Ar/Ar geochronology/thermochronology activities

1. Rearrange the following equation to solve for t:

$^{40}Ar^* = 0.1048\ ^{40}K\ (e^{\lambda t} - 1)$

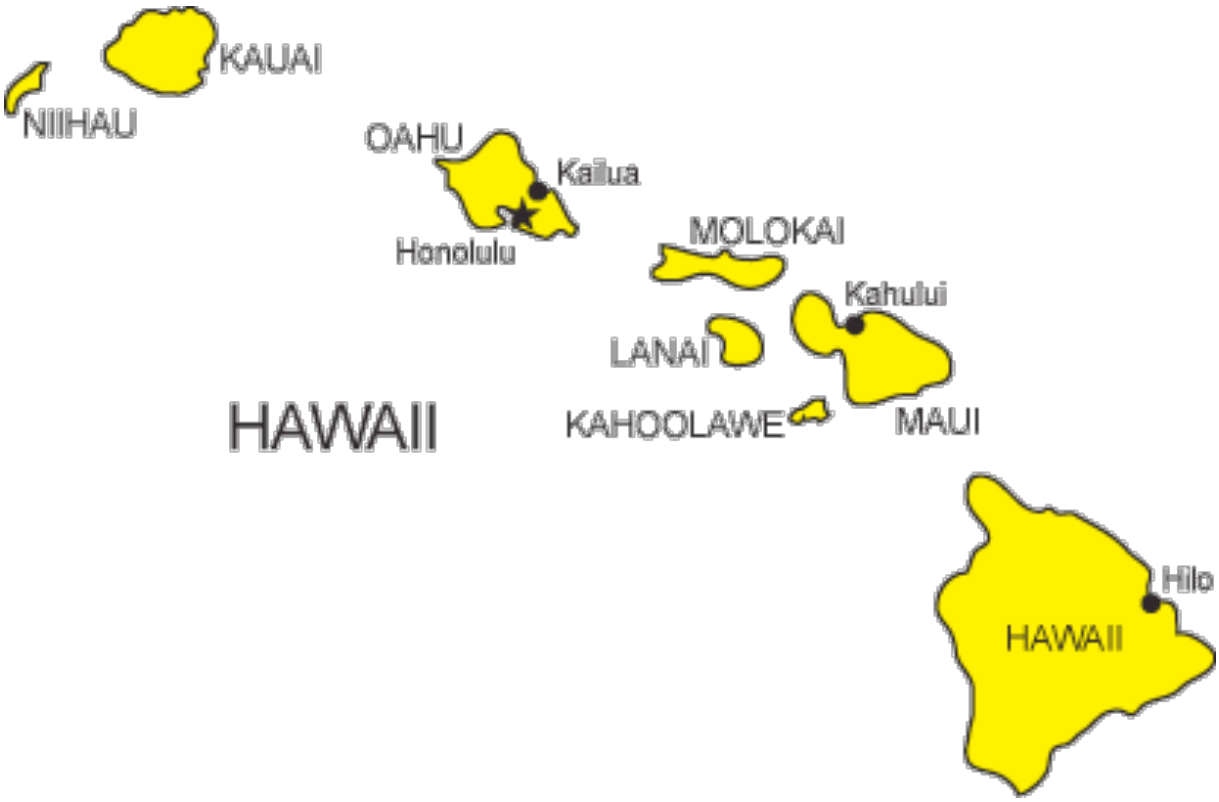
($^{40}Ar^*$ is the radiogenic ^{40}Ar produced by the decay of ^{40}K. The constant 0.1048 is the branching ratio (most ^{40}K decays to ^{40}Ca).

2. What is $1/\lambda$ in Ma? $\lambda = 5.543 \times 10^{-10}\ a^{-1}$

3. Calculate the K-Ar age range for each Hawaiian Island: (Use a spreadsheet)

Island	**$^{40}Ar/^{40}K$ max**	**$^{40}Ar/^{40}K$ min**	**Age in Ma?**
Kauai	3.34×10^{-4}	2.22×10^{-4}	
W Oahu	2.14×10^{-4}	1.60×10^{-4}	
East Oahu	1.30×10^{-4}	1.50×10^{-4}	
W Molokai	1.08×10^{-4}	--	
E Molokai	8.81×10^{-5}	7.74×10^{-5}	
W Maui	7.68×10^{-5}	6.77×10^{-5}	
E Maui	4.86×10^{-5}	--	

$t = 1804.077 \ln [(^{40}Ar/0.1048\ ^{40}K) + 1]$



4. How many ^{40}K atoms are there for every ^{39}K?

- Every ^{39}Ar forms from a ^{39}K
  - ^{39}K (stable; 93.2581%)
  - ^{40}K (radioactive; 0.0117%)

5. Which minerals are these?

Formula
$KAl_3Si_3O_{10}(OH)_2$
$K(Mg,Fe)_3AlSi_3O_{10}(F,OH)_2$

$(K,Na)_{0-1}(Ca,Na,Fe,Mg)_2(Mg,Fe,Al)_5(Al,Si)_8O_{22}(OH)_2$
$KAlSi_3O_8$
$(K,Na)AlSi_3O_8$ - $CaAl_2Si_2O_8$
$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$

6. Calculate the following J values:

J = exp (λt) -1 / R where R = $^{40}Ar^*/^{39}Ar$

Standard	t (Ma)	Age ref	R	J?
GA 1550	99.738	Renne et al 2011	0.9361	
GA 1550	99.738	Renne et al 2011	0.6752	
FCT	29.305	Renne et al 2010	1.112	

7. Calculate the ages of the following data:

First, correct ^{40}Ar, ^{39}Ar and ^{36}Ar for blank (background)
Correct ^{40}Ar for atmosphere ($^{40}Ar/^{36}Ar$ = 278.56)
Calculate $^{40}Ar^*/^{39}Ar$

Calculate age

$t = 1/\lambda \ln (1 + JR)$

$J = 0.008733$

Grain	^{40}Ar	^{39}Ar	^{36}Ar
1	2.80241	0.10112	0.000069
2	1.64699	0.05999	0.000029
3	4.63017	0.17070	0.000009
4	1.16425	0.04235	0.000049
5	2.54924	0.09347	0.000019
6	1.29521	0.04536	0.000039
7	2.31139	0.08456	0.000049
8	5.03872	0.18459	0.000059
9	2.32016	0.08485	0.000059
10	7.54618	0.28182	0.000039
Blank	0.002958	0.000015	0.000012