

Ar isotopic data for AL-8 biotite separate (analysis provided by Wanda Taylor, UNLV; performed at University of Maine Ar lab)

Temp	40/39	37/39	36/39	moles 39	% Total	% RAD	K/Ca	Age (Ma)	error
690	10.677	0.057	0.0123	69.3	5.9	65.9	8.55	88.07	0.94
770	9.010	0.036	0.0034	156.2	13.3	88.6	13.70	99.64	1.67
840	8.657	0.022	0.0012	194.3	16.6	95.6	22.78	103.23	1.23
900	8.504	0.060	0.0004	97.6	8.4	98.5	8.13	104.42	1.10
970	8.479	0.093	0.0003	46.5	4.0	99.0	5.25	104.66	1.09
1030	8.509	0.092	0.0004	76.5	6.5	98.6	5.30	104.61	1.09
1100	8.507	0.124	0.0004	119.7	10.2	98.6	3.95	104.59	1.08
1150	8.567	0.229	0.0004	168.7	14.4	98.7	2.14	105.44	1.04
FUSE	8.646	0.331	0.0004	242.0	20.7	98.6	1.48	106.25	1.08
TOTAL								103.18	1.17
J=0.007115									

Temp	Mass ^{39}Ar	40/39	error	36/39	error	37/39	error	$^{36}\text{Ar}/^{40}\text{Ar}$	$^{39}\text{Ar}/^{40}\text{Ar}$
690	104.2839	10.67676	0.12	0.01229472	1.337	0.0572874	0.263	0.001151775	0.09379648
770	234.8944	9.01004	0.094	0.00343452	15.994	0.0357546	5.474	0.0003807679	0.1111795
840	292.2218	8.65617	0.085	0.00123170	55.055	0.0215099	7.866	0.0001418642	0.1157294
900	147.2712	8.504272	0.11	0.00039664	2.537	0.0603049	12.356	0.0000447807	0.1178019
970	69.9645	8.479311	0.088	0.00025533	2.438	0.0932718	18.578	0.0000271491	0.1181467
1030	115.0422	8.509319	0.127	0.00036853	4.142	0.0923977	11.496	0.0000404087	0.1177293
1100	180.0609	8.507167	0.102	0.00037653	2.706	0.1241225	11.529	0.0000403371	0.1177566
1150	253.7544	8.567194	0.07	0.00037394	0.385	0.2294264	5.207	0.0000363772	0.1169215
FUSE	363.9663	8.646222	0.113	0.00046551	0.258	0.3314991	6.72	0.0000412171	0.1158427

ISOCHRON INFORMATION

SLOPE = -21.22379 ± 0.766574

$^{39}\text{Ar}/^{40}\text{Ar} = 0.1183694 \pm 0.00031303$

$^{36}\text{Ar}/^{40}\text{Ar} = 0.00577206 \pm 0.000373873$

$^{40}\text{Ar}/^{36}\text{Ar} = 179.3012 \pm 12.0196$

INTERCEPT AGE = 105.3016 ± 0.7819252

S = 18

MSWD = 2.571429

Apatite fission track data for AL-8 (analysis provided by Steffan Boettcher, Exxon-Sprint; performed at the University of Texas FT lab)

Ns	Ni	Rho s	Rho i	Area	Age (Ma)	Age error	U ppm
117	414	3.8259	13.5379	49	76.5	8.1	133
34	161	1.1118	5.2647	49	57.2	10.8	52
48	226	1.5382	7.2424	50	57.6	9.2	71
71	343	2.3217	11.2162	49	56.1	7.4	110
53	259	1.6984	8.3	50	55.5	8.4	81
55	194	1.7985	6.3438	49	76.7	11.8	62
64	291	2.0928	8.5157	49	59.6	8.3	93
64	256	2.0928	8.3712	49	67.7	9.5	82
55	231	1.7985	8.5537	49	64.5	9.7	74
56	218	1.8312	7.1286	49	69.6	10.5	70
35	185	0.8763	4.6317	64	51.3	9.5	45
110	506	3.5970	16.5463	49	58.9	6.3	162
31	121	1.0137	3.9567	49	69.4	14.0	39
28	104	0.9156	3.4008	49	72.9	15.6	33
79	252	5.0633	16.1513	25	84.8	11.0	158
55	257	1.7985	8.4039	49	58.0	8.7	82
40	151	1.3080	4.9377	49	71.7	12.8	48
47	238	1.5369	7.7826	49	53.5	8.6	76
101	374	3.3027	12.2299	49	73.1	8.3	120
45	172	1.4421	5.5119	50	70.8	11.9	54
POOLED DATA							
1188	4953	1.9544	8.1481	974	65.0	2.4	80

Pooled age = 65.0±2.4 Ma

Mean age = 65.3±9.3

Chi squared = 47%; Pass

Zeta = 343±4

Zeta error = 0.0103

Dosimeter = 1587352

R = 0.9327

Electron microprobe data for metamorphic rocks from Alvord Mountain

All data obtained on an ARL microprobe at University of California, Los Angeles. Standardization was done using natural and synthetic silicate and oxide standards and Bence-Albee matrix correction. Microprobe operating conditions were 15 kV with a sample current of 15 μ A. Abbreviations: int=interior of grain but not necessarily core, incl=inclusion, rim=edge (rim) of grain, core=core of grain, repl=replacing. Comma followed by mineral abbreviation indicates analysis location and mineral adjacent to analysis (e.g., rim, mus means analysis of rim with analyzed mineral in contact with muscovite)

Biotite analyses

Sample	AVM90-006	AVM90-006	AVM90-006	AVM90-006	AVM90-012	AVM90-012	AVM90-012
	int	incl, ilm	rim, ilm	rim	rim	rim, mus	Int
SiO ₂	34.03	34.75	34.68	35.98	33.75	33.72	33.56
Al ₂ O ₃	18.04	19.10	18.37	18.22	19.10	18.93	18.55
TiO ₂	2.41	1.71	2.09	1.82	2.88	2.75	2.71
FeO	19.60	19.77	19.84	19.69	21.64	22.22	22.00
MnO	0.17	0.16	0.23	0.19	0.19	0.18	0.15
MgO	11.51	13.17	12.54	11.58	8.49	8.77	8.31
CaO	0.03	0.07	0.11	0.12	0.02	0.00	0.02
Na ₂ O	0.05	0.06	0.05	0.07	0.09	0.14	0.08
K ₂ O	9.44	9.00	9.51	9.71	9.73	9.67	9.78
Total	95.28	97.79	97.42	97.38	95.89	96.38	95.16

cations/11 oxygens

Si	2.611	2.582	2.600	2.689	2.599	2.591	2.614
Al	1.632	1.673	1.624	1.605	1.734	1.715	1.703
Ti	0.139	0.096	0.118	0.102	0.167	0.159	0.159
Fe ²⁺	1.258	1.229	1.244	1.231	1.394	1.428	1.433
Mn	0.011	0.010	0.015	0.012	0.012	0.012	0.010
Mg	1.316	1.459	1.401	1.290	0.974	1.004	0.964
Ca	0.002	0.006	0.009	0.010	0.002	0.000	0.002
Na	0.007	0.009	0.007	0.010	0.013	0.021	0.012
K	0.924	0.853	0.910	0.926	0.956	0.948	0.972

Total	7.900	7.916	7.982	7.874	7.851	7.877	7.868
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Sample	AVM90-020	AVM090-020	AVM090-020	AVM090-020	AVM090-020	1-3-90c	1-3-90c
	rim	int	rim, cpx	rim, bio	int	int	Rim
SiO ₂	36.56	36.19	36.66	36.30	35.43	36.08	35.44
Al ₂ O ₃	16.15	15.68	16.15	16.89	16.70	17.32	17.37
TiO ₂	2.13	2.36	2.11	1.55	1.38	3.22	3.16
FeO	14.16	14.65	15.11	16.76	16.05	23.23	23.01
MnO	0.77	0.67	0.67	0.50	0.44	0.56	0.64
MgO	14.66	14.45	14.40	13.73	13.74	7.29	7.48
CaO	0.08	0.12	0.13	0.06	0.10	0.04	0.02
Na ₂ O	0.13	0.31	0.08	0.08	0.11	0.04	0.03
K ₂ O	8.97	8.45	9.30	9.76	9.17	9.45	9.57
Total	94.06	92.88	94.61	95.63	93.12	97.23	96.72
cations/11 oxygens							
Si	2.763	2.768	2.765	2.734	2.729	2.746	2.718
Al	1.439	1.414	1.436	1.499	1.517	1.554	1.570
Ti	0.121	0.136	0.120	0.088	0.080	0.184	0.182
Fe ²⁺	0.924	0.937	0.953	1.056	1.034	1.479	1.476
Mn	0.049	0.043	0.043	0.032	0.029	0.036	0.042
Mg	1.651	1.647	1.618	1.541	1.577	0.827	0.855
Ca	0.006	0.010	0.011	0.005	0.008	0.003	0.002
Na	0.019	0.046	0.012	0.012	0.016	0.006	0.004
K	0.865	0.824	0.895	0.938	0.901	0.918	0.936
Total	7.838	7.825	7.851	7.904	7.891	7.754	7.785

Muscovite analyses

Sample	AVM90-006 small	AVM90-006 in qtz	AVM90-006	AVM90-006	AVM90-012 rim	AVM90-012 int	AVM90-012 Rim
SiO ₂	46.20	45.03	46.90	47.23	44.70	45.19	45.49
Al ₂ O ₃	35.75	33.66	36.82	33.80	35.37	36.99	35.39
TiO ₂	0.11	0.30	0.20	0.62	0.75	0.91	0.95
FeO	2.79	2.15	4.55	2.98	2.80	3.01	2.87
MnO	0.03	0.02	0.00	0.03	0.00	0.00	0.00
MgO	0.74	0.98	1.16	0.99	0.54	0.50	0.68
CaO	0.03	0.42	0.14	0.01	0.04	0.03	0.03
Na ₂ O	0.76	0.35	0.46	0.24	0.48	0.55	0.45
K ₂ O	9.46	8.14	7.73	9.47	8.66	9.23	9.21
Total	95.87	91.05	97.96	95.37	93.34	96.41	95.07
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cations/11 oxygens							
Si	3.061	3.110	3.030	3.140	3.030	2.979	3.037
Al	2.792	2.740	2.804	2.649	2.827	2.875	2.786
Ti	0.005	0.016	0.010	0.031	0.038	0.045	0.048
Fe ²⁺	0.155	0.124	0.246	0.166	0.159	0.166	0.160
Mn	0.002	0.001	0.000	0.002	0.000	0.000	0.000
Mg	0.073	0.101	0.112	0.098	0.055	0.049	0.068
Ca	0.002	0.031	0.010	0.001	0.003	0.002	0.002
Na	0.098	0.047	0.058	0.031	0.063	0.070	0.058
K	0.800	0.717	0.637	0.803	0.749	0.776	0.785
Total	6.987	6.887	6.906	6.921	6.924	6.962	6.944

Muscovite analyses continued

Sample	AM5-3 int	AM5-3 int	AM5-3 rim	AM5-3 rim	1-3-90c small	1-3-90c small	1-3-90c fsp repl
SiO ₂	46.43	46.74	45.22	45.87	44.93	45.41	44.88
Al ₂ O ₃	35.82	33.86	34.08	34.86	31.02	33.85	31.31
TiO ₂	0.26	0.62	0.28	0.50	0.92	0.09	0.86
FeO	2.12	2.77	3.46	2.88	4.35	4.35	4.66
MnO	0.00	0.02	0.01	0.02	0.02	0.02	0.01
MgO	0.43	0.78	0.94	0.55	1.02	0.90	1.12
CaO	0.04	0.06	0.06	0.03	0.37	0.02	0.00
Na ₂ O	0.51	0.53	0.46	0.48	0.37	0.39	0.32
K ₂ O	8.87	8.74	9.25	7.00	8.78	9.08	9.68
Total	94.39	94.12	93.76	92.19	91.78	93.94	92.84
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cations/11 oxygens							
Si	3.089	3.136	3.073	3.108	3.135	3.086	3.115
Al	2.815	2.687	2.731	2.785	2.552	2.712	2.562
Ti	0.013	0.031	0.014	0.025	0.048	0.005	0.045
Fe ²⁺	0.118	0.155	0.197	0.163	0.254	0.238	0.271
Mn	0.000	0.001	0.001	0.001	0.001	0.001	0.001
Mg	0.043	0.078	0.095	0.056	0.106	0.091	0.116
Ca	0.003	0.004	0.004	0.002	0.028	0.001	0.000
Na	0.066	0.069	0.061	0.063	0.050	0.051	0.043
K	0.754	0.748	0.802	0.605	0.782	0.787	0.857
Total	6.901	6.902	6.978	6.808	6.956	6.973	7.009

Muscovite analyses continued

Sample	1-3-90c	AM4-3
	matrix	deformed
SiO ₂	46.58	44.10
Al ₂ O ₃	30.57	33.14
TiO ₂	0.33	0.26
FeO	5.41	4.43
MnO	0.06	0.02
MgO	2.16	0.68
CaO	0.02	0.04
Na ₂ O	0.13	0.26
K ₂ O	10.26	9.91
Total	95.52	92.84
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cations/11 oxygens		
Si	3.159	3.060
Al	2.444	2.711
Ti	0.017	0.014
Fe ²⁺	0.307	0.257
Mn	0.003	0.001
Mg	0.218	0.070
Ca	0.001	0.003
Na	0.017	0.035
K	0.888	0.877
Total	7.055	7.028

Chlorite analyses

Sample	AVM90-006	AM5-3	AM5-3	AM5-3	1-3-90c	1-3-90c	1-3-90c
	rim	rim	rim	rim	after musc	after bio	after bio
SiO ₂	26.19	23.58	25.17	24.84	24.58	25.15	25.23
Al ₂ O ₃	22.45	22.28	22.37	22.34	21.97	21.35	21.33
TiO ₂	0.09	0.06	0.08	0.10	0.06	0.10	0.14
FeO	22.22	26.88	25.61	24.33	29.74	28.97	30.56
MnO	0.28	0.31	0.29	0.22	0.83	0.70	0.97
MgO	17.83	11.59	14.19	14.93	10.81	12.00	11.13
CaO	0.06	0.09	0.09	0.04	0.10	0.07	0.09
Na ₂ O	0.00	0.00	0.00	0.00	0.02	0.01	0.02
K ₂ O	0.08	0.09	0.11	0.03	0.15	0.03	0.06
Total	89.20	84.88	87.91	86.83	88.26	88.38	89.53
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cations/14 oxygens							
Si	2.662	2.603	2.650	2.631	2.647	2.687	2.686
Al	2.690	2.900	2.776	2.789	2.789	2.690	2.677
Ti	0.007	0.005	0.006	0.008	0.005	0.008	0.011
Fe ²⁺	1.889	2.482	2.255	2.155	2.678	2.589	2.721
Mn	0.024	0.029	0.026	0.020	0.076	0.063	0.087
Mg	2.701	1.907	2.226	2.357	1.735	1.911	1.766
Ca	0.007	0.011	0.010	0.005	0.012	0.008	0.010
Na	0.000	0.000	0.000	0.000	0.004	0.002	0.004
K	0.010	0.013	0.015	0.004	0.021	0.004	0.008
Total	9.991	9.948	9.963	9.968	9.966	9.963	9.971

Plagioclase analyses

Sample	AVM90-006	AVM90-006	AVM90-006	AVM90-006	AVM90-020	AVM90-020	AVM90-020
					rim bio	rim bio	
SiO ₂	61.22	60.11	61.84	61.20	46.24	49.34	49.27
Al ₂ O ₃	25.78	25.44	24.91	24.95	33.90	34.22	33.95
TiO ₂	0.01	0.05	0.00	0.00	0.00	0.03	0.03
FeO	0.15	0.57	0.00	0.00	0.33	0.35	0.29
MnO	0.03	0.04	0.00	0.00	0.00	0.01	0.00
MgO	0.05	0.00	0.00	0.00	0.06	0.09	0.08
CaO	5.77	5.69	6.23	6.21	15.53	15.52	15.17
Na ₂ O	8.80	8.78	8.47	8.44	2.25	3.05	3.17
K ₂ O	0.13	0.14	0.26	0.10	0.11	0.09	0.14
Total	101.94	100.82	101.71	100.90	98.42	102.70	102.10
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cations/8 oxygens							
Si	2.675	2.664	2.707	2.699	2.155	2.201	2.209
Al	1.328	1.329	1.285	1.297	1.862	1.800	1.795
Ti	0.000	0.002	0.000	0.000	0.000	0.001	0.001
Fe ²⁺	0.005	0.021	0.000	0.000	0.013	0.013	0.011
Mn	0.001	0.002	0.000	0.000	0.000	0.000	0.000
Mg	0.003	0.000	0.000	0.000	0.004	0.006	0.005
Ca	0.270	0.270	0.292	0.293	0.775	0.742	0.729
Na	0.746	0.755	0.719	0.722	0.203	0.264	0.276
K	0.007	0.008	0.015	0.006	0.007	0.005	0.008
Total	5.037	5.051	5.017	5.016	5.019	5.032	5.034

Plagioclase analyses continued

Sample	AVM90-012	AM5-3	1-3-90c	1-3-90c	1-3-90c	1-3-90c	1-3-90c
	core	core	core	int	rim	int	Rim
SiO ₂	61.86	67.74	64.46	64.62	64.49	64.26	63.37
Al ₂ O ₃	23.98	22.20	23.57	22.61	23.40	23.17	23.35
TiO ₂	0.05	0.00	0.00	0.00	0.01	0.01	0.00
FeO	0.50	0.11	0.02	0.04	0.03	0.02	0.02
MnO	0.00	0.00	0.00	0.01	0.00	0.00	0.00
MgO	0.25	0.02	0.01	0.02	0.02	0.00	0.00
CaO	4.32	1.97	4.15	3.28	3.82	3.91	4.17
Na ₂ O	9.77	11.00	9.41	9.46	9.37	9.44	9.31
K ₂ O	0.20	0.10	0.14	0.45	0.20	0.19	0.27
Total	100.93	103.14	101.76	100.49	101.34	101.00	100.49
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cations/8 oxygens							
Si	2.731	2.887	2.789	2.836	2.808	2.809	2.790
Al	1.248	1.115	1.206	1.170	1.201	1.194	1.212
Ti	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Fe ²⁺	0.018	0.004	0.001	0.001	0.001	0.001	0.001
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mg	0.016	0.001	0.001	0.001	0.001	0.000	0.000
Ca	0.204	0.090	0.193	0.154	0.178	0.183	0.197
Na	0.835	0.909	0.792	0.805	0.791	0.800	0.795
K	0.011	0.005	0.008	0.025	0.011	0.011	0.015
Total	5.067	5.012	4.999	4.994	4.992	4.999	5.009

Plagioclase analyses
continued

Sample AM4.17

SiO ₂	56.95
Al ₂ O ₃	27.00
TiO ₂	0.00
FeO	0.20
MnO	0.00
MgO	0.05
CaO	8.88
Na ₂ O	6.62
K ₂ O	0.20

Total 99.90

cations/8 oxygens

Si	2.560
Al	1.431
Ti	0.000
Fe ²⁺	0.008
Mn	0.000
Mg	0.003
Ca	0.428
Na	0.577
K	0.011

Total 5.018

Amphibole analyses

Sample	AVM90-020							
	rim, cpx	int	rim, quartz	rim, amp	int	rim, ksp	int	deep int
SiO ₂	46.34	46.34	46.49	45.93	46.27	46.14	45.99	45.73
Al ₂ O ₃	8.00	8.26	8.27	8.29	8.52	7.70	7.97	7.93
TiO ₂	0.76	0.74	0.82	0.78	0.78	0.85	0.99	0.93
FeO	13.32	13.48	13.74	13.96	14.12	12.88	13.31	13.37
MnO	0.99	0.97	0.65	0.88	0.85	0.95	0.94	0.93
MgO	14.95	14.61	14.61	14.19	14.28	14.77	14.50	14.54
CaO	11.37	11.31	11.33	11.46	11.09	11.51	11.51	11.81
Na ₂ O	0.97	1.01	1.08	1.05	1.13	0.82	1.03	0.99
K ₂ O	0.82	0.89	0.84	0.87	0.84	0.78	0.83	0.87
Total	97.52	97.61	98.03	97.41	97.88	96.40	97.07	97.10
cations/15 oxygens								
Si	6.705	6.714	6.711	6.695	6.697	6.753	6.715	6.684
Al	1.365	1.411	1.407	1.425	1.454	1.329	1.372	1.366
Ti	0.083	0.081	0.078	0.086	0.085	0.094	0.087	0.051
Fe ³⁺	0.890	0.812	0.822	0.782	0.809	0.810	0.748	0.779
Fe ²⁺	0.722	0.821	0.837	0.920	0.900	0.767	0.877	0.855
Mn	0.121	0.119	0.116	0.109	0.104	0.118	0.116	0.115
Mg	3.224	3.155	3.143	3.082	3.08	3.222	3.155	3.167
Ca	1.763	1.756	1.753	1.790	1.72	1.805	1.801	1.85
Na	0.272	0.284	0.302	0.297	0.317	0.233	0.292	0.281
K	0.151	0.165	0.155	0.162	0.155	0.146	0.155	0.162
Total	15.296	15.153	15.169	15.186	15.166	15.131	15.163	15.148

Amphibole analyses continued

Sample	AM4.17				
	small	int	rim	lg, int	rim, pl
SiO ₂	42.39	41.74	41.20	39.38	38.94
Al ₂ O ₃	9.85	10.82	11.20	10.33	11.17
TiO ₂	0.31	0.29	0.33	0.41	0.45
FeO	20.47	20.53	20.61	21.47	22.54
MnO	0.94	0.98	0.98	0.75	0.81
MgO	9.42	9.32	9.02	8.26	7.62
CaO	11.87	11.88	11.94	11.50	11.68
Na ₂ O	1.27	1.30	1.34	1.30	1.23
K ₂ O	1.06	1.23	1.42	1.44	1.73
Total	97.58	98.09	98.04	94.84	96.17
<hr/> cations/15 oxygens <hr/>					
Si	6.411	6.284	6.231	6.199	6.084
Al	1.756	1.921	1.997	1.917	2.057
Ti	0.035	0.033	0.038	0.049	0.053
Fe ³⁺	0.856	0.919	0.87	0.968	1
Fe ²⁺	1.733	1.666	1.737	1.859	1.946
Mn	0.12	0.125	0.126	0.1	0.107
Mg	2.123	2.091	2.033	1.938	1.774
Ca	1.924	1.917	1.935	1.94	1.955
Na	0.416	0.48	0.391	0.396	0.397
K	0.205	0.236	0.274	0.289	0.345
Total	15.374	15.436	15.358	15.366	15.373