

ATTACHMENT NO. 4

K-Ar AGE DETERMINATIONS OF SEVEN
SAMPLES RELATED TO THE INFERRED PORTSMOUTH FAULT

GEOCHRON LABORATORIES DIVISION

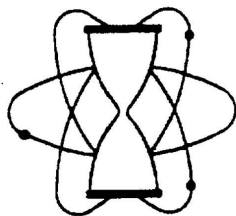
KRUEGER ENTERPRISES, INC.

CAMBRIDGE, MASSACHUSETTS

for

WESTON GEOPHYSICAL RESEARCH, INC.

WESTBORO, MASSACHUSETTS



KRUEGER ENTERPRISES, INC.

GEOCHRON LABORATORIES DIVISION

24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

20 August 1974

Richard J. Holt
Weston Geophysical Res. Inc.
P.O. Box 550
Westboro, MA 01581

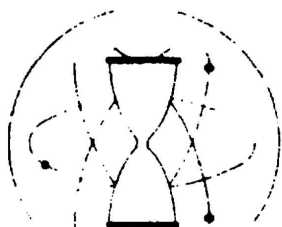
Dear Mr. Holt:

Enclosed are the analytical reports Mr. Rand requested. They are B-1236, B-1237 and B-1238 which were submitted for analyses on 20 January 1969.

Please forward these reports to Mr. Rand and if we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

Derreth McStowe
Office Manager



KRUEGER ENTERPRISES, INC.

GEOCHRON LABORATORIES DIVISION

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POTASSIUM-ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. B-1236

Date Received: 20 January 1969

Your Reference: B2 129.5

Date Reported: 31 January 1969

Submitted by: Ed Levine
Weston Geophysical Research Inc.
P.O. Box 364
Weston, MA

Sample Description & Locality:

Newburyport quartz diorite, biotite-bearing phase, drill core B2,
Seabrook, N.H.

Material Analyzed:

Biotite concentrate, -20/+100 mesh

$Ar^{40*}/K^{40} = 0.0186$

AGE = $294 (\pm 9) \times 10^6$ yrs.

Argon Analyses:

Ar^{40*} , ppm.	$Ar^{40*}/\text{Total } Ar^{40}$	Ave. Ar^{40*} , ppm.
0.1431	0.950	0.1432
0.1432	0.953	

Potassium Analyses:

% K	Ave. %K	K^{40} , ppm
6.295	6.306	7.693
6.316		

Constants Used:

$\lambda_{\beta} = 4.72 \times 10^{-10}$ / year

$\lambda_e = 0.585 \times 10^{-10}$ / year

$K^{40}/K = 1.22 \times 10^{-4}$ g./g.

$$AGE = \frac{1}{\lambda_{\beta} + \lambda_e} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40} .

M.Y. refers to millions of years.



24 Blackstone Street, Cambridge, Mass. 02138
Telephone: TWenbridge 8-8601

REPORT OF ANALYTICAL WORK

POTASSIUM-ARGON AGE DETERMINATION

Our Sample No. **B-1237**
Your Reference: **ME # 93**

Date Received: **20 January 1969**
Date Reported: **31 January 1969**

Submitted by:
Mr. M. Levine
Wentworth Geological Research, Inc.
P. O. Box 364
Wentworth, Mass.

Sample Description & Locality:

**Biotite-rich metasediment of the Merrimack Group,
Drill Core ME #4, 93', Seabrook, N. H.**

Material Analyzed:

**Biotite concentrate, -60/+200 mesh. The biotite was too fine
grained to be completely free grains, therefore, a concentrate of
the most biotite-rich grains was used. Estimated 70-80% biotite.**

$Ar^{40*}/K^{40} = 0.0159$

AGE = **254 (29) x 10⁶ years.**

Argon Analyses:

Ar^{40*} , ppm.	$Ar^{40*}/Total\ Ar^{40}$	Ave. Ar^{40*} , ppm.
0.0483	0.892	
0.0483	0.897	0.0483

Potassium Analyses:

% K	Ave. %K	K^{40} , ppm
2.430		
2.542	2.486	3.033

Constants Used:

$\lambda_{\beta} = 4.72 \times 10^{-10}/\text{year}$

$\lambda_e = 0.585 \times 10^{-10}/\text{year}$

$K^{40}/K = 1.22 \times 10^{-4} \text{ g/g.}$

$$AGE = \frac{1}{\lambda_e + \lambda_{\beta}} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40}



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REPORT OF ANALYTICAL WORK

POTASSIUM-ARGON AGE DETERMINATION

Our Sample No. **B-1238**

Date Received: **20 January 1969**

Your Reference: **B9 12.3°**

Date Reported: **21 January 1969**

Submitted by:

**Mr. M. Levine
Boston Geophysical Ass., Inc.
P. O. Box 364
Boston, Mass.**

Sample Description & Locality:

Miotite phase of Newburyport Quartz Diorite, Drill core B9, Brookline, M.H. Coarse-grained diorite in igneous contact with dark, fine-grained rock.

Material Analyzed: Miotite concentrate. -40/+100 mesh, from coarse igneous phase. Fresh biotite, 7%; Chlorite, 15%; Amphibole, 10%.

$\text{Ar}^{40}/\text{K}^{40} = 0.0179$

AGE = 284 (29) $\times 10^6$ years.

Argon Analyses:

Ar^{40} , ppm.	$\text{Ar}^{40}/\text{Total Ar}^{40}$	Ave. Ar^{40} , ppm.
0.0854	0.935	
0.0904*	0.917	0.0857
0.0860		

(*Poor gas sample - not used in age calculation).

Potassium Analyses:

% K	Ave. %K	K^{40} , ppm
3.998		
	3.933	4.798
3.868		

Constants Used:

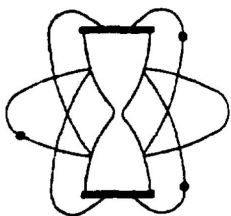
$\lambda_\beta = 4.72 \times 10^{-10}$ / year

$\lambda_e = 0.585 \times 10^{-10}$ / year

$\text{K}^{40}/\text{K} = 1.22 \times 10^{-4}$ g./g.

$$\text{AGE} = \frac{1}{\lambda_e + \lambda_\beta} \ln \left[\frac{\lambda_\beta + \lambda_e}{\lambda_e} \times \frac{\text{Ar}^{40}}{\text{K}^{40}} + 1 \right]$$

Note: Ar^{40} refers to radiogenic Ar^{40} .



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19 August 1974

Richard J. Holt
Weston Geophysical Res. Inc.
P.O. Box 550
Westboro, MA 01581

Dear Mr. Holt:


Enclosed are the analytical reports of the K-Ar age determinations on the seven (7) rock samples described in John Rand's letter of 18 July 1974.

These samples were a little difficult to work with because of the type of materials, however we did the best we could with them. The measured K-Ar ages are about what I would expect for these rocks.

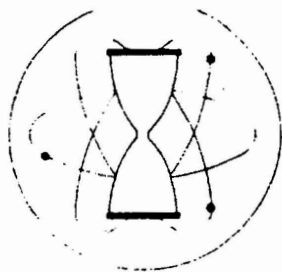
I will be away for a few days, but Hal Krueger will be here. I have discussed these results with him, and he is quite familiar with the geology of the area in question and with the work we did for you in this area several years ago. He will be happy to discuss these results with you in greater detail if you care to give him a call.

In the meantime, I am enclosing our invoice for this work. We look forward to serving you again in the near future.

Sincerely,


Richard H. Reesman
General Manager *R.H.*

RHR/dm
nelc: 7 reports & invoice #4473
cc: J.R. Rand (letter)



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POTASSIUM-ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. B-2882

Date Received: 22 July 1974

Your Reference: PF - S1

Date Reported: 16 August 1974

Submitted by: Richard J. Holt
Weston Geophysical Res., Inc.
P.O. Box 550
Westboro, MA 01581

Sample Description & Locality: Kittery quartzite
Towle Road, Hampton-Exeter Expressway
Hampton, New Hampshire

Material Analyzed: Chloritized biotite concentrate, -80/+200 mesh.

$Ar^{40*}/K^{40} = .01687$

AGE = 268 ± 10 M.Y.

Argon Analyses:

Ar^{40*} , ppm.	$Ar^{40*}/\text{Total } Ar^{40}$	Ave. Ar^{40*} , ppm.
.06717	.834	.06653
.06588	.862	

Potassium Analyses:

% K	Ave. %K	K^{40} , ppm
3.224	3.233	3.944
3.242		

Constants Used:

$\lambda_{\beta} = 4.72 \times 10^{-10} / \text{year}$

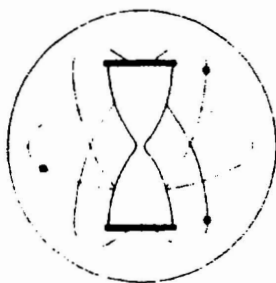
$\lambda_e = 0.585 \times 10^{-10} / \text{year}$

$K^{40}/K = 1.22 \times 10^{-4} \text{ g./g.}$

$$\text{AGE} = \frac{1}{\lambda_e + \lambda_{\beta}} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40} .

M.Y. refers to millions of years.



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POTASSIUM-ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. A-2883

Date Received: 22 July 1974

Your Reference: PF - S2

Date Reported: 16 August 1974

Submitted by: Richard J. Holt
Weston Geophysical Res., Inc.
P.O. Box 550
Westboro, MA 01581

Sample Description & Locality: Rye fm. feldspathic quartzite
Winnicut Road, Route 151
North Hampton, New Hampshire

Material Analyzed: Amphibole concentrate, -80/+200 mesh. Estimated composition:
95% gray-black amphibole, 5% adhering groundmass.

$Ar^{40*}/K^{40} = .01960$

AGE = 308 ± 14 M.Y.

Argon Analyses:

Ar^{40*} , ppm.	$Ar^{40*}/Total\ Ar^{40}$	Ave. Ar^{40*} , ppm.
.01794	.674	.01773
.01752	.668	

Potassium Analyses:

% K	Ave. %K	K^{40} , ppm
.752	.741	.904
.731		

Constants Used:

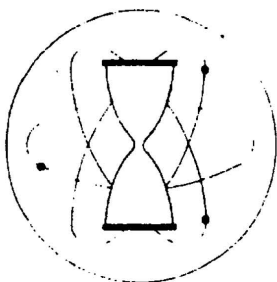
$\lambda_{\beta} = 4.72 \times 10^{-10}/\text{year}$

$\lambda_e = 0.585 \times 10^{-10}/\text{year}$

$K^{40}/K = 1.22 \times 10^{-4} \text{ g./g.}$

$$AGE = \frac{1}{\lambda_e + \lambda_{\beta}} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40} .
M.Y. refers to millions of years.



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POTASSIUM-ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. M-2884

Date Received: 22 July 1974

Your Reference: PF - S3

Date Reported: 16 August 1974

Submitted by: Richard J. Holt
Weston Geophysical Research Inc.
P.O. Box 550
Westboro, MA 01581

Sample Description & Locality: Rye fm. feldspathic gneiss
Route 1 Bypass, Lafayette Road
Portsmouth, New Hampshire

Material Analyzed: Muscovite concentrate, -80/+200 mesh. Estimated composition:
90% muscovite, 5% biotite, 5% quartz and feldspar.

$Ar^{40}*/K^{40} = .01864$

AGE = 294 ± 10 M.Y.

Argon Analyses:

$Ar^{40}*$, ppm.	$Ar^{40}*/Total\ Ar^{40}$	Ave. $Ar^{40}*$, ppm.
.1522	.852	.1500
.1478	.782	

Potassium Analyses:

% K	Ave. %K	K^{40} , ppm
6.563	6.597	8.048
6.631		

Constants Used:

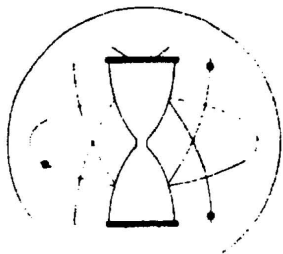
$$\lambda_{\beta} = 4.72 \times 10^{-10} / \text{year}$$

$$\lambda_e = 0.585 \times 10^{-10} / \text{year}$$

$$K^{40}/K = 1.22 \times 10^{-4} \text{ g./g.}$$

$$AGE = \frac{1}{\lambda_e + \lambda_{\beta}} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40}*}{K^{40}} + 1 \right]$$

Note: $Ar^{40}*$ refers to radiogenic Ar^{40} .
M.Y. refers to millions of years.



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POTASSIUM-ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. M-2885

Date Received: 22 July 1974

Your Reference: PF - S4

Date Reported: 16 August 1974

Submitted by: Richard J. Holt
Weston Geophysical Res., Inc.
P.O. Box 550
Westboro, MA 01581

Sample Description & Locality: Rye fm. feldspathic quartzite
Route 1 Bypass, Greenleaf Road
Portsmouth, New Hampshire

Material Analyzed: Concentrate of fine-grained mica-quartz aggregates, -80/+200 mesh.

$Ar^{40*}/K^{40} = .01645$

AGE = 262 ± 11 M.Y.

Argon Analyses:

Ar^{40*} , ppm.	$Ar^{40*}/Total\ Ar^{40}$	Ave. Ar^{40*} , ppm.
.02042	.625	.02046
.02049	.645	

Potassium Analyses:

% K	Ave. %K	K^{40} , ppm
1.015	1.019	1.243
1.023		

Constants Used:

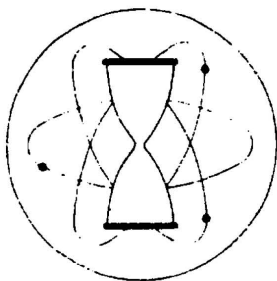
$\lambda_{\beta} = 4.72 \times 10^{-10}/\text{year}$

$\lambda_e = 0.585 \times 10^{-10}/\text{year}$

$K^{40}/K = 1.22 \times 10^{-4} \text{ g./g.}$

$$AGE = \frac{1}{\lambda_e + \lambda_{\beta}} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40} .
M.Y. refers to millions of years.



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POTASSIUM-ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. A-2886

Date Received: 22 July 1974

Your Reference: SRF - S1

Date Reported: 16 August 1974

Submitted by: Richard J. Holt
Weston Geophysical Res., Inc.
P.O. Box 550
Westboro, MA 01581

Sample Description & Locality: Diorite
Scotland Road, Interstate 95
Newbury, Massachusetts

Material Analyzed: Amphibole concentrate, -80/+200 mesh. Estimated composition:
85% amphibole, 10% biotite, 5% chlorite.

$Ar^{40*}/K^{40} = .02764$

AGE = 422 ± 17 M.Y.

Argon Analyses:

Ar ^{40*} , ppm.	Ar ^{40*} / Total Ar ⁴⁰	Ave. Ar ^{40*} , ppm.
.03714	.807	.03892
.04070	.389	

Potassium Analyses:

% K	Ave. %K	K ⁴⁰ , ppm
1.154	1.154	1.407
1.154		

Constants Used:

$\lambda_{\beta} = 4.72 \times 10^{-10} / \text{year}$

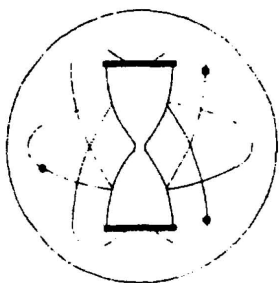
$\lambda_e = 0.585 \times 10^{-10} / \text{year}$

$K^{40}/K = 1.22 \times 10^{-4} \text{ g./g.}$

$$AGE = \frac{1}{\lambda_e + \lambda_{\beta}} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar⁴⁰.

M.Y. refers to millions of years.



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POTASSIUM-ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. A-2887

Date Received: 22 July 1974

Your Reference: SRF - S2

Date Reported: 16 August 1974

Submitted by: Richard J. Holt
Weston Geophysical Res., Inc.
P.O. Box 550
Westboro, MA 01581

Sample Description & Locality: Schist
Highfield Road, Abandoned RR grade
Newbury, Massachusetts

Material Analyzed: Chlorite - amphibole concentrate, -80/+200 mesh. Estimated composition: 40% amphibole, 60% chlorite.

$Ar^{40*}/K^{40} = .01932$

AGE = 304 ± 15 M.Y.

Argon Analyses:

Ar^{40*} , ppm.	$Ar^{40*}/Total\ Ar^{40}$	Ave. Ar^{40*} , ppm.
.01162	.381	.01149
.01136	.548	

Potassium Analyses:

% K	Ave. %K	K^{40} , ppm
.492	.487	.594
.483		

Constants Used:

$\lambda_{\beta} = 4.72 \times 10^{-10}/\text{year}$

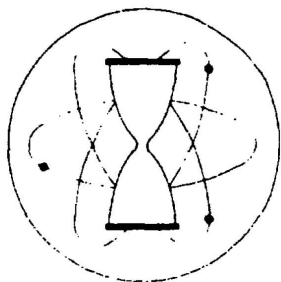
$\lambda_e = 0.585 \times 10^{-10}/\text{year}$

$K^{40}/K = 1.22 \times 10^{-4} \text{ g./g.}$

$$AGE = \frac{1}{\lambda_e + \lambda_{\beta}} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40} .

M.Y. refers to millions of years.



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POTASSIUM-ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. B-2888

Date Received: 22 July 1974

Your Reference: SRF - S3

Date Reported: 16 August 1974

Submitted by: Richard J. Holt
Weston Geophysical Res., Inc.
P.O. Box 550
Westboro, MA 01581

Sample Description & Locality: Newburyport granodiorite
Parker Street, Little River area
Newburyport, Massachusetts

Material Analyzed: Chlorite-biotite concentrate, -80/+200 mesh. Estimated
composition: 70% chloritized biotite, 30% quartz.

$Ar^{40*}/K^{40} = .01860$

AGE = 294 ± 20 M.Y.

Argon Analyses:

Ar ^{40*} , ppm.	Ar ^{40*} / Total Ar ⁴⁰	Ave. Ar ^{40*} , ppm.
.005765	.325	.005548
.005330	.370	

Potassium Analyses:

% K	Ave. %K	K ⁴⁰ , ppm
.245	.244	.298
.244		

Constants Used:

$\lambda_{\beta} = 4.72 \times 10^{-10} / \text{year}$

$\lambda_e = 0.585 \times 10^{-10} / \text{year}$

$K^{40}/K = 1.22 \times 10^{-4} \text{ g./g.}$

$$AGE = \frac{1}{\lambda_e + \lambda_{\beta}} \ln \left[\frac{\lambda_{\beta} + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar⁴⁰.

M.Y. refers to millions of years.