Ar/Ar geochronology/thermochronology activities

1. Rearrange the following equation to solve for t:

 40Ar\* = 0.1048 40K (*e*λt -1)

(40Ar\* is the radiogenic 40Ar produced by the decay of 40K.

The constant 0.1048 is the branching ratio (most 40K decays to 40Ca).

2. What is 1/λ in Ma? λ=5.543 x 10-10 a-1

3. Calculate the K-Ar age range for each Hawaiian Island:

(Use a spreadsheet)

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

t = 1804.077 ln [ (40Ar/0.1048 40K) +1 ]



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

* Every 39Ar forms from a 39K
	+ 39K (stable; 93.2581%)
	+ 40K(radioactive; 0.0117%)

5. Which minerals are these?

|  |
| --- |
| **Formula** |
| KAl3Si3O10(OH)2 |
| K(Mg,Fe)3AlSi3O10(F,OH)2 |
| (K,Na)0-1(Ca,Na,Fe,Mg)2(Mg,Fe,Al)5(Al,Si)8O22(OH)2 |
| KAlSi3O8 |
| (K,Na)AlSi3O8- CaAl2Si2O8 |
| (K,H3O)(Al,Mg,Fe)2(Si,Al)4O10[(OH)2,(H2O)] |

6. Calculate the following J values:

J = exp (λt) -1 / R where R = 40Ar\*/39Ar

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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 40Ar, 39Ar and 36Ar for blank (background)

Correct 40Ar for atmosphere (40Ar/36Ar = 278.56)

Calculate 40Ar\*/39Ar

Calculate age

t= 1/λ ln (1 + JR)

J = 0.008733

|  |  |  |  |
| --- | --- | --- | --- |
| **Grain** | **40Ar** | **39Ar** | **36Ar** |
| 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 |