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$^{40}Ar/^{39}Ar$ Age-Spectrum Data for Whole Rock Samples of the Martinsburg Formation, Lehigh Gap Area, Pennsylvania.

by

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INTRODUCTION

This publication contains reduced $^{40}Ar/^{39}Ar$ data of whole rock slate and mudstone samples from the Martinsburg Formation in the Lehigh Gap area of Pennsylvania and is intended only to be a preliminary publication of these results, in more detail than can be accommodated in today's professional journals. Also included in this report is information on the location of the samples, and a brief description of both the outcrop from which the samples were collected. The data contained herein are not interpreted in a geological context and care should be taken by users unfamiliar with argon isotopic data in the use of these results. No geological meaning is implied for any of the apparent ages presented below and many of the individual apparent ages are not geologically meaningful. This report is a detailed source document for subsequent publications that will integrate this data into a geological context.

SAMPLING STRATEGY

The rocks analyzed in this report were selected from a collection of more than 200 samples from the Lehigh Gap area of Pennsylvania. All of the samples are mudstones or graywacke of the Martinsburg Formation collected across the mudstone to slate transition in this area, and have been the subject of a paper by Wintsch, Kvale, and Kisch (1991) on the development of slaty cleavage in the Martinsburg Formation. Wintsch, Kvale, and Kisch (1991) divided the rocks of the Martinsburg Formation in the Lehigh Gap area into four Fabric Zones. The specific samples chosen for $^{40}Ar/^{39}Ar$ analytical work represent cleaved and non-cleaved mudstones, and cleaved graywackes (slates) from three of their four Fabric Zones. Both the cleaved and non-cleaved rocks contain detrital white mica and a generation of diagenetic white mica. The cleaved rocks also contain a generation of white mica that grew during the development of the regional cleavage in this area of Pennsylvania. All of the samples were prepared from thin section billets from which Wintsch, Kvale, and Kisch (1991) made their detailed petrographic studies.

METHODS

Sample Preparation

All of the mudstone and slate samples were crushed, ground, and sized using 250, 180, and 150 μm sieves. The samples were washed in acetone, alcohol, and deionized water(X3) in a Branson B-220 ultrasonic cleaner to remove dust and then re-sieved by hand using 250 and 180 μm sieves.

Approximately 100-200 mg of mudstone or slate were packaged in aluminum capsules and sealed under vacuum in quartz tubes. The samples were then irradiated (RD59) in the central thimble facility at the TRIGA reactor (GSTR) at the U.S. Geological Survey, Denver, Colorado. Two of the samples were also irradiated in a second package (RD99) at the GSTR to show sample reproducibility. The monitor mineral used in both packages was MMhb-1 with an age of 519.4 ± 2.5 Ma (Alexander et

al.,1978; and Dalrymple et al., 1981). The type of container, and the geometry of samples and standards is similar to that described by Snee et al. (1988).

Sample Analysis

All samples were analyzed on a VG Isotopes, Ltd, Model 1200 B Mass Spectrometer fitted with a Faraday cup collector and an electron multiplier at the U.S. Geological Survey, Reston, using the $^{40}Ar/^{39}Ar$ step heating method of dating. Heating for 10 minutes per step followed a schedule of 8-18 steps per sample. The number and temperature of heating steps was selected to limit the percentage of gas released to less than 20%/step for most samples.

Heating of all samples was done in a small volume molybdenum-lined "low blank" tantalum furnace. Temperature was monitored by a W_5Re-$W_{26}Re$ thermocouple and controlled by a proportional, programmable controller. The furnace and the rear manifold were pumped between steps with a turbo molecular pump. Two isolated ion pumps evacuated the front manifold and the mass spectrometer tube between each incremental step. During normal operation, the gas to be analyzed was purified in the rear manifold by a Saes ST707 Fe-V getter operated at room temperature. Gas was equilibrated with the front manifold with an empty cold finger (in the rear manifold) chilled with liquid N_2 to remove condensables (chiefly water), and cleaned in the front manifold by a Saes ST101 Al-Zr getter operated at 400°C and a Ti (H_2) getter operated at a constant 350°C. An activated charcoal finger submerged in a constant boiling mixture of dry ice and acetone was used to remove gasses with a molecular weight greater than 60 or 80 (primarily other noble gasses) prior to the admission of the argon dominated gas to the mass spectrometer by expansion. The Argon-rich gas was further purified in the mass spectrometer by a second Saes ST101 active gas getter operated at room temperature. Its successful operation could be monitored by the drop in counts of mass 44 (dominated by CO_2) after the first gas analysis cycle. Argon isotopes with masses 40 through 36 and CO_2, mass 44 were analyzed as a function of time in five analysis cycles. ^{40}Ar, ^{39}Ar, and ^{36}Ar peaks and their baselines, were measured as a series of four, five second integrations in each of the five cycles, that were then averaged. ^{38}Ar and ^{37}Ar peaks, and their baselines, were measured for only one, five second integration per cycle. For samples from irradiation package RD59 the signal was measured with the Faraday cup collector, for those from RD 96 the electron multiplier was used. After the analysis the mass spectrometer was evacuated. All phases of the sample heating, cleanup, equilibration and sample analysis were preformed under computer control.

Isotopic Data Reduction

All the Ar isotopic data were reduced using an updated version of the computer program ArAr* (Haugerud and Kunk, 1988) and decay constants recommended by Steiger and Jäger (1977). The isotopic measurements made in the five cycle analysis had baseline values subtracted and then were regressed, to time zero, using standard linear regression techniques. These

regressed values and associated statistical estimates of analytical uncertainties of the time zero peak values were used in the data reduction. For samples from irradiation package RD 59 system blank in all cases was less than 0.1% and was not subtracted. For samples from package RD 96 system blanks (^{40}Ar and ^{36}Ar only) were measured for the temperature range over which the samples degassed immediately prior to the time of the sample analysis. Because there was no significant increase in blank with increasing temperature of extraction the results were averaged. The mean of these results was subtracted from each analysis. Errors associated with the blanks (1SD of the mean) were propagated.

Corrections for interfering reactor-produced argon isotopes from Ca, K, and Cl in the sample were made using the production ratios given in Dalrymple et al. (1981). Errors included in calculating ages or ratios include analytical errors in the analysis, decay factor uncertainties, measured atmospheric or calculated initial $^{40}Ar/^{36}Ar$ ratios, the irradiation parameter J, the production ratios of the various reactor induced argon producing reactions, the initial $^{38}Ar/^{36}Ar$ ratio, and the age of the monitor (Haugerud and Kunk, 1988).

The tables and figures below include the identification of individual step ages, maximum ages, and total gas ages. Although no plateau ages were found we have calculated composite ages for some intermediate temperature steps (saddle ages). Total gas ages represent the age calculated from the addition of all of the measured argon peaks for all steps in a single sample. The total gas ages are roughly equivalent to conventional K/Ar ages. No analytical precision is calculated for total gas ages, saddle ages or maximum ages. Isotope correlation analysis of the analytical data to assess if non-atmospheric argon components were trapped in any samples and to calculate an isochron age was not used due to the presence of several generations of white mica in the samples.

SAMPLE DESCRIPTIONS

The locations and brief descriptions of the samples analyzed in this project are given below in Table 1. Detailed petrographic descriptions have been presented elsewhere (Wintsch, Kvale, and Kisch, 1991; Wintsch, Kunk, and Epstein, in press).

Sample #	Lithology	Distance (m)	Fabric Zone
87L-39.5	Mudstone	39.5	II
87L-4A	Mudstone	4	I
87L-113.8B	Graywacke/ slate	113.8	IV
87L-WC1A1	Graywacke/ slate	1415	IV
87L-WC1AZ	Mudstone/ slate	1415	IV

Table 1. Samples analyzed in this report. Distances are in meters from the Shawangunk Conglomerate-Martinsburg Formation contact, of Wintsch, Kvale, and Kisch (1991). The Fabric Zone assignment is also from Wintsch, Kvale, and Kisch, (1991). All but the "WC" samples are located at 40° 47' 11" N. and 75 ° 37' 32" E in the Palmerton, PA 7½' quadrangle, in Carbon county along an abandoned railroad cut. The "WC" samples are located at 40° 46' 27" N. and 75° 37' 33" E in the Palmerton, PA 7½' Quadrangle, in Lehigh County along an unimproved dirt road that runs between the abandoned railroad tracks and State Route 145.

RESULTS

$^{40}Ar/^{39}Ar$ Data

The $^{40}Ar/^{39}Ar$ data presented in this report are presented in two different formats. Data within both formats are arranged in the same order as the section on sample descriptions.

The first of these formats is a condensed tabular form (Table 2). The data presented in this table are organized by site. These tables summarize the data contained in the succeeding, more detailed individual data sets. Included in this table are: the sample numbers; the material analyzed; the apparent age and its error (see below for a detailed explanation); the percent ^{39}Ar of the total that this apparent age represents; the number of steps / total number of steps that this apparent age represents; and; a comment listing the type of apparent age.

The individual data sets include a series of four tables, as well as one or two graphical representations of some of the age spectrum data.

The first table, RAW DATA (a), includes the computer file number of the individual argon analysis, the temperature of the step, regressed peak values and their precision, the trap current (filament amperage, in microamps) and the manifold splitting option used. The relationship between the trap currents and manifold options can be found in the footnotes of the third table. For samples from RD 59 no corrections have been made to the peak values, these are raw numbers for samples from RD 96 blanks have been subtracted from the ^{40}Ar and ^{36}Ar peaks. The size of the blanks subtracted as well as their analytical uncertainties is listed in the footnote of the table. Also included as footnotes are: (1) the trap current at which the samples were run in micro amps of current; (2) the manifold splitting option used; (3) the sensitivity of the mass spectrometer at the time of the analysis for samples measured as All or Eall at a trap current of 200 μA; (4) an estimate of the limit of reproducibility of the mass spectrometer when the sample was analyzed (If an intra-sample error is less than this value times the age of the step, this value should be used when comparing with other steps from the same age spectrum) and; The detection limit of the mass spectrometer in counts. For a further explanation of these footnotes see Haugarud and Kunk, 1988.

The second table, CORRECTIONS (b), contains calculated corrections for decay of radioactive isotopes of argon, as well as the production of interfering isotopes during irradiation, and a calculated initial ^{38}Ar value. All of these values have been corrected only for the affects of mass discrimination as discerned by measuring atmospheric argon. The measured atmospheric argon value used is 296.5 ± 0.5% for samples from RD 59 and 290.3 ± 0.6% for samples from RD 96. All tabular data in this table, as well as the two subsequent tables, is indexed by the temperature of the step analyzed.

The third data table, MOLAR VALUES (c), lists molar quantities of the indicated argon isotope derived from the sources indicated. The age of the step and an estimate of intra-sample precision in millions of years (Ma) are given. The occurrence of asterisk indicates that the signal measured was lower than the detection limit of the mass spectrometer. All precision estimates, in all tables, are at the one sigma level of confidence. The precision stated for the ages of individual temperature steps does not include the error in J.

The fourth table (d) includes the percent of potassium derived $^{39}Ar_K$ of the age spectrum total that each step contains, the radiogenic yield (percentage of ^{40}Ar (R) that is derived from the decay of potassium), calculated apparent K/Ca and K/Cl ratios for each step (or asterisk if the measured ^{38}Ar or ^{37}Ar signal measured was less than the detection limit of the mass spectrometer), a corrected $^{40}Ar_R/^{39}Ar_K$ ratio from which the age can be directly calculated, a calculated age for the step, in millions of years and an estimate of the precision of each age. The sample precision includes estimates of the errors that are unique to a single sample and can be used only for comparisons with other steps of the same sample. This error estimate does not include the error in "J".The J-value and its precision estimate, and sample weight are listed near the top of this table.

The figure with each age spectrum data set includes one or two graphs. The lower and larger graph plots cumulative percent $^{39}Ar_K$ of the steps in the age spectrum against

apparent age in millions of years. The precision estimate used to construct the error boxes of each step is two sigma. The upper, smaller graph plots the apparent K/Ca ratio of each step against cumulative $^{39}Ar_K$ released. Many times the degree of sample purity or the presence of compositional zoning can be inferred from this figure. Homogeneous samples with no compositional zoning or impurities are reflected by horizontal patterns in this figure, the patterns of those with zoning or impurities typically depart from horizontal.

For additional information on the sample data sets see Haugerud and Kunk(1988).

Table 2. Condensed tabular $^{40}Ar/^{39}Ar$ data.

Sample No.	Lithology	Irradiation Package	No. Steps	AGE (Ma)		
				Max	Saddle	ΣGAS
87L-39.5	Mudstone	RD59	17	644	413	407
87L-39.5	Mudstone	RD96	17	603	403	408
87L-4A	Mudstone	RD59	8	634	386	392
87L-113.8B	Graywacke/ slate	RD59	12	462	360	372
87L-113.8B	Graywacke/ slate	RD96	8	453	362	375
87L-WC1A1	Graywacke/ slate	RD59	15	710	374	404
87L-WC1AZ	Mudstone/ slate	RD59	18	636	379	400

Table 3a.

v 09/06/94 87L39.5 #100 RD59 Whole Rock Mudstone 02:43:30 17 Sep 1994

RAW DATA

File	Temp (°C)	^{40}Ar	^{39}Ar	^{38}Ar	^{37}Ar	^{36}Ar	Trap	Manifold
22700	550	151918	16205	269	9	331	200	EALL
	±	83	14	18	7	10		
22701	575	153610	13636	186	0	93	200	EALL
	±	100	11	22	11	12		
22702	600	155819	12073	142	0	71	200	EALL
	±	96	26	4	8	7		
22703	625	186883	13287	163	8	65	200	EALL
	±	126	37	26	12	5		
22704	650	358794	20664	223	13	46	200	EALL
	±	311	9	6	9	10		
22705	675	529059	27531	334	1	38	200	EALL
	±	180	8	9	7	4		
22706	700	799389	39987	499	4	34	200	EALL
	±	369	15	13	8	7		
22707	725	1140167	47145	523	1	37	200	EALL
	±	371	23	21	11	5		
22708	750	1568503	58298	655	12	42	200	EALL
	±	1141	25	13	10	11		
22709	775	2109251	74682	795	17	52	200	EALL
	±	817	67	28	6	10		
22710	800	2446227	84665	824	0	43	200	EALL
	±	891	11	16	13	8		
22711	850	4605956	160268	1982	0	55	200	EALL
	±	473	101	12	9	5		
22712	900	4923159	172005	2145	0	36	200	EALL
	±	3518	131	10	10	9		
22713	950	3588269	121315	1571	5	60	200	EALL
	±	2271	84	14	16	6		
22714	1000	2697853	77983	847	2	59	200	EALL
	±	631	64	19	9	8		
22715	1050	1859517	43455	458	0	45	200	EALL
	±	1090	37	12	18	9		
22716	1150	1731924	35885	451	0	63	200	EALL
	±	803	24	13	11	7		

All values are in counts.

Precisions are at the 1 sigma level, and are from linear regression statistics.

Trap current factors: 40 = 5.66 100 = 2.62 200 = 1

Manifold factors: All = 1, Split1 = 3.3, Split2 = 10.89, Split 3 = 35.937

EAll = 2, Esplit1 = 6.6, Esplit2 = 21.78

Sensitivity = 1 $x10^{-17}$ moles/count. Reproducibility limit = .25 %. Detection limit = 40 counts.

Table 3b.
v 09/06/94 87L39.5 #100 RD59 Whole Rock Mudstone 02:43:30 17 Sep 1994

CORRECTIONS

Temp (°C)	^{39}Ar decay	^{37}Ar decay	----- ^{40}Ar	K-derived ^{38}Ar	----- ^{37}Ar	----- ^{39}Ar	Ca-derived ^{38}Ar	----- ^{36}Ar	Cl-derived ^{36}Ar	initial ^{38}Ar
550	47	25182	92	218	0	17	1	7	0	61
575	40	0	78	183	0	0	0	0	0	18
600	35	0	69	162	0	0	0	0	0	13
625	39	20655	76	179	0	14	1	5	0	11
650	60	34881	118	278	0	24	1	9	0	7
675	80	2124	157	370	0	1	0	1	0	7
700	116	9800	228	538	0	7	0	3	0	6
725	137	2126	269	634	0	1	0	1	0	7
750	169	31300	332	784	0	21	1	8	0	6
775	217	46244	426	1004	0	31	1	12	0	8
800	246	0	483	1139	0	0	0	0	0	8
850	465	0	914	2156	0	0	0	0	0	10
900	499	0	981	2314	0	0	0	0	0	7
950	352	12999	692	1632	0	9	0	3	0	11
1000	226	5247	445	1049	0	4	0	1	0	11
1050	126	0	248	584	0	0	0	0	0	8
1150	104	0	205	483	0	0	0	0	0	12

All values are in counts and have been corrected for mass discrimination.

Table 3c.
v 09/06/94 87L39.5 #100 RD59 Whole Rock Mudstone 02:43:30 17 Sep 1994

MOLAR VALUES

Temp (°C)	$^{40}Ar^*$	$^{39}Ar_K$	$^{38}Ar_{Cl}$	$^{37}Ar_{Ca}$	$^{36}Ar_i$	Apparent Age and Precision	
550	3.037	0.325	0.002	0.505	***	55.01	3.33
575	3.071	0.274	***	0.000	***	143.93	4.63
600	3.115	0.242	***	0.000	***	172.66	3.39
625	3.736	0.266	***	0.414	***	195.75	3.55
650	7.174	0.414	***	0.700	***	254.62	2.47
675	10.578	0.553	***	0.043	***	282.06	1.02
700	15.983	0.803	***	0.197	***	295.21	0.96
725	22.798	0.946	***	0.043	***	352.07	0.92
750	31.363	1.170	***	0.628	***	388.94	0.97
775	42.177	1.499	***	0.928	***	406.56	0.60
800	48.915	1.700	***	0.000	***	414.92	0.65
850	92.101	3.217	***	0.000	***	413.57	0.23
900	98.444	3.453	***	0.000	***	412.57	0.39
950	71.752	2.435	***	0.261	***	423.95	0.55
1000	53.948	1.565	***	0.105	***	486.18	0.53
1050	37.185	0.872	***	0.000	***	584.01	1.61
1150	34.634	0.720	***	0.000	***	644.75	1.28

All gas quantities are in moles x 10^{-12}.
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
*** Below the detection Limit of the mass spectrometer.

Table 3d.
v 09/06/94 87L39.5 #100 RD59 Whole Rock Mudstone 02:43:30 17 Sep 1994

Temp (°C)	Percent ^{39}Ar of Total	Radiogenic Yield (%)	$^{39}Ar_K$	$^{40}Ar_R/^{39}Ar_K$	Apparent K/Ca	Apparent K/Cl	Apparent Age and Precision	
			87L39.5 #100 RD59 Whole Rock Mudstone					
	J = .009033 ± 0.5					Sample wt. = .2046 g		
550	1.6	36.7	0.325	3.428	***	352	55.01	3.33
575	1.3	82.0	0.274	9.195	***	1656	143.93	4.63
600	1.2	86.5	0.242	11.119	***	***	172.66	3.39
625	1.3	90.5	0.266	12.689	***	***	195.75	3.55
650	2.0	96.9	0.414	16.782	***	***	254.62	2.47
675	2.7	97.9	0.553	18.736	***	***	282.06	1.02
700	3.9	98.8	0.803	19.683	***	***	295.21	0.96
725	4.6	99.0	0.946	23.858	***	***	352.07	0.92
750	5.7	99.4	1.170	26.636	***	***	388.94	0.97
775	7.3	99.4	1.499	27.984	***	***	406.56	0.60
800	8.3	99.5	1.700	28.628	***	***	414.92	0.65
850	15.7	99.6	3.217	28.524	***	***	413.57	0.23
900	16.9	99.8	3.453	28.447	***	***	412.57	0.39
950	11.9	99.5	2.435	29.327	***	***	423.95	0.55
1000	7.7	99.4	1.565	34.242	***	***	486.18	0.53
1050	4.3	99.3	0.872	42.320	***	***	584.01	1.61
1150	3.5	98.9	0.720	47.560	***	***	644.75	1.28
Total Gas	100	97.9	20.456	28.029	***	28	407.14	

NO PLATEAU

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
$^{39}Ar_K$ gas quantities are in moles x 10^{-12}.
*** Below the detection Limit of the mass spectrometer.

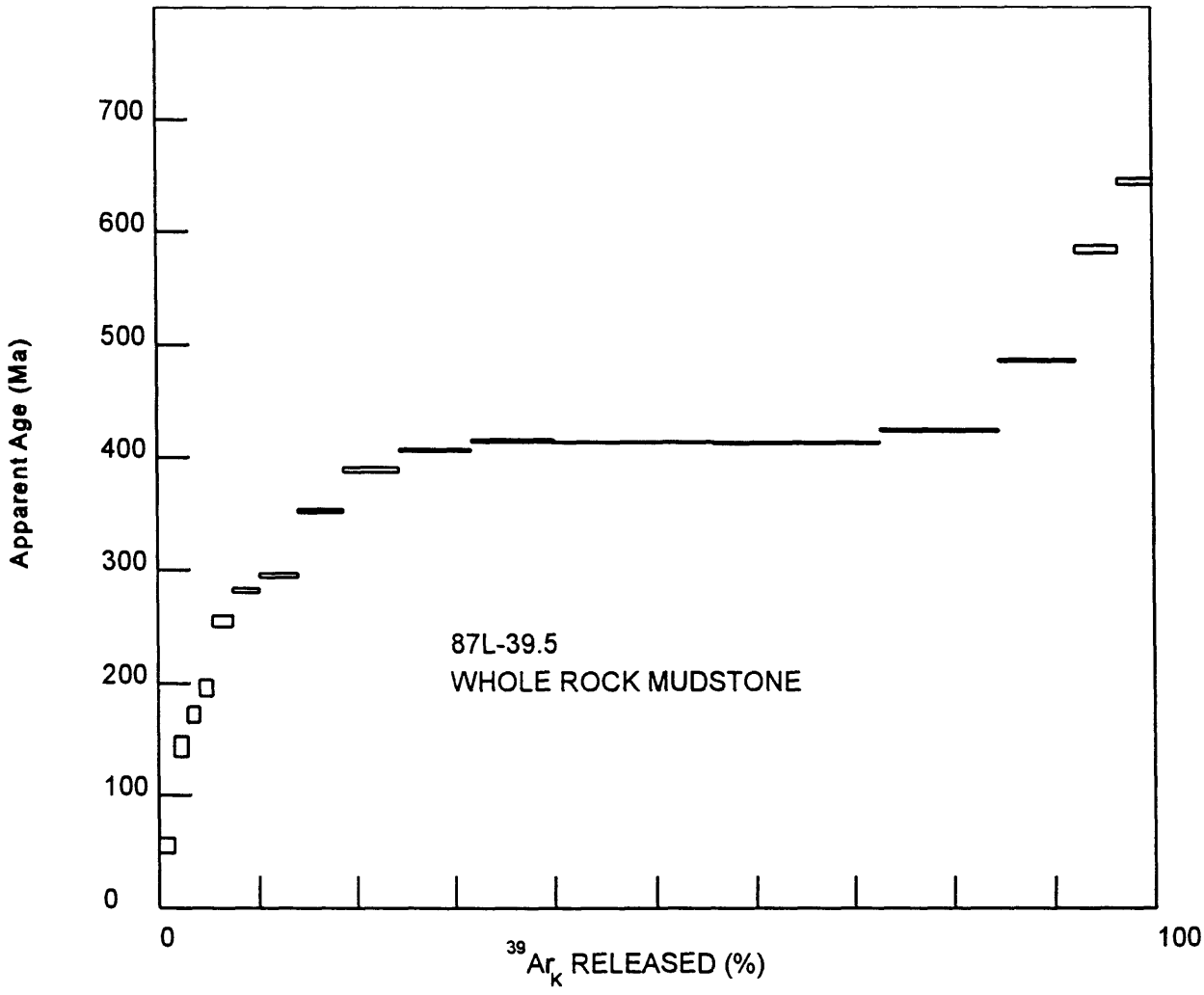

Figure 1. $^{40}Ar/^{39}Ar$ age spectrum diagram for 87L-39.5 whole rock mudstone, #100 RD59.

Table 4a.
v 09/06/94 87L-39.5 #32 RD96 Whole Rock Mudstone 01:27:41 16 Sep 1994

RAW DATA

File	Temp (°C)	^{40}Ar	^{39}Ar	^{38}Ar	^{37}Ar	^{36}Ar	Trap
40057	550	111918	16016	201	103	32	200
	±	225	3	8	7	2	
40058	575	216473	19086	211	115	19	200
	±	256	35	6	12	2	
40059	600	298646	18670	189	103	15	200
	±	602	41	8	7	4	
40060	625	380575	19788	158	83	11	200
	±	49	26	7	7	2	
40061	650	323376	15789	125	68	9	200
	±	178	23	14	3	2	
40062	675	500968	24985	365	103	15	200
	±	370	77	4	4	2	
40063	700	802046	32240	433	92	16	200
	±	198	139	7	3	3	
40064	725	1078487	41480	527	100	19	200
	±	1393	93	3	2	4	
40065	750	1338773	49771	619	99	21	200
	±	873	45	12	2	2	
40066	775	1528659	55827	690	95	25	200
	±	713	4	9	5	3	
40067	800	1464620	52626	662	86	113	200
	±	619	21	5	6	3	
40068	850	2413105	89388	1138	148	121	200
	±	588	64	10	5	3	
40069	900	2221343	84746	1069	164	36	200
	±	3014	138	14	6	2	
40070	950	1541386	52206	678	103	23	200
	±	1435	31	3	3	2	
40071	1000	1784536	50176	667	98	26	200
	±	1492	35	8	4	2	
40072	1050	1262584	30868	413	166	28	200
	±	824	35	7	11	2	
40073	1150	528697	12498	154	506	38	200
	±	277	26	7	5	3	

All values are in counts.

^{40}Ar blank = 924 ± 12 ^{36}Ar blank = 4.5 ± 2.0

Precisions are at the 1 sigma level, and are from linear regression statistics.

Trap current factors: 40 = 5.66 100 = 2.62 200 = 1

Manifold factors: All = 1, Split1 = 3.3, Split2 = 10.89, Split 3 = 35.937

EAll = 2, Esplit1 = 6.6, Esplit2 = 21.78

Sensitivity = 1.436 x10^{-18} moles/count. Reproducibility limit = .25 %. Detection limit = 40 counts.

Table 4b.
v 09/06/94 87L-39.5 #32 RD96 Whole Rock Mudstone 01:27:41 16 Sep 1994

Temp (°C)	^{39}Ar decay	^{37}Ar decay	^{40}Ar	K-derived ^{38}Ar	^{37}Ar	^{39}Ar	Ca-derived ^{38}Ar	^{36}Ar	Cl-derived ^{36}Ar	initial ^{38}Ar
550	8	285	91	214	0	0	0	0	0	6
575	9	318	108	255	0	0	0	0	0	3
600	9	286	106	249	0	0	0	0	0	3
625	9	231	112	264	0	0	0	0	0	2
650	7	187	89	211	0	0	0	0	0	2
675	12	286	141	333	0	0	0	0	0	3
700	15	256	182	430	0	0	0	0	0	3
725	20	279	235	554	0	0	0	0	0	3
750	23	274	282	664	0	0	0	0	0	4
775	26	265	316	745	0	0	0	0	0	5
800	25	239	298	702	0	0	0	0	0	21
850	42	411	506	1193	0	0	0	0	0	22
900	40	456	479	1131	0	0	0	0	0	7
950	25	286	295	697	0	0	0	0	0	4
1000	24	274	284	670	0	0	0	0	0	5
1050	15	462	175	412	0	0	0	0	0	5
1150	6	1413	71	167	0	1	0	0	0	7

All values are in counts and have been corrected for mass discrimination.

Table 4c.
v 09/06/94 87L-39.5 #32 RD96 Whole Rock Mudstone 01:27:41 16 Sep 1994

MOLAR VALUES

Temp (°C)	$^{40}Ar^*$	$^{39}Ar_K$	$^{38}Ar_{Cl}$	$^{37}Ar_{Ca}$	$^{36}Ar_i$	Apparent Age and Precision	
550	0.321	0.046	***	0.001	***	107.64	0.72
575	0.621	0.055	***	0.001	***	181.68	0.56
600	0.857	0.053	***	0.001	***	253.91	1.01
625	1.093	0.057	***	0.001	***	302.99	0.50
650	0.928	0.045	***	0.001	***	320.97	0.68
675	1.438	0.071	***	0.001	***	314.74	0.42
700	2.303	0.092	***	0.001	***	383.87	0.34
725	3.097	0.119	***	0.001	***	399.68	0.64
750	3.844	0.142	***	0.001	***	412.25	0.31
775	4.389	0.160	***	0.001	***	418.80	0.27
800	4.206	0.151	***	0.001	0.003	418.14	0.26
850	6.929	0.256	***	0.002	0.003	409.83	0.15
900	6.378	0.242	***	0.002	***	402.73	0.50
950	4.426	0.149	***	0.001	***	447.96	0.41
1000	5.124	0.144	***	0.001	***	527.42	0.43
1050	3.626	0.088	***	0.002	***	593.63	0.43
1150	1.518	0.036	***	0.005	***	603.52	0.80

All gas quantities are in moles x 10^{-12}.
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
*** Below the detection Limit of the mass spectrometer.

Table 4d.
v 09/06/94 87L-39.5 #32 RD96 Whole Rock Mudstone 01:27:41 16 Sep 1994

Temp (°C)	Percent ^{39}Ar of Total	Radiogenic Yield (%)	$^{39}Ar_K$	$^{40}Ar_R/^{39}Ar_K$	Apparent K/Ca	Apparent K/Cl	Apparent Age and Precision	
			87L-39.5 #32 RD96 Whole Rock Mudstone					
	J = .009552 ± .5					Sample wt. = .0345 g		
550	2.4	91.8	0.046	6.437	21.70	***	107.64	0.72
575	2.9	97.5	0.055	11.092	23.11	***	181.68	0.56
600	2.8	98.6	0.053	15.822	25.20	***	253.91	1.01
625	3.0	99.2	0.057	19.146	33.06	***	302.99	0.50
650	2.4	99.2	0.045	20.386	32.50	***	320.97	0.68
675	3.8	99.2	0.071	19.955	33.68	***	314.74	0.42
700	4.8	99.4	0.092	24.825	48.50	***	383.87	0.34
725	6.2	99.5	0.119	25.964	57.42	***	399.68	0.64
750	7.5	99.6	0.142	26.878	70.05	***	412.25	0.31
775	8.4	99.5	0.160	27.356	81.31	***	418.80	0.27
800	7.9	97.8	0.151	27.308	84.97	***	418.14	0.26
850	13.4	98.5	0.256	26.701	84.04	***	409.83	0.15
900	12.7	99.5	0.242	26.185	71.80	***	402.73	0.50
950	7.8	99.6	0.149	29.508	70.41	***	447.96	0.41
1000	7.5	99.6	0.144	35.551	70.82	***	527.42	0.43
1050	4.6	99.4	0.088	40.794	25.83	***	593.63	0.43
1150	1.9	97.9	0.036	41.594	3.42	***	603.52	0.80
Total Gas	100.0	98.9	1.906	26.567	62.11	***	407.99	

NO PLATEAU

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
$^{39}Ar_K$ gas quantities are in moles x 10^{-12}.
*** Below the detection Limit of the mass spectrometer.

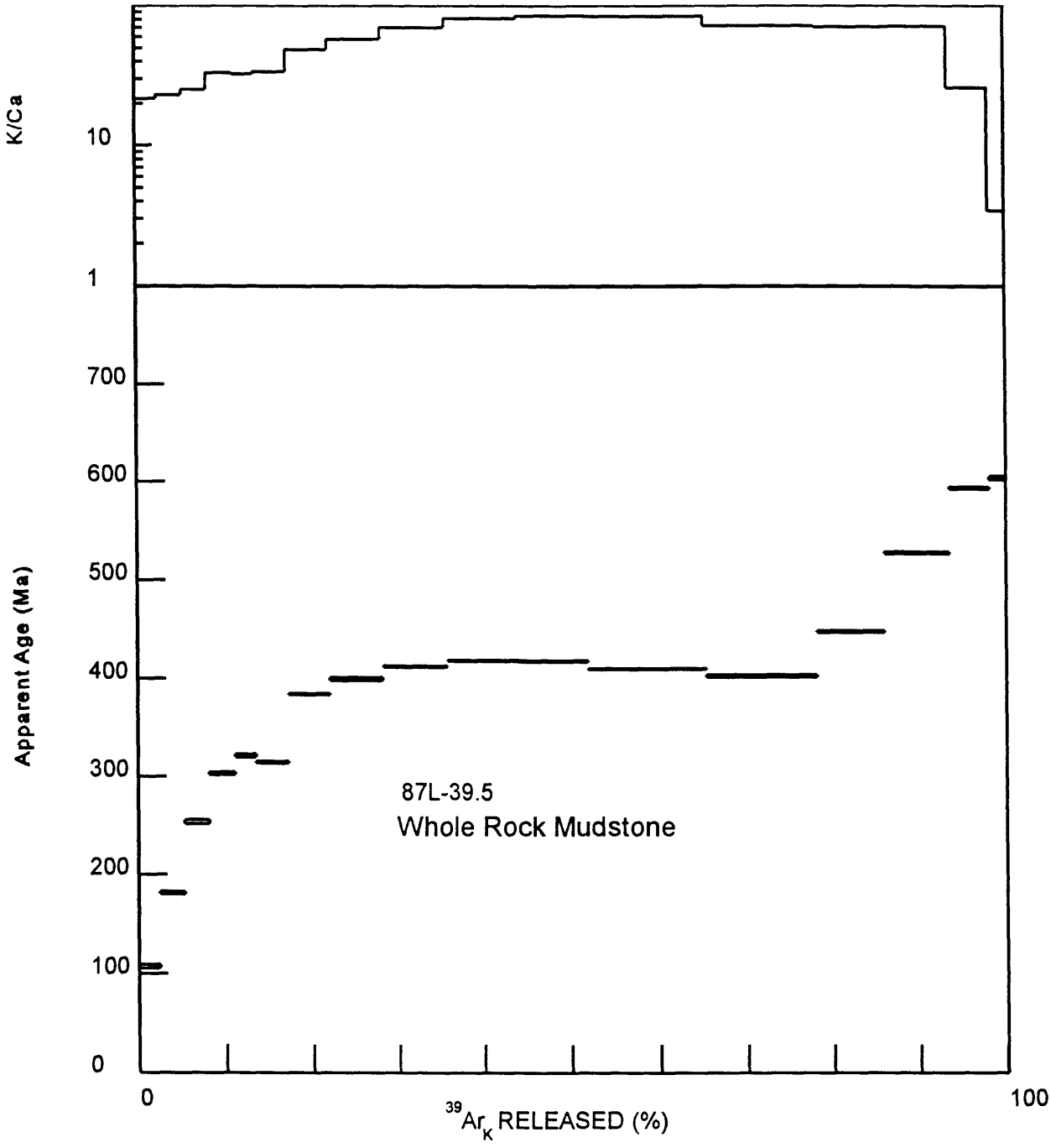

Figure 2. $^{40}Ar/^{39}Ar$ age spectrum and K/Ca diagrams for sample 87L-39.5 whole rock mudstone, #32 RD96.

Table 5a.
v 09/06/94 87L-4A #99 RD59 Whole Rock Mudstone 03:34:30 17 Sep 1994

RAW DATA

File	Temp (°C)	^{40}Ar	^{39}Ar	^{38}Ar	^{37}Ar	^{36}Ar	Trap	Manifold
20423	450	943269	63064	892	0	143	200	ALL
	±	279	38	10	5	15		
20424	550	3239341	183534	2712	0	101	200	ALL
	±	1281	56	20	6	9		
20425	650	4798885	194600	2534	9	63	100	ALL
	±	2680	49	14	12	18		
20427	750	2902795	110653	1428	126	35	40	ALL
	±	1402	45	13	30	30		
20428	850	3830210	130856	1708	0	29	100	ALL
	±	1420	106	3	12	10		
20430	950	2483114	60138	770	5	29	100	ALL
	±	553	36	11	11	5		
20432	1000	1138205	24391	378	81	38	200	ALL
	±	408	14	3	7	20		
20433	1100	897224	25425	480	259	38	200	ALL
	±	870	70	13	13	15		

All values are in counts.
Precisions are at the 1 sigma level, and are from linear regression statistics.
Trap current factors: 40 = 5.66 100 = 2.62 200 = 1
Manifold factors: All = 1, Split1 = 3.3, Split2 = 10.89, Split 3 = 35.937
EAll = 2, Esplit1 = 6.6, Esplit2 = 21.78
Sensitivity = 1 $x10^{-17}$ moles/count. Reproducibility limit = .25 %. Detection limit = 40 counts.

Table 5b.
v 09/06/94 87L-4A #99 RD59 Whole Rock Mudstone 03:34:30 17 Sep 1994

CORRECTIONS

Temp (°C)	^{39}Ar decay	^{37}Ar decay	^{40}Ar	K-derived ^{38}Ar	^{37}Ar	^{39}Ar	Ca-derived ^{38}Ar	^{36}Ar	Cl-derived ^{36}Ar	initial ^{38}Ar
450	87	4	359	847	0	0	0	0	0	27
550	255	0	1045	2465	0	0	0	0	0	19
650	270	422	1108	2613	0	0	0	0	0	12
750	154	5665	630	1486	0	4	0	2	0	6
850	182	0	745	1757	0	0	0	0	0	5
950	83	219	342	808	0	0	0	0	0	5
1000	34	3672	139	328	0	3	0	1	0	7
1100	35	11732	145	341	0	8	0	3	0	7

All values are in counts and have been corrected for mass discrimination.

Table 5c.
v 09/06/94 87L-4A #99 RD59 Whole Rock Mudstone 03:34:30 17 Sep 1994

MOLAR VALUES

Temp (°C)	$^{40}Ar^*$	$^{39}Ar_K$	$^{38}Ar_{Cl}$	$^{37}Ar_{Ca}$	$^{36}Ar_i$	Apparent Age and Precision	
450	9.429	0.632	0.001	***	0.001	220.73	1.04
550	32.383	1.839	0.003	***	0.001	266.71	0.23
650	125.702	5.110	***	***	0.002	364.40	0.41
750	164.263	6.277	***	0.329	***	385.51	1.07
850	100.332	3.436	***	***	***	425.69	0.32
950	65.049	1.579	***	***	***	574.46	0.33
1000	11.381	0.244	0.001	0.038	***	634.19	2.76
1100	8.971	0.255	0.001	0.120	***	498.11	2.17

All gas quantities are in moles x 10^{-12}.
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
*** Below the detection Limit of the mass spectrometer.

Table 5d.
v 09/06/94 87L-4A #99 RD59 Whole Rock Mudstone 03:34:30 17 Sep 1994

Temp (°C)	Percent ^{39}Ar of Total	Radiogenic Yield (%)	$^{39}Ar_K$	$^{40}Ar_R/^{39}Ar_K$	Apparent K/Ca	Apparent K/Cl	Apparent Age and Precision	
			87L-4A #99 RD59 Whole Rock Mudstone					
	J = .009135 ± 0.5					Sample wt. = .1997 g		
450	3.3	95.5	0.632	14.248	***	2094	220.73	1.04
550	9.5	99.1	1.839	17.442	***	1644	266.71	0.23
650	26.4	99.6	5.110	24.504	***	***	364.40	0.41
750	32.4	99.7	6.277	26.081	9.93	***	385.51	1.07
850	17.7	99.8	3.436	29.133	***	***	425.69	0.32
950	8.2	99.7	1.579	41.049	***	***	574.46	0.33
1000	1.3	99.0	0.244	46.115	***	1022	634.19	2.76
1100	1.3	98.9	0.255	34.811	1.10	423	498.11	2.17
Total Gas	100	99.5	19.373	26.588	327.29	243	392.24	

NO PLATEAU

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
$^{39}Ar_K$ gas quantities are in moles x 10^{-12}.
*** Below the detection Limit of the mass spectrometer.

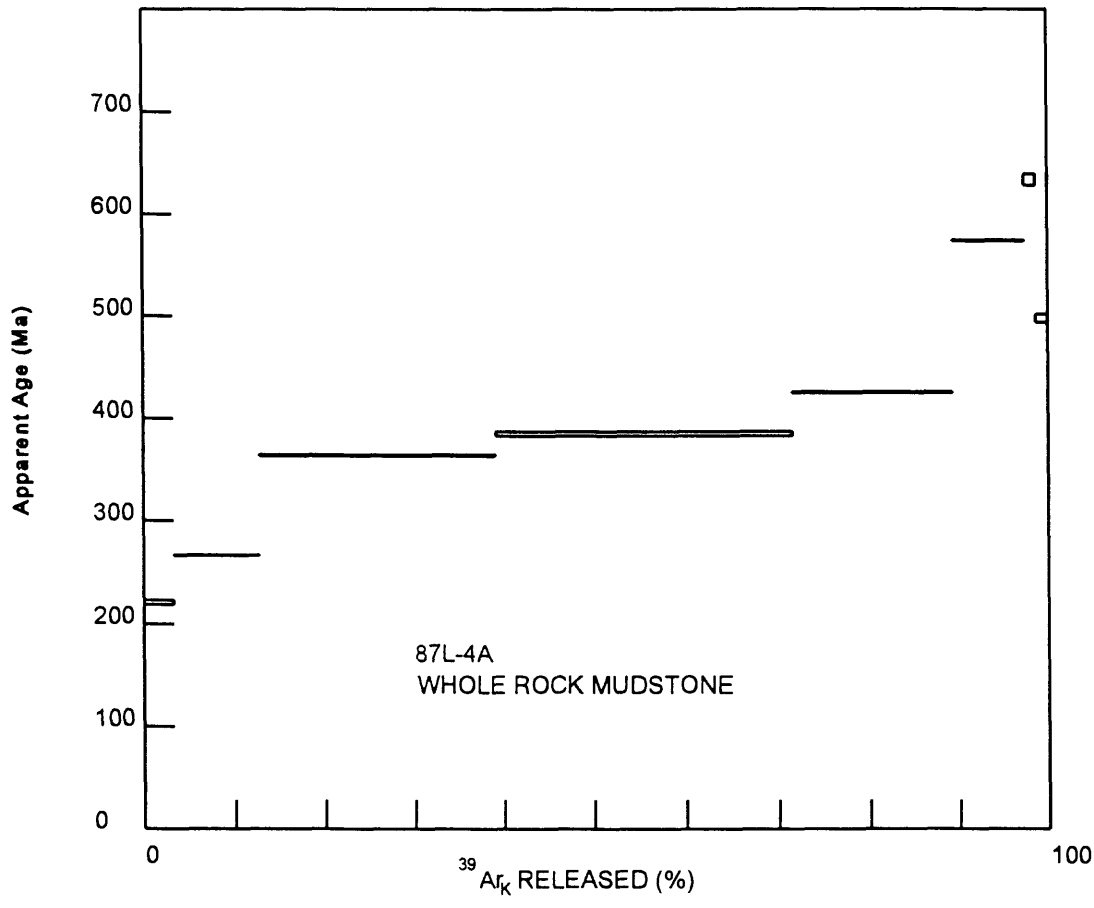

Figure 3. $^{40}Ar/^{39}Ar$ age spectrum diagram for sample 87L-4A whole rock mudstone #99 RD59.

Table 6a.
v 09/06/94 87L-113.8 B4 102&103 RD59 Graywacke/Slate 02:11:17 17 Sep 1994

RAW DATA

File	Temp (°C)	^{40}Ar	^{39}Ar	^{38}Ar	^{37}Ar	^{36}Ar	Trap	Manifold
20438	350	525976	20875	641	0	1313	200	ALL
	±	248	25	10	15	15		
20439	450	699638	44925	825	0	346	200	ALL
	±	327	37	18	16	32		
20440	550	2547959	157444	2597	25	162	200	ALL
	±	990	63	24	6	22		
20442	600	1924872	83108	1170	6	41	100	ALL
	±	843	82	14	9	19		
20443	650	3106454	121895	1549	0	38	100	ALL
	±	2167	47	13	6	5		
20444	700	4035543	163244	2071	0	46	100	ALL
	±	1596	56	22	20	18		
20446	750	2897905	119980	1536	39	40	100	ALL
	±	1661	88	6	11	19		
20448	850	3387567	130830	1676	59	64	100	ALL
	±	1860	65	10	4	14		
20449	950	3479355	119895	1576	0	46	100	ALL
	±	364	23	5	15	17		
20450	1050	1352391	42591	651	73	41	100	ALL
	±	236	12	6	10	19		
20451	1150	2200337	68733	1914	728	110	200	ALL
	±	210	28	24	11	18		
20452	1250	871492	26852	1230	465	74	200	ALL
	±	287	13	34	11	11		

All values are in counts.
Precisions are at the 1 sigma level, and are from linear regression statistics.
Trap current factors: 40 = 5.66 100 = 2.62 200 = 1
Manifold factors: All = 1, Split1 = 3.3, Split2 = 10.89, Split 3 = 35.937
EAll = 2, Esplit1 = 6.6, Esplit2 = 21.78
Sensitivity = 1.E-17 moles/count. Reproducibility limit = .25 %. Detection limit = 40 counts.

Table 6b.
v 09/06/94 87L-113.8 B4 102&103 RD59 Graywacke/Slate 02:11:17 17 Sep 1994

CORRECTIONS

Temp (°C)	^{39}Ar decay	^{37}Ar decay	^{40}Ar	K-derived ^{38}Ar	^{37}Ar	^{39}Ar	Ca-derived ^{38}Ar	^{36}Ar	Cl-derived ^{36}Ar	initial ^{38}Ar
350	29	0	119	280	0	0	0	0	0	246
450	63	0	256	603	0	0	0	0	0	65
550	220	1145	896	2114	0	1	0	0	0	30
600	116	293	473	1116	0	0	0	0	0	8
650	170	0	694	1637	0	0	0	0	0	7
700	228	0	929	2192	0	0	0	0	0	9
750	167	1809	683	1611	0	1	0	0	0	7
850	183	2717	745	1757	0	2	0	1	0	12
950	167	0	683	1610	0	0	0	0	0	9
1050	59	3364	242	572	0	2	0	1	0	8
1150	96	33673	391	923	0	23	1	9	0	19
1250	38	21495	153	360	0	15	1	6	0	13

All values are in counts and have been corrected for mass discrimination.

Table 6c.
v 09/06/94 87L-113.8 B4 102&103 RD59 Graywacke/Slate 02:11:17 17 Sep 1994

MOLAR VALUES

Temp (°C)	$^{40}Ar^*$	$^{39}Ar_K$	$^{38}Ar_{Cl}$	$^{37}Ar_{Ca}$	$^{36}Ar_i$	Apparent Age and Precision	
350	5.259	0.209	0.006	***	0.013	105.40	3.45
450	6.994	0.450	0.003	***	0.003	207.94	3.09
550	25.471	1.578	0.005	***	0.002	245.86	0.61
600	50.419	2.182	0.002	***	0.001	346.31	0.95
650	81.371	3.201	***	***	***	378.59	0.29
700	105.707	4.287	***	***	0.001	368.43	0.47
750	75.907	3.150	***	***	0.001	360.54	0.67
850	88.735	3.435	***	0.073	0.002	383.41	0.46
950	91.141	3.148	***	***	0.001	425.25	0.56
1050	35.426	1.118	0.002	0.090	0.001	458.61	1.71
1150	21.999	0.689	0.010	0.345	0.001	460.08	0.98
1250	8.713	0.269	0.009	0.220	0.001	461.87	1.54

All gas quantities are in moles x 10^{-12}.
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
*** Below the detection Limit of the mass spectrometer.

Table 6d.
v 09/06/94 87L-113.8 B4 102&103 RD59 Graywacke/Slate 02:11:17 17 Sep 1994

Temp (°C)	Percent ^{39}Ar of Total	Radiogenic Yield (%)	$^{39}Ar_K$	$^{40}Ar_R/^{39}Ar_K$	Apparent K/Ca	Apparent K/Cl	Apparent Age and Precision	
			87L-113.8 B4 102&103 RD59 Graywacke/Slate					
	J = .009219 ± .5					Sample wt. = .4065 g		
350	0.9	26.0	0.209	6.526	***	83	105.40	3.45
450	1.9	85.3	0.450	13.252	***	378	207.94	3.09
550	6.7	98.1	1.578	15.838	***	738	245.86	0.61
600	9.2	99.4	2.182	22.956	***	3184	346.31	0.95
650	13.5	99.6	3.201	25.329	***	***	378.59	0.29
700	18.1	99.7	4.287	24.577	***	***	368.43	0.47
750	13.3	99.6	3.150	23.997	***	***	360.54	0.67
850	14.5	99.4	3.435	25.687	24.5	***	383.41	0.46
950	13.3	99.6	3.148	28.835	***	***	425.25	0.56
1050	4.7	99.1	1.118	31.397	***	1177	458.61	1.71
1150	2.9	98.6	0.689	31.512	***	165	460.08	0.98
1250	1.1	97.7	0.269	31.650	0.64	74	461.87	1.54
Total Gas	100.0	98.5	23.717	24.826	26.3	411	371.79	

NO PLATEAU

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
$^{39}Ar_K$ gas quantities are in moles x 10^{-12}.
*** Below the detection Limit of the mass spectrometer.

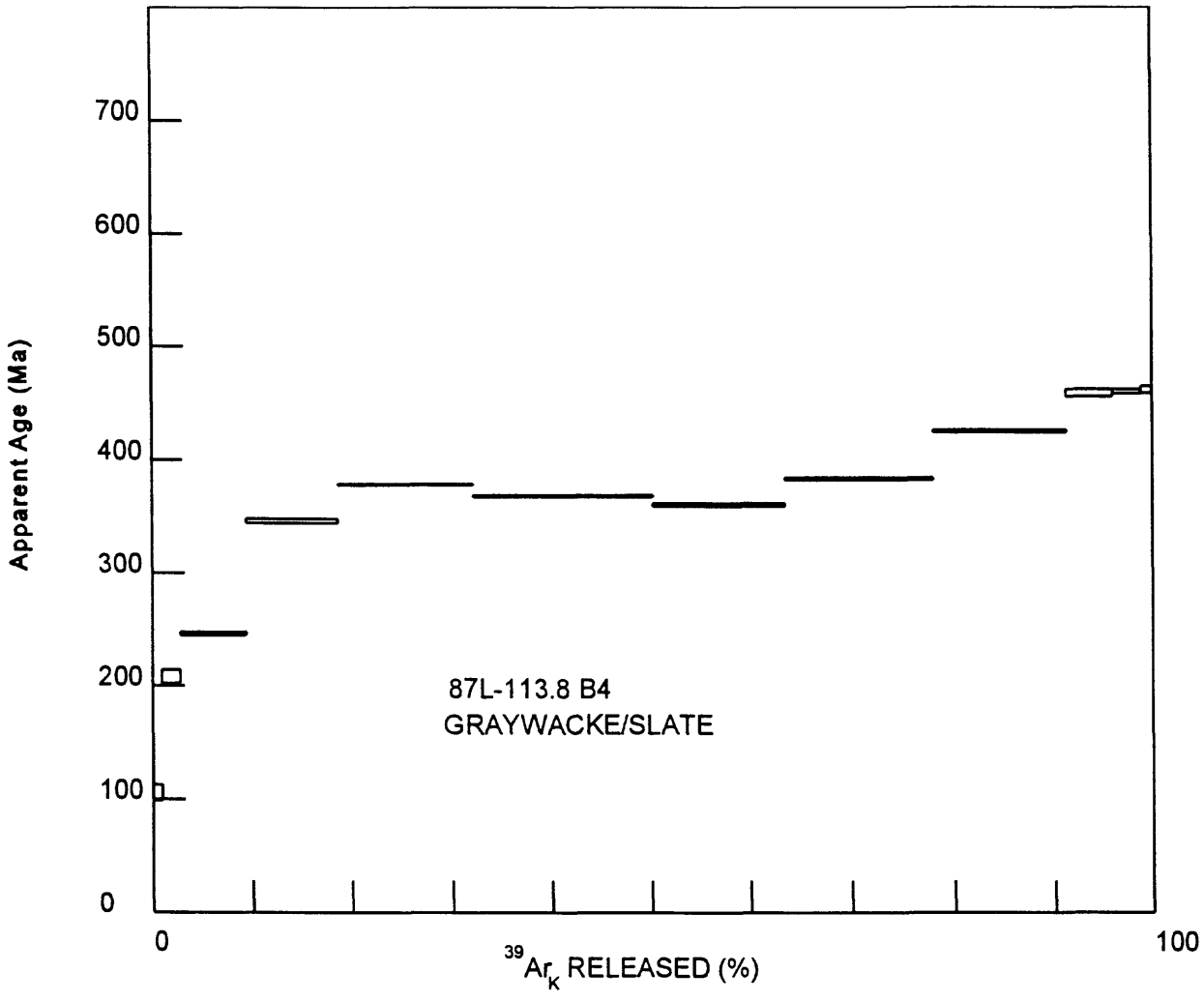

Figure 4. $^{40}Ar/^{39}Ar$ age spectrum for 87L-113.8 B4 Graywacke/Slate #102&103 RD59.

Table 7a.
v 09/06/94 87L-113.8 #31RD 96 Graywacke/Slate 01:49:56 16 Sep 1994

RAW DATA

File	Temp (°C)	^{40}Ar	^{39}Ar	^{38}Ar	^{37}Ar	^{36}Ar	Trap	Manifold
40089	650	315649	22617	424	168	27	200	EALL
	±	156	28	1	7	5		
40090	700	779665	65845	1115	612	50	200	EALL
	±	617	53	10	3	4		
40091	750	2380363	100579	1480	382	86	200	EALL
	±	852	98	6	3	6		
40092	850	1910364	77360	993	202	71	200	ESPLIT 1
	±	3798	80	3	4	3		
40093	950	1778905	76268	991	232	20	200	ESPLIT 1
	±	736	69	10	3	3		
40094	1050	2396040	91502	1172	276	23	200	ESPLIT 1
	±	1595	33	14	7	3		
40095	1150	3078513	103283	1570	2199	82	200	EALL
	±	1456	46	18	20	3		
40096	1250	875768	28628	865	4312	73	200	EALL
	±	539	41	9	23	5		

All values are in counts.
Precisions are at the 1 sigma level, and are from linear regression statistics.
Trap current factors: 40 = 5.66 100 = 2.62 200 = 1
Manifold factors: All = 1, Split1 = 3.3, Split2 = 10.89, Split 3 = 35.937
EAll = 2, Esplit1 = 6.6, Esplit2 = 21.78
Sensitivity = 1.436 x10^{-18} moles/count. Reproducibility limit = .25 %. Detection limit = 40 counts.

Table 7b.
v 09/06/94 87L-113.8 #31RD 96 Graywacke/Slate 01:49:56 16 Sep 1994

CORRECTIONS

Temp (°C)	^{39}Ar decay	^{37}Ar decay	----- ^{40}Ar	K-derived ^{38}Ar	----- ^{37}Ar	----- ^{39}Ar	Ca-derived ^{38}Ar	----- ^{36}Ar	Cl-derived ^{36}Ar	initial ^{38}Ar
650	11	476	128	302	0	0	0	0	0	5
700	31	1741	373	879	0	2	0	1	0	9
750	48	1086	569	1342	0	1	0	0	0	16
850	37	577	438	1033	0	1	0	0	0	13
950	36	662	431	1018	0	1	0	0	0	4
1050	44	787	518	1221	0	1	0	0	0	4
1150	49	6279	584	1378	0	6	0	2	0	15
1250	14	12320	162	382	0	11	1	4	0	13

All values are in counts and have been corrected for mass discrimination.

Table 7c.
v 09/06/94 87L-113.8 #31RD 96 Graywacke/Slate 01:49:56 16 Sep 1994

MOLAR VALUES

Temp (°C)	$^{40}Ar^*$	$^{39}Ar_K$	$^{38}Ar_{Cl}$	$^{37}Ar_{Ca}$	$^{36}Ar_i$	Apparent Age and Precision	
650	0.906	0.065	***	0.002	***	220.57	1.02
700	2.238	0.188	0.001	0.007	0	190.02	0.30
750	6.835	0.288	***	0.004	0	364.44	0.27
850	18.102	0.730	***	0.007	0.001	378.63	0.70
950	16.856	0.720	***	0.008	***	362.03	0.21
1050	22.704	0.864	***	0.010	***	402.03	0.28
1150	8.840	0.295	0.001	0.024	0	449.31	0.22
1250	2.515	0.082	0.001	0.047	0	453.62	0.67

All gas quantities are in moles x 10^{-12}.
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
*** Below the detection Limit of the mass spectrometer.

Table 7d.
v 09/06/94 87L-113.8 #31RD 96 Graywacke/Slate 01:49:56 16 Sep 1994

Temp (°C)	Percent ^{39}Ar of Total	Radiogenic Yield (%)	$^{39}Ar_K$	$^{40}Ar_R/^{39}Ar_K$	Apparent K/Ca	Apparent K/Cl	Apparent Age and Precision	
			87L-113.8 #31RD 96 Graywacke/Slate					
	J = .009524 ± 0.5					Sample wt. = .1017 g		
650	2.0	97.5	0.065	13.656	18.43	440	220.57	1.02
700	5.8	98.2	0.188	11.663	14.69	673	190.02	0.30
750	8.9	99.0	0.288	23.506	35.98	1724	364.44	0.27
850	22.6	98.9	0.730	24.520	52.13	***	378.63	0.70
950	22.3	99.7	0.720	23.334	44.74	***	362.03	0.21
1050	26.7	99.7	0.864	26.212	45.17	***	402.03	0.28
1150	9.1	99.3	0.295	29.696	6.39	1298	449.31	0.22
1250	2.5	97.7	0.082	30.018	0.90	142	453.62	0.67
Total Gas	100.0	99.2	3.232	24.263	38.85	324	375.05	

NO PLATEAU

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
$^{39}Ar_K$ gas quantities are in moles x 10^{-12}.
*** Below the detection Limit of the mass spectrometer.

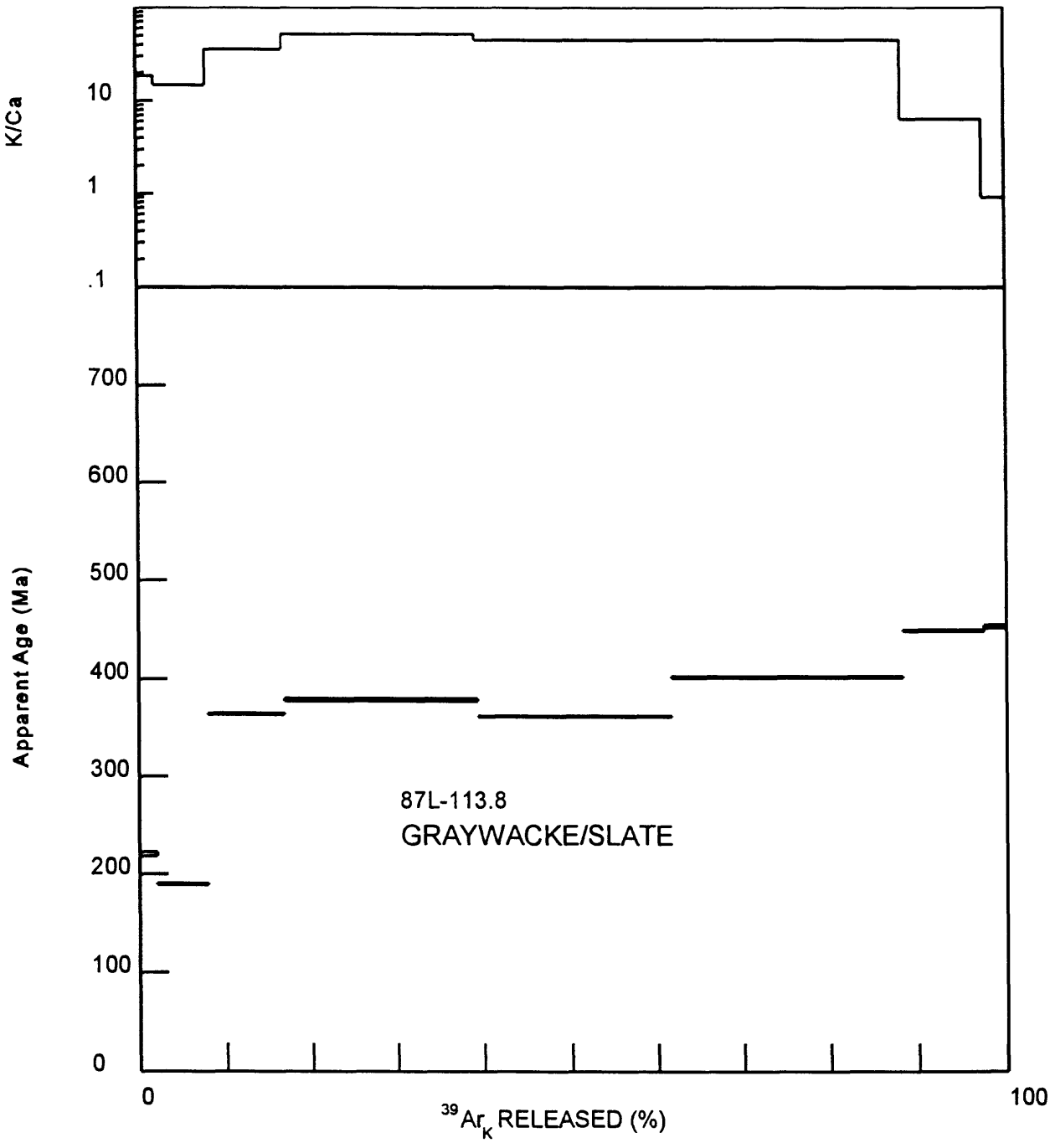

Figure 5. $^{40}Ar/^{39}Ar$ Age spectrum and K/Ca diagrams for sample 87L-113.8 Graywacke/Slate, #31 RD 96.

Table 8a.
v 09/06/94 87L-WC1A1 #104&105RD59 Graywacke/Slate 03:44:12 17 Sep 1994

RAW DATA

File	Temp (°C)	^{40}Ar	^{39}Ar	^{38}Ar	^{37}Ar	^{36}Ar	Trap	Manifold
22617	550	385765	29881	491	0	537	200	EALL
	±	259	27	19	18	14		
22618	575	752126	38764	478	14	120	200	EALL
	±	219	31	11	4	11		
22619	600	1086714	49073	525	0	39	200	EALL
	±	457	26	17	14	8		
22620	625	732360	30213	332	0	28	200	EALL
	±	411	7	12	2	3		
22621	650	1628133	63348	669	4	31	200	EALL
	±	742	56	7	14	6		
22622	675	2060821	76116	779	0	41	200	EALL
	±	869	45	15	7	7		
22623	700	2122763	76849	794	5	35	200	EALL
	±	452	32	18	5	11		
22624	725	2427692	88998	923	0	38	200	EALL
	±	853	53	32	9	7		
22625	750	2216661	83774	828	11	39	200	EALL
	±	1247	58	21	10	8		
22626	800	3108964	122719	1597	0	43	200	EALL
	±	2214	46	36	6	10		
22627	850	2807957	107394	1425	0	42	200	EALL
	±	634	92	11	8	9		
22628	900	2648973	84152	899	0	44	200	EALL
	±	1699	30	19	11	9		
22629	950	2583027	68233	760	0	49	200	EALL
	±	1080	40	23	17	5		
22630	1000	1696509	36466	429	0	50	200	EALL
	±	1281	24	11	4	15		
22631	1050	752721	14025	225	0	43	200	EALL
	±	260	20	11	5	6		

All values are in counts.
Precisions are at the 1 sigma level, and are from linear regression statistics.
Trap current factors: 40 = 5.66 100 = 2.62 200 = 1
Manifold factors: All = 1, Split1 = 3.3, Split2 = 10.89, Split 3 = 35.937
EAll = 2, Esplit1 = 6.6, Esplit2 = 21.78
Sensitivity = 1.E-17 moles/count. Reproducibility limit = .25 %. Detection limit = 40 counts.

Table 8b.
v 09/06/94 87L-WC1A1 #104&105RD59 Graywacke/Slate 03:44:12 17 Sep 1994
CORRECTIONS

Temp (°C)	^{39}Ar decay	^{37}Ar decay	---- ^{40}Ar	K-derived ^{38}Ar	---- ^{37}Ar	---- ^{39}Ar	Ca-derived ^{38}Ar	---- ^{36}Ar	Cl-derived ^{36}Ar	initial ^{38}Ar
550	86	0	170	402	0	0	0	0	0	101
575	112	35323	221	521	0	24	1	9	0	21
600	142	0	280	660	0	0	0	0	0	7
625	87	0	172	406	0	0	0	0	0	5
650	183	9308	361	852	0	6	0	2	0	5
675	220	0	434	1024	0	0	0	0	0	8
700	222	12001	438	1034	0	8	0	3	0	6
725	257	0	507	1197	0	0	0	0	0	7
750	242	29470	478	1126	0	20	1	8	0	6
800	354	422	700	1651	0	0	0	0	0	8
850	310	0	612	1444	0	0	0	0	0	8
900	243	0	480	1132	0	0	0	0	0	8
950	197	0	389	918	0	0	0	0	0	9
1000	105	0	208	490	0	0	0	0	0	9
1050	40	0	80	189	0	0	0	0	0	8

All values are in counts and have been corrected for mass discrimination.

Table 8c.
v 09/06/94 87L-WC1A1 #104&105RD59 Graywacke/Slate 03:44:12 17 Sep 1994

MOLAR VALUES

Temp (°C)	$^{40}Ar^*$	$^{39}Ar_K$	$^{38}Ar_{Cl}$	$^{37}Ar_{Ca}$	$^{36}Ar_i$	Apparent Age and Precision	
550	7.712	0.600	0.004	***	0.011	120.80	2.91
575	15.038	0.778	0	***	0.002	282.73	1.20
600	21.729	0.985	0	***	***	329.30	1.15
625	14.644	0.607	0	***	***	357.31	0.53
650	32.555	1.272	0	***	***	378.87	0.85
675	41.208	1.528	0	***	0.001	396.74	0.51
700	42.447	1.543	0	***	***	404.53	0.62
725	48.544	1.787	0	***	***	399.87	0.46
750	44.324	1.681	0	***	***	389.35	0.59
800	62.165	2.464	0	***	0.001	374.33	0.45
850	56.147	2.156	0	***	0.001	385.03	0.42
900	52.970	1.689	0	***	0.001	454.18	0.63
950	51.653	1.370	0	***	0.001	533.46	0.90
1000	33.926	0.732	0	***	0.001	634.54	1.49
1050	15.053	0.282	0.001	***	0.001	710.05	1.88

All gas quantities are in moles x 10^{-12}.
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
*** Below the detection Limit of the mass spectrometer.

Table 8d.
v 09/06/94 87L-WC1A1 #104&105RD59 Graywacke/Slate 03:44:12 17 Sep 1994

Temp (°C)	Percent ^{39}Ar of Total	Radiogenic Yield (%)	$^{39}Ar_K$	$^{40}Ar_R/^{39}Ar_K$	Apparent K/Ca	Apparent K/Cl	Apparent Age and Precision	
			87L-WC1A1 #104&105RD59 Graywacke/Slate					
	J = .009176 ± 0.5					Sample wt. = .4036 g		
550	3.1	58.7	0.600	7.548	***	380	120.80	2.91
575	4.0	95.6	0.778	18.491	***	***	282.73	1.20
600	5.1	98.9	0.985	21.824	***	***	329.30	1.15
625	3.1	98.9	0.607	23.871	***	***	357.31	0.53
650	6.5	99.5	1.272	25.468	***	***	378.87	0.85
675	7.8	99.4	1.528	26.807	***	***	396.74	0.51
700	7.9	99.6	1.543	27.394	***	***	404.53	0.62
725	9.2	99.5	1.787	27.043	***	***	399.87	0.46
750	8.6	99.6	1.681	26.252	***	***	389.35	0.59
800	12.7	99.6	2.464	25.130	***	***	374.33	0.45
850	11.1	99.6	2.156	25.928	***	***	385.03	0.42
900	8.7	99.5	1.689	31.200	***	***	454.18	0.63
950	7.0	99.4	1.370	37.498	***	***	533.46	0.90
1000	3.8	99.1	0.732	45.940	***	***	634.54	1.49
1050	1.4	98.3	0.282	52.561	***	765	710.05	1.88
Total Gas	100	98	19.471	27.386	***	23	404.42	

NO PLATEAU

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
$^{39}Ar_K$ gas quantities are in moles x 10^{-12}.
*** Below the detection Limit of the mass spectrometer.

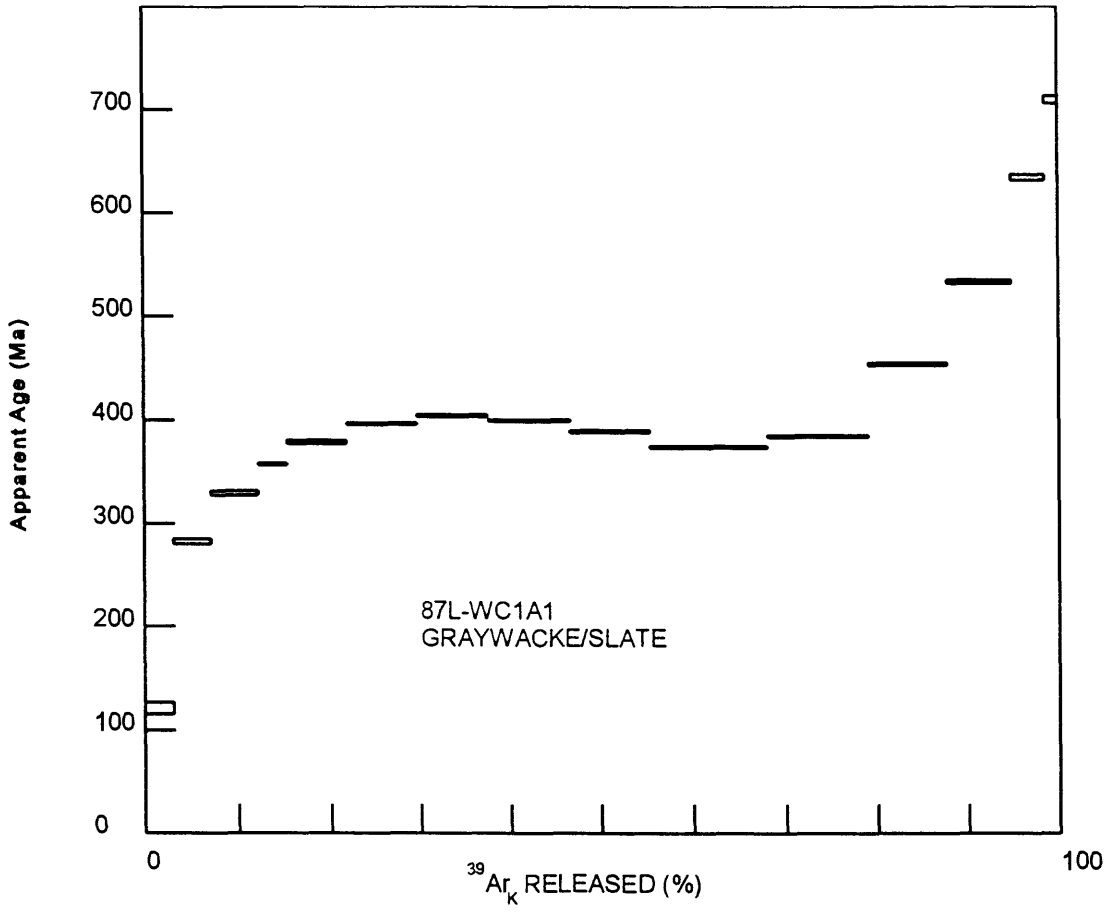

Figure 6. $^{40}Ar/^{39}Ar$ age spectrum diagram for 87L-WC1A1 graywacke/slate, #104&105 RD59.

Table 9a.
v 09/06/94 87L-WC1AZ #101 RD59 Mudstone/Slate 02:57:45 17 Sep 1994

RAW DATA

File	Temp (°C)	^{40}Ar	^{39}Ar	^{38}Ar	^{37}Ar	^{36}Ar	Trap	Manifold
22727	550	412305	29702	391	8	101	200	EALL
	±	327	33	4	9	9		
22728	575	827984	36502	393	7	31	200	EALL
	±	458	23	8	5	5		
22729	600	308275	11593	131	16	19	200	EALL
	±	187	15	3	7	2		
22730	625	579148	20827	241	4	22	200	EALL
	±	354	32	7	10	6		
22731	650	1548647	53473	557	0	32	200	EALL
	±	935	40	11	6	4		
22732	675	1760255	59969	620	17	32	200	EALL
	±	434	44	12	11	6		
22733	700	1898438	65458	665	17	35	200	EALL
	±	904	60	21	9	5		
22734	725	1825631	65009	631	5	32	200	EALL
	±	1339	61	23	19	10		
22735	750	1895596	70281	708	0	38	200	EALL
	±	770	16	16	4	6		
22736	775	1518673	57651	587	4	25	200	EALL
	±	347	52	20	5	2		
22737	800	1365091	52235	562	19	28	200	EALL
	±	529	40	6	13	4		
22738	825	1128203	42277	459	0	32	200	EALL
	±	155	23	20	17	3		
22739	850	903731	31037	372	17	25	200	EALL
	±	718	17	10	7	2		
22740	875	677770	20285	247	0	22	200	EALL
	±	285	28	2	11	3		
22741	900	512275	13508	185	21	26	200	EALL
	±	397	19	9	13	11		
22742	925	409901	9961	129	27	25	200	EALL
	±	282	16	5	15	2		
22743	950	373982	8530	117	0	27	200	EALL
	±	152	3	4	18	6		
22744	1000	380849	7855	104	0	36	200	EALL
	±	350	12	16	7	9		

All values are in counts.

Precisions are at the 1 sigma level, and are from linear regression statistics.

Trap current factors: 40 = 5.66 100 = 2.62 200 = 1

Manifold factors: All = 1, Split1 = 3.3, Split2 = 10.89, Split 3 = 35.937

EAll = 2, Esplit1 = 6.6, Esplit2 = 21.78

Sensitivity = 1.E-17 moles/count. Reproducibility limit = .25 %. Detection limit = 40 counts.

Table 9b.
v 09/06/94 87L-WC1AZ #101 RD59 Mudstone/Slate 02:57:45 17 Sep 1994

CORRECTIONS

Temp (°C)	^{39}Ar decay	^{37}Ar decay	—— ^{40}Ar	K-derived ^{38}Ar	—— ^{37}Ar	—— ^{39}Ar	Ca-derived ^{38}Ar	—— ^{36}Ar	Cl-derived ^{36}Ar	initial ^{38}Ar
550	86	20923	169	399	0	14	1	6	0	18
575	106	20632	208	491	0	14	1	5	0	5
600	34	44430	66	156	0	30	1	12	0	1
625	61	9730	119	280	0	7	0	3	0	4
650	156	0	305	719	0	0	0	0	0	6
675	175	47393	342	806	0	32	2	13	0	4
700	191	46919	373	880	0	32	1	12	0	4
725	189	14127	371	874	0	10	0	4	0	5
750	205	0	401	945	0	0	0	0	0	7
775	168	12048	329	775	0	8	0	3	0	4
800	152	53990	298	702	0	36	2	14	0	3
825	123	0	241	569	0	0	0	0	0	6
850	90	47799	177	417	0	32	2	13	0	2
875	59	0	116	273	0	0	0	0	0	4
900	39	57039	77	181	0	38	2	15	0	2
925	29	74751	57	133	0	50	2	20	0	1
950	25	0	49	115	0	0	0	0	0	5
1000	23	0	45	106	0	0	0	0	0	7

All values are in counts and have been corrected for mass discrimination.

Table 9c.
v 09/06/94 87L-WC1AZ #101 RD59 Mudstone/Slate 02:57:45 17 Sep 1994

MOLAR VALUES

Temp (°C)	$^{40}Ar^*$	$^{39}Ar_K$	$^{38}Ar_{Cl}$	$^{37}Ar_{Ca}$	$^{36}Ar_l$	Apparent Age and Precision	
550	8.243	0.596	0	0.420	0.002	198.02	1.73
575	16.556	0.733	0	0.414	***	331.38	0.74
600	6.164	0.232	0	0.891	***	384.28	2.26
625	11.581	0.418	0	0.195	***	398.28	1.97
650	30.967	1.073	0	0.000	***	414.33	0.55
675	35.198	1.203	0	0.951	***	420.57	0.78
700	37.961	1.313	0	0.941	***	415.95	0.58
725	36.505	1.305	0	0.283	***	403.63	1.24
750	37.904	1.411	0	0.000	***	388.78	0.40
775	30.367	1.157	0	0.242	***	381.19	0.37
800	27.296	1.048	0	1.083	***	379.11	0.95
825	22.559	0.849	0	0.000	***	384.16	1.45
850	18.071	0.622	0	0.959	***	417.44	0.90
875	13.553	0.407	0	0.000	***	468.78	1.94
900	10.244	0.270	0	1.144	***	526.62	4.48
925	8.197	0.199	0	1.499	***	567.29	5.33
950	7.479	0.171	0	0.000	***	587.26	7.69
1000	7.616	0.158	0	0.000	***	636.15	5.00

All gas quantities are in moles x 10^{-12}.
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
*** Below the detection Limit of the mass spectrometer.

Table 9d.
v 09/06/94 87L-WC1AZ #101 RD59 Mudstone/Slate 02:57:45 17 Sep 1994

Temp (°C)	Percent ^{39}Ar of Total	Radiogenic Yield (%)	$^{39}Ar_K$	$^{40}Ar_R/^{39}Ar_K$	Apparent K/Ca	Apparent K/Cl	Apparent Age and Precision	
87L-WC1AZ #101 RD59 Mudstone/Slate								
J = .009005 ± 0.5						Sample wt. = .2032 g		
550	4.5	93.2	0.596	12.884	0.74	7829	198.02	1.73
575	5.6	99.1	0.733	22.393	***	***	331.38	0.74
600	1.8	99.3	0.232	26.363	***	***	384.28	2.26
625	3.2	99.0	0.418	27.434	***	***	398.28	1.97
650	8.2	99.4	1.073	28.671	***	***	414.33	0.55
675	9.1	99.7	1.203	29.156	***	***	420.57	0.78
700	10.0	99.6	1.313	28.797	***	***	415.95	0.58
725	9.9	99.5	1.305	27.846	***	***	403.63	1.24
750	10.7	99.4	1.411	26.706	***	***	388.78	0.40
775	8.8	99.6	1.157	26.129	***	***	381.19	0.37
800	8.0	99.7	1.048	25.97	***	***	379.11	0.95
825	6.4	99.2	0.849	26.354	***	***	384.16	1.45
850	4.7	99.6	0.622	28.913	***	***	417.44	0.90
875	3.1	99.0	0.407	32.953	***	***	468.78	1.94
900	2.1	99.4	0.270	37.645	***	6824	526.62	4.48
925	1.5	99.6	0.199	41.035	***	***	567.29	5.33
950	1.3	97.8	0.171	42.728	***	2746	587.26	7.69
1000	1.2	97.2	0.158	46.953	***	3942	636.15	5.00
Total Gas	100.0	99.1	13.166	27.621	0.77	577	400.71	

NO PLATEAU

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.
$^{39}Ar_K$ gas quantities are in moles x 10^{-12}.
*** Below the detection Limit of the mass spectrometer.

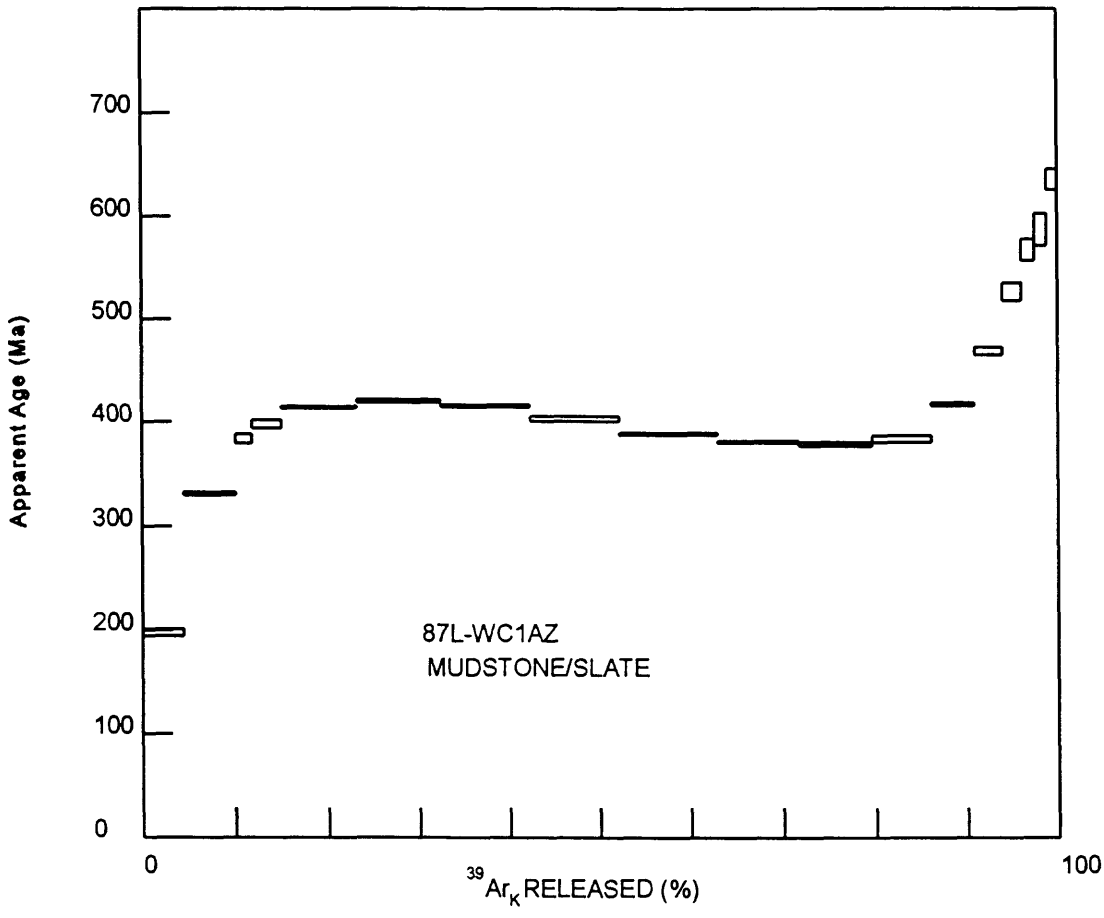

Figure 7. $^{40}Ar/^{39}Ar$ age spectrum diagram for 87L-WC1AZ mudstone/slate #101 RD 59.

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