 ± 0.007	0.02894 ± 0.00045	0.004308 ± 0.000063	1.63	65.1	38.9	15	61.05 ± 0.99
* 32C1bl4	0.52	4.717 ± 0.058	0.22084 ± 0.00538	0.009129 ± 0.000800	0.15	43.1	2.7	2	52.39 ± 12.30
* 32C1bl5	1.50	7.687 ± 0.026	0.14915 ± 0.00224	0.020836 ± 0.000282	0.94	20.0	10.7	3	39.78 ± 4.26
no plateau or isochron							Total fusion age ± 2σ		51.41 ± 0.90
* UW32C1bm: 3 crystals									
* 32C1bm1	0.15	5.686 ± 0.013	0.01981 ± 0.00070	0.013997 ± 0.000166	1.51	27.2	29.2	22	40.03 ± 2.53
* 32C1bm2	0.23	4.272 ± 0.013	0.02377 ± 0.00069	0.007042 ± 0.000163	0.80	51.2	20.7	18	56.36 ± 2.49
32C1bm3	0.39	4.352 ± 0.009	0.04249 ± 0.00066	0.006927 ± 0.000066	1.64	52.9	41.3	10	59.27 ± 1.02
32C1bm4	0.52	4.437 ± 0.062	0.30894 ± 0.00562	0.005631 ± 0.000751	0.14	62.9	3.5	1	71.62 ± 11.55
32C1bm5	1.50	17.710 ± 0.088	0.18794 ± 0.00322	0.053357 ± 0.001118	0.86	11.0	5.4	2	50.40 ± 16.55
Inverse isochron age ± 2σ		60.69 ± 5.65					Total fusion age ± 2σ		53.03 ± 1.39
$^{40}Ar/^{39}Ar$ intercept ± 2σ		288.0 ± 29.4		MSWD 2.84			Weighted mean age ± 2σ		59.34 ± 1.70
# UW32C1bn: 3 crystals									
* 32C1bn1	0.15	11.241 ± 0.017	0.03695 ± 0.00082	0.033555 ± 0.000233	3.05	11.8	35.3	12	34.30 ± 3.51
32C1bn2	0.23	5.630 ± 0.024	0.05383 ± 0.00133	0.012156 ± 0.000244	0.76	36.2	17.6	8	52.51 ± 3.70
32C1bn3	0.39	5.242 ± 0.013	0.06490 ± 0.00090	0.010491 ± 0.000170	1.23	40.9	30.5	7	55.19 ± 2.57
32C1bn4	0.52	5.175 ± 0.027	0.11076 ± 0.00227	0.010022 ± 0.000254	0.48	42.9	12.1	4	57.10 ± 3.91
32C1bn5	1.50	4.991 ± 0.058	0.60292 ± 0.01199	0.010598 ± 0.000764	0.18	38.1	4.6	1	49.10 ± 11.77
Inverse isochron age ± 2σ		71.38 ± 19.53					Total fusion age ± 2σ		47.33 ± 1.75
$^{40}Ar/^{39}Ar$ intercept ± 2σ		234.6 ± 78.0		MSWD 1.31			Weighted mean age ± 2σ		54.80 ± 2.10

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
Halfway Draw tuff HD-1b biotite continued									
Combined multi-crystal incremental heating ages									
Inverse isochron age ± 2σ		55.99 ± 2.37				Total fusion age ± 2σ			50.97 ± 0.41
$^{40}Ar/^{39}Ar$ intercept ± 2σ		291.7 ± 11.5	MSWD 0.38			Weighted mean: plateau ages ± 2σ			55.29 ± 1.13
Grand combined incremental heating ages									
Inverse isochron age ± 2σ		54.33 ± 1.56				Total fusion age ± 2σ			50.28 ± 0.39
$^{40}Ar/^{39}Ar$ intercept ± 2σ		299.1 ± 6.9	MSWD 1.60			Weighted mean: total fusion ages ± 2σ			51.53 ± 0.44
			MSWD 1.10			Weighted mean: plateau ages ± 2σ			55.06 ± 0.85
White Lignitic tuff WL-1b biotite *J* = 0.009489 ± 0.16% μ = 1.0050									
Single crystal incremental heating experiments									
UW39E3ba: 1 crystal									
39E3ba1	0.13	3.549 ± 0.032	0.01905 ± 0.00082	0.003332 ± 0.000526	0.28	72.3	2.0	23	43.38 ± 5.29
39E3ba2	0.23	2.974 ± 0.009	0.01092 ± 0.00030	0.000491 ± 0.000063	1.37	95.1	11.6	39	47.78 ± 0.68
39E3ba3	0.32	2.957 ± 0.008	0.01158 ± 0.00025	0.000388 ± 0.000064	1.88	96.1	16.0	37	48.02 ± 0.68
39E3ba4	0.41	3.090 ± 0.005	0.10485 ± 0.00092	0.000968 ± 0.000057	1.73	91.0	14.1	4	47.49 ± 0.58
39E3ba5	0.63	2.934 ± 0.004	0.02250 ± 0.00021	0.000362 ± 0.000020	6.03	96.4	51.9	19	47.77 ± 0.23
39E3ba6	1.50	2.957 ± 0.027	0.00066 ± 0.00061	0.000288 ± 0.000259	0.51	97.1	4.3	652	48.49 ± 2.70
Inverse isochron age ± 2σ		48.07 ± 0.41				Total fusion age ± 2σ			47.72 ± 0.26
$^{40}Ar/^{39}Ar$ intercept ± 2σ		253.0 ± 48.6		MSWD 0.90		Weighted mean age ± 2σ			47.76 ± 0.21
UW39E3bb: 1 crystal									
39E3bb1	0.16	3.082 ± 0.008	0.00483 ± 0.00033	0.001130 ± 0.000081	1.55	89.1	19.6	89	46.43 ± 0.83
39E3bb2	0.26	3.028 ± 0.006	0.00383 ± 0.00021	0.000594 ± 0.000079	1.73	94.2	22.4	112	48.17 ± 0.80
39E3bb3	0.32	3.100 ± 0.013	0.02024 ± 0.00047	0.000941 ± 0.000173	0.76	91.1	9.6	21	47.68 ± 1.75
39E3bb4	0.47	3.047 ± 0.004	0.01834 ± 0.00022	0.000742 ± 0.000047	3.00	92.8	38.5	23	47.78 ± 0.49
39E3bb5	0.58	2.978 ± 0.016	0.00218 ± 0.00041	0.000356 ± 0.000238	0.70	96.4	9.2	197	48.50 ± 2.40
39E3bb6	1.50	3.616 ± 0.115	0.00194 ± 0.00705	0.001623 ± 0.002593	0.05	86.7	0.6	222	52.90 ± 25.76
Inverse isochron age ± 2σ		49.66 ± 0.85				Total fusion age ± 2σ			47.69 ± 0.45
$^{40}Ar/^{39}Ar$ intercept ± 2σ		138.8 ± 68.2		MSWD 2.24		Weighted mean age ± 2σ			47.62 ± 0.54
UW39E3bc: 1 crystal									
39E3bc1	0.14	5.439 ± 0.121	0.03088 ± 0.01232	0.007893 ± 0.003047	0.06	57.2	0.3	14	52.45 ± 30.16
39E3bc2	0.23	3.149 ± 0.013	0.00877 ± 0.00159	0.001196 ± 0.000363	0.35	88.8	2.9	49	47.24 ± 3.60
39E3bc3	0.32	2.949 ± 0.009	0.00644 ± 0.00049	0.000472 ± 0.000171	0.69	95.3	6.2	67	47.47 ± 1.71
39E3bc4	0.41	2.901 ± 0.007	0.00838 ± 0.00032	0.000246 ± 0.000073	1.57	97.5	14.3	51	47.77 ± 0.75
39E3bc5	0.50	2.940 ± 0.010	0.05618 ± 0.00085	0.000446 ± 0.000089	1.17	95.6	10.5	8	47.51 ± 0.93
39E3bc6	1.50	2.878 ± 0.005	0.00990 ± 0.00015	0.000191 ± 0.000021	7.14	98.0	65.7	43	47.67 ± 0.26
Inverse isochron age ± 2σ		47.67 ± 0.51				Total fusion age ± 2σ			47.66 ± 0.29
$^{40}Ar/^{39}Ar$ intercept ± 2σ		288.4 ± 124.2		MSWD 0.08		Weighted mean age ± 2σ			47.67 ± 0.24
UW39E3bd: 1 crystal									
39E3bd1	0.14	4.431 ± 0.092	0.01184 ± 0.00765	0.006738 ± 0.002199	0.06	55.1	0.5	36	41.30 ± 21.93
39E3bd2	0.23	3.122 ± 0.014	0.00528 ± 0.00132	0.001570 ± 0.000303	0.43	85.1	5.0	81	44.92 ± 3.02
39E3bd3	0.32	3.002 ± 0.008	0.00489 ± 0.00062	0.000559 ± 0.000160	0.77	94.5	9.3	88	47.92 ± 1.60
39E3bd4	0.41	3.015 ± 0.009	0.00376 ± 0.00071	0.000685 ± 0.000133	0.79	93.3	9.6	114	47.50 ± 1.34
39E3bd5	0.50	3.045 ± 0.007	0.01093 ± 0.00052	0.000738 ± 0.000106	1.05	92.8	12.6	39	47.76 ± 1.06
39E3bd6	1.50	2.981 ± 0.006	0.01050 ± 0.00017	0.000579 ± 0.000020	5.14	94.3	62.9	41	47.48 ± 0.28
Inverse isochron age ± 2σ		48.09 ± 1.08				Total fusion age ± 2σ			47.40 ± 0.36
$^{40}Ar/^{39}Ar$ intercept ± 2σ		235.9 ± 113.7		MSWD 0.75		Weighted mean age ± 2σ			47.49 ± 0.27

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
White Lignitic tuff WL-1b biotite continued									
UW39E3be: 1 crystal									
39E3be1	0.23	3.854 ± 0.029	0.01544 ± 0.00215	0.004010 ± 0.000643	0.24	69.3	2.1	28	45.13 ± 6.40
39E3be2	0.32	3.065 ± 0.016	0.00609 ± 0.00095	0.000749 ± 0.000181	0.51	92.8	5.5	71	48.02 ± 1.85
39E3be3	0.41	3.024 ± 0.016	0.00539 ± 0.00067	0.000722 ± 0.000303	0.53	92.9	5.7	80	47.48 ± 3.03
39E3be4	0.50	3.023 ± 0.014	0.00575 ± 0.00132	0.000648 ± 0.000230	0.45	93.7	4.9	75	47.83 ± 2.31
39E3be5	1.50	2.982 ± 0.005	0.01723 ± 0.00025	0.000605 ± 0.000025	7.44	94.0	81.8	25	47.36 ± 0.30
Inverse isochron age ± 2σ		47.62 ± 1.09					Total fusion age ± 2σ		47.38 ± 0.37
$^{40}Ar/^{39}Ar$ intercept ± 2σ		272.1 ± 104.2		MSWD 0.29			Weighted mean age ± 2σ		47.38 ± 0.30
UW39E3bf: 1 crystal									
39E3bf1	0.23	3.727 ± 0.025	0.00597 ± 0.00166	0.003551 ± 0.000562	0.25	71.8	2.4	72	45.25 ± 5.59
39E3bf2	0.32	3.092 ± 0.009	0.00368 ± 0.00074	0.000923 ± 0.000176	0.58	91.2	6.9	117	47.62 ± 1.75
39E3bf3	0.41	2.925 ± 0.010	0.00233 ± 0.00052	0.000489 ± 0.000231	0.71	95.0	8.8	185	46.96 ± 2.30
39E3bf4	0.50	2.949 ± 0.014	0.00253 ± 0.00072	0.000435 ± 0.000250	0.52	95.6	6.5	170	47.64 ± 2.51
39E3bf5	1.50	2.966 ± 0.003	0.00699 ± 0.00014	0.000548 ± 0.000024	6.10	94.5	75.3	61	47.38 ± 0.26
Inverse isochron age ± 2σ		47.62 ± 0.92					Total fusion age ± 2σ		47.32 ± 0.38
$^{40}Ar/^{39}Ar$ intercept ± 2σ		268.8 ± 95.3		MSWD 0.21			Weighted mean age ± 2σ		47.37 ± 0.27
* UW39E3bg: 1 crystal									
* 39E3bg1	0.23	5.647 ± 0.025	0.00222 ± 0.00158	0.010991 ± 0.000439	0.39	42.5	4.1	194	40.60 ± 4.38
39E3bg2	0.32	3.124 ± 0.014	0.00271 ± 0.00069	0.000714 ± 0.000213	0.57	93.2	11.1	158	49.18 ± 2.14
39E3bg3	0.41	2.991 ± 0.013	0.00273 ± 0.00094	0.000555 ± 0.000166	0.57	94.5	11.4	158	47.74 ± 1.68
39E3bg4	0.50	2.978 ± 0.011	0.00164 ± 0.00089	0.000474 ± 0.000289	0.39	95.3	7.9	262	47.92 ± 2.87
39E3bg5	1.50	2.999 ± 0.006	0.01343 ± 0.00022	0.000599 ± 0.000039	3.27	94.1	65.4	32	47.67 ± 0.44
Inverse isochron age ± 2σ		41.38 ± 23.58					Total fusion age ± 2σ		47.57 ± 0.51
$^{40}Ar/^{39}Ar$ intercept ± 2σ		934.2 ± 2969.8		MSWD 0.64			Weighted mean age ± 2σ		47.74 ± 0.42
UW39E3bh: 1 crystal									
39E3bh1	0.23	3.404 ± 0.060	0.01551 ± 0.00817	0.003293 ± 0.001901	0.06	71.4	1.2	28	41.14 ± 18.90
39E3bh2	0.32	3.122 ± 0.026	0.00889 ± 0.00347	0.000887 ± 0.000636	0.17	91.6	3.6	48	48.31 ± 6.32
39E3bh3	0.41	2.996 ± 0.015	0.00675 ± 0.00201	0.000532 ± 0.000369	0.24	94.7	5.5	64	47.96 ± 3.67
39E3bh4	0.50	2.995 ± 0.024	0.00766 ± 0.00192	0.000582 ± 0.000376	0.23	94.3	5.1	56	47.69 ± 3.78
39E3bh5	1.50	3.108 ± 0.006	0.02575 ± 0.00040	0.001029 ± 0.000048	3.92	90.3	84.6	17	47.39 ± 0.51
Inverse isochron age ± 2σ		48.70 ± 3.51					Total fusion age ± 2σ		47.39 ± 0.61
$^{40}Ar/^{39}Ar$ intercept ± 2σ		218.1 ± 218.5		MSWD 0.16			Weighted mean age ± 2σ		47.41 ± 0.50
UW39E3bi: 1 crystal									
39E3bi1	0.23	4.586 ± 0.011	0.00508 ± 0.00136	0.006114 ± 0.000301	0.53	60.6	4.8	85	46.96 ± 2.99
39E3bi2	0.32	2.990 ± 0.008	0.00414 ± 0.00041	0.000579 ± 0.000132	0.78	94.3	10.6	104	47.61 ± 1.33
39E3bi3	0.41	2.962 ± 0.009	0.00537 ± 0.00048	0.000564 ± 0.000131	0.72	94.4	10.0	80	47.23 ± 1.32
39E3bi4	0.50	2.954 ± 0.008	0.00553 ± 0.00058	0.000555 ± 0.000136	0.62	94.4	8.6	78	47.12 ± 1.37
39E3bi5	1.50	3.197 ± 0.006	0.00899 ± 0.00021	0.001350 ± 0.000028	5.18	87.5	66.1	48	47.26 ± 0.32
Inverse isochron age ± 2σ		47.35 ± 0.74					Total fusion age ± 2σ		47.27 ± 0.35
$^{40}Ar/^{39}Ar$ intercept ± 2σ		291.7 ± 31.6		MSWD 0.09			Weighted mean age ± 2σ		47.27 ± 0.30
UW39E3bj: 1 crystal									
39E3bj1	0.23	6.631 ± 0.144	0.00003 ± 0.01727	0.010794 ± 0.004727	0.05	51.9	1.0	12434	57.95 ± 46.48
39E3bj2	0.32	3.526 ± 0.051	0.00074 ± 0.00745	0.001238 ± 0.002002	0.07	89.6	2.7	579	53.29 ± 19.73
39E3bj3	0.41	3.102 ± 0.049	0.01070 ± 0.00496	0.000842 ± 0.001421	0.09	92.0	3.7	40	48.19 ± 14.09
39E3bj4	0.50	2.960 ± 0.027	0.00052 ± 0.00239	0.000636 ± 0.000740	0.14	93.6	6.2	825	46.83 ± 7.35
39E3bj5	1.50	2.998 ± 0.007	0.00168 ± 0.00027	0.000596 ± 0.000054	1.95	94.1	86.3	256	47.66 ± 0.57
Inverse isochron age ± 2σ		46.80 ± 3.55					Total fusion age ± 2σ		47.88 ± 1.12
$^{40}Ar/^{39}Ar$ intercept ± 2σ		381.2 ± 356.4		MSWD 0.14			Weighted mean age ± 2σ		47.66 ± 0.57

Table 2. Complete $^{40}Ar/^{39}Ar$ results

Sample Experiment	laser power (W)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$	$^{40}Ar^*$ X10^{-14} mol	$^{40}Ar^*$ %	$^{39}Ar_K$ %	K/Ca	Apparent Age ± 2σ Ma
White Lignitic tuff WL-1b biotite continued									
UW39E3bk: 1 crystal									
39E3bk1	0.14	6.660 ± 0.072	0.01593 ± 0.00753	0.012365 ± 0.002382	0.10	45.1	1.3	27	50.75 ± 23.51
39E3bk2	0.23	3.276 ± 0.011	0.00437 ± 0.00100	0.001377 ± 0.000265	0.40	87.6	10.4	98	48.45 ± 2.64
39E3bk3	0.32	3.020 ± 0.011	0.00423 ± 0.00069	0.000781 ± 0.000217	0.50	92.3	14.2	102	47.11 ± 2.17
39E3bk4	0.41	3.051 ± 0.021	0.00282 ± 0.00197	0.000922 ± 0.000518	0.20	91.0	5.7	153	46.94 ± 5.15
39E3bk5	0.50	3.026 ± 0.007	0.03281 ± 0.00073	0.000770 ± 0.000123	0.70	92.5	19.6	13	47.32 ± 1.23
39E3bk6	1.50	3.045 ± 0.006	0.00716 ± 0.00028	0.000791 ± 0.000060	1.74	92.3	48.8	60	47.49 ± 0.62
Inverse isochron age ± 2σ		46.98 ± 1.79					Total fusion age ± 2σ		47.52 ± 0.71
$^{40}Ar/^{39}Ar$ intercept ± 2σ		332.0 ± 126.0		MSWD 0.17			Weighted mean age ± 2σ		47.47 ± 0.53
UW39E3bl: 1 crystal									
39E3bl1	0.14	3.213 ± 0.025	0.01074 ± 0.00174	0.001967 ± 0.000443	0.20	81.9	4.5	40	44.50 ± 4.44
39E3bl2	0.23	2.963 ± 0.008	0.00755 ± 0.00083	0.000561 ± 0.000201	0.50	94.4	12.0	57	47.26 ± 2.00
39E3bl3	0.32	2.963 ± 0.007	0.01043 ± 0.00066	0.000552 ± 0.000124	0.70	94.5	16.8	41	47.30 ± 1.25
39E3bl4	0.41	3.017 ± 0.011	0.11843 ± 0.00166	0.000791 ± 0.000122	0.76	92.5	17.8	4	47.16 ± 1.26
39E3bl5	0.50	2.912 ± 0.006	0.00343 ± 0.00040	0.000411 ± 0.000082	1.20	95.8	29.2	125	47.15 ± 0.84
39E3bl6	1.50	2.885 ± 0.009	0.00122 ± 0.00058	0.000280 ± 0.000110	0.80	97.1	19.7	352	47.32 ± 1.12
Inverse isochron age ± 2σ		47.62 ± 1.01					Total fusion age ± 2σ		47.11 ± 0.55
$^{40}Ar/^{39}Ar$ intercept ± 2σ		242.5 ± 112.6		MSWD 0.32			Weighted mean age ± 2σ		47.19 ± 0.52
Combined single crystal incremental heating ages									
Inverse isochron age ± 2σ		47.71 ± 0.18					Total fusion age ± 2σ		47.46 ± 0.14
$^{40}Ar/^{39}Ar$ intercept ± 2σ		276.9 ± 14.2		MSWD 0.98			Weighted mean: total fusion ages ± 2σ		47.50 ± 0.14
				MSWD 1.40			Weighted mean: plateau ages ± 2σ		47.52 ± 0.14

All ages calculated relative to 28.34 Ma for the Taylor Creek rhyolite sanidine (Renne et al., 1998); using the decay constants of Steiger and Jäger (1977); uncertainties in Ar isotope ratios reported at 1σ analytical precision, uncertainties in ages reported at 2σ analytical precision. Corrected for ^{37}Ar and ^{39}Ar decay, half lives of 35.2 days and 269 years, respectively.

*indicates analyses or experiments that have been excluded from plateau age calculation.

#indicates experiments that have been excluded from calculation of weighted mean of total fusion ages.

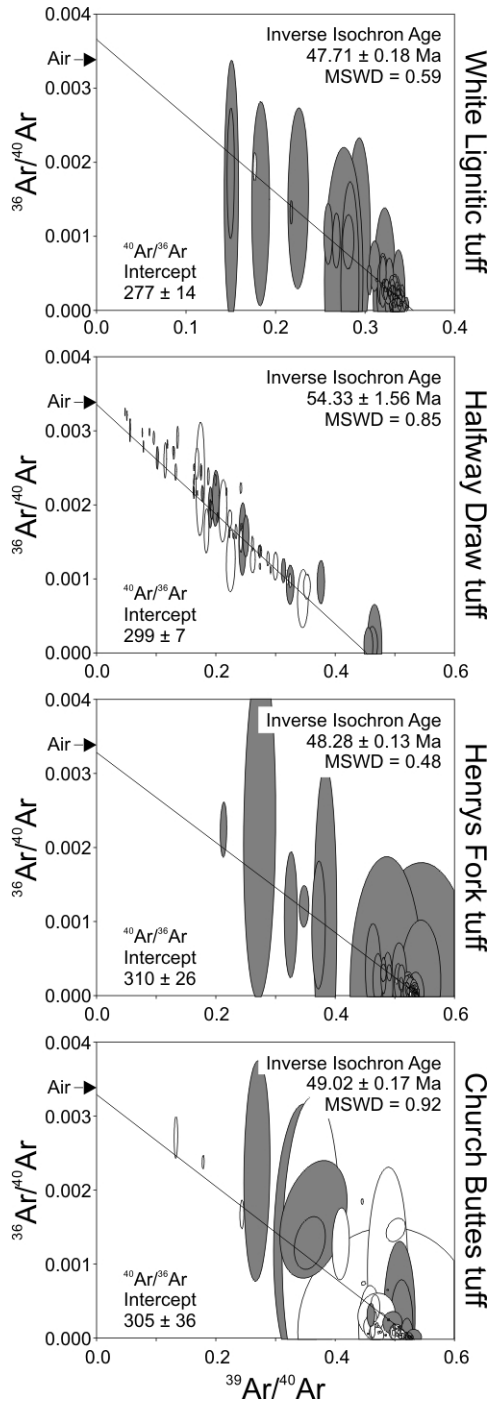

Figure 1. Inverse isochron diagrams and apparent ages (with 2σ analytical uncertainties) for laser fusion and incremental heating analyses of biotite phenocrysts. Shaded ellipses represent 2σ uncertainty on analyses that are included in the inverse isochron age calculation; open ellipses represent excluded analyses.

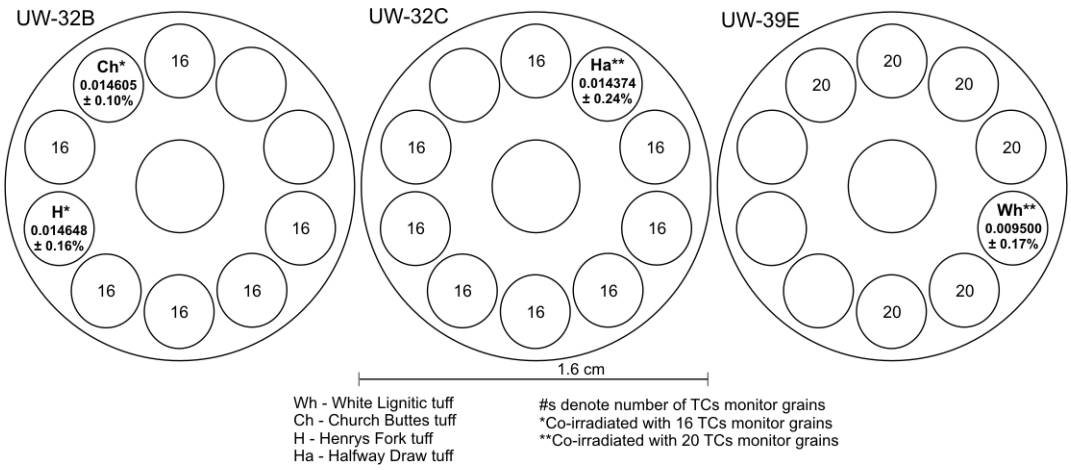

Figure 2. Sanidine flux moniter and sample positions within stacked aluminum irradiation discs and resulting *J* values, calculated for sample positions using a distance-weighted interpolation algorithm.

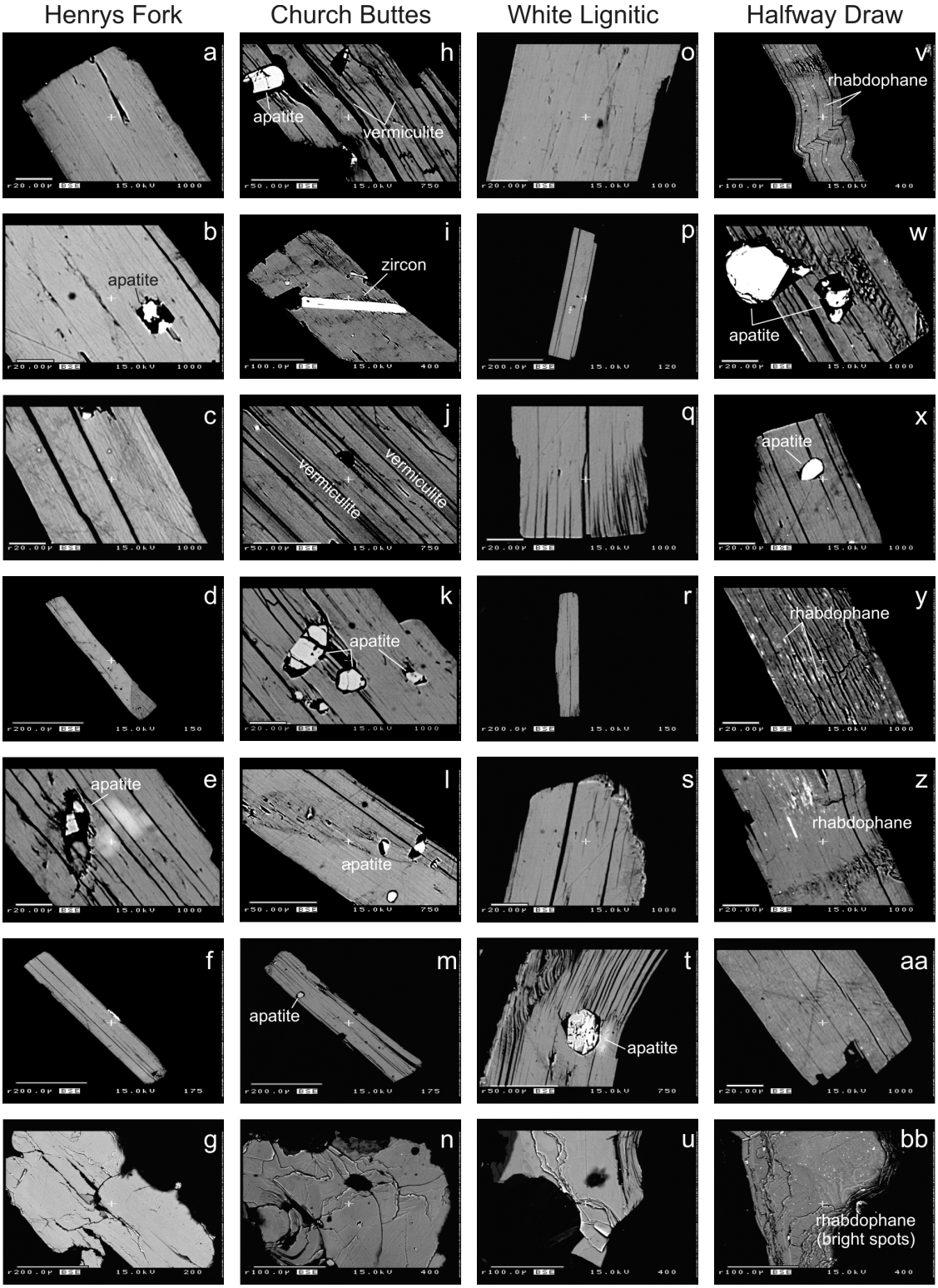

Figure 3. Additional microprobe BSE images at various scales of biotite from sampled Eocene ash beds. Inclusions were identified using EDS. All except lowest row were taken ~orthogonal to the cleavage (a,b)-plane of biotite grains, lowest row is imaged parallel to cleavage.

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