

Package ‘PbIso’

August 12, 2021

Title Common calculations for Pb isotope data

Version 0.0.0.9000

Description Calculates commonly used Pb isotope values such as model age, model source mu, time-integrated kappa, initial Pb isotope ratios. Includes functions for generating model curve data.

License `use_gpl3_license()`

Encoding UTF-8

LazyData true

Roxygen list(markdown = TRUE)

RoxygenNote 7.1.1

URL <https://github.com/shereearmistead/PbIso>

BugReports <https://github.com/shereearmistead/PbIso/issues>

Depends R (>= 2.10)

NeedsCompilation no

Author Sheree Armistead [aut, cre] (<<https://orcid.org/0000-0002-9614-3553>>)

Maintainer Sheree Armistead <sheree.armistead@gmail.com>

R topics documented:

Calc64	2
Calc64in	2
Calc74	3
Calc74in	4
Calc84	5
Calc84in	5
CalcKa	6
CalcModAge	7
CalcMu	8
geochron76slope	8
geochron76yint	9
geochron86slope	10
geochron86yint	10
modelcurve	11
mslope	12
Index	13

 Calc64

Calculate the 206Pb/204Pb ratio

Description

This function calculates the 206Pb/204Pb ratio for a given time, either by using Stacey & Kramers (1975) 2nd stage model parameters as default, or by setting optional arguments.

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model.
Calc64(t, ...)

# Advanced usage with optional arguments
Calc64(t, T1, X1, Mu1, L8)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Mu1	238U/204Pb model. Default is 9.74
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma
Calc64(2700)

# Example of using optional arguments based on Stacey & Kramers (1975) 1st stage model
Calc64(2700, T1 = 4570, X1 = 9.307, Mu1 = 7.19)

# Example of using the optional argument for Mu1 = 8 only, and accepting the other defaults
Calc64(2700, Mu1 = 8)
```

 Calc64in

Calculate the initial 206Pb/204Pb ratio

Description

This function calculates the initial 206Pb/204Pb for a sample with a known age (t), measured 206Pb/204Pb (x) and measured 207Pb/204Pb (y) ratios

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model
Calc64in(t, x, y, ...)

# Advanced usage with optional arguments
Calc64in(t, x, y, T1, X1, Y1, U8U5, L5, L8)
```

Arguments

t	sample age or time (Ma)
x	sample $^{206}\text{Pb}/^{204}\text{Pb}$ ratio
y	sample $^{207}\text{Pb}/^{204}\text{Pb}$ ratio
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	$^{206}\text{Pb}/^{204}\text{Pb}$ model starting composition. Default is 11.152
Y1	$^{207}\text{Pb}/^{204}\text{Pb}$ model starting composition. Default is 12.998
U8U5	Present-day $^{238}\text{U}/^{235}\text{U}$ ratio. Default is 137.88
L5	^{235}U decay constant. Default is 9.8485×10^{-10}
L8	^{238}U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma, measured
#  $^{206}\text{Pb}/^{204}\text{Pb} = 13.5$  and  $^{207}\text{Pb}/^{204}\text{Pb} = 14.5$ 
Calc64in(2700, 13.5, 14.5)

# Example of using additional optional arguments based on Stacey & Kramers (1975) 1st stage model
Calc64in(2700, 13.5, 14.5, T1 = 4570, X1 = 9.307, Y1 = 10.294)
```

Calc74

*Calculate the $^{207}\text{Pb}/^{204}\text{Pb}$ ratio***Description**

This function calculates the $^{207}\text{Pb}/^{204}\text{Pb}$ ratio for a given time, either by using Stacey & Kramers (1975) 2nd stage model parameters as default, or by setting optional arguments.

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model
Calc74(t, ...)

# Advanced usage with optional arguments
Calc74(t, T1, Y1, Mu1, L5)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
T1	model start time (Ma). Default is 3700
Y1	$^{207}\text{Pb}/^{204}\text{Pb}$ model starting composition. Default is 12.998
Mu1	$^{238}\text{U}/^{204}\text{Pb}$ model. Default is 9.74
U8U5	Present-day $^{238}\text{U}/^{235}\text{U}$ ratio. Default is 137.88
L5	^{235}U decay constant. Default is 9.8485×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma
Calc74(2700)

# Example of using optional arguments based on Stacey & Kramers (1975) 1st stage model
Calc74(2700, T1 = 4570, Y1 = 10.294, Mu1 = 7.19)

# Example of using the optional argument for Mu1 = 8 only, and accepting the other defaults
Calc74(2700, Mu1 = 8)
```

Calc74in

Calculate the initial 207Pb/204Pb ratio

Description

This function calculates the initial 207Pb/204Pb for a sample with a known age (t), measured 206Pb/204Pb (x) and measured 207Pb/204Pb (y) ratios

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model
Calc74in(t, x, y, ...)

# Advanced usage with optional arguments
Calc74in(t, x, y, T1, X1, Y1, U8U5, L5, L8)
```

Arguments

t	sample age or time (Ma)
x	sample 206Pb/204Pb ratio
y	sample 207Pb/204Pb ratio
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Y1	207Pb/204Pb model starting composition. Default is 12.998
U8U5	Present-day 238U/235U ratio. Default is 137.88
L5	235U decay constant. Default is 9.8485×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma, measured
# 206Pb/204Pb = 13.5 and 207Pb/204Pb = 14.5
Calc74in(2700, 13.5, 14.5)

# Example of using additional optional arguments based on Stacey & Kramers (1975) 1st stage model
Calc74in(2700, 13.5, 14.5, T1 = 4570, X1 = 9.307, Y1 = 10.294)
```

Calc84

*Calculate the 208Pb/204Pb ratio***Description**

This function calculates the 208Pb/204Pb ratio for a given time, either by using Stacey & Kramers (1975) 2nd stage model parameters as default, or by setting optional arguments.

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model
Calc84(t, ...)

# Advanced usage with optional arguments
Calc84(t, T1, Z1, W1, L2)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
T1	model start time (Ma). Default is 3700
Z1	208Pb/204Pb model starting composition. Default is 31.23
W1	232Th/204Pb model. Default is 36.84
L2	232Th decay constant. Default is 0.49475×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma
Calc84(2700)

# Example of using optional arguments based on Stacey & Kramers (1975) 1st stage model
Calc84(2700, T1 = 4570, Z1 = 29.487, W1 = 32.21)

# Example of using the optional argument for W1 = 30 only, and accepting the other defaults
Calc84(2700, W1 = 30)
```

Calc84in

*Calculate the initial 208Pb/204Pb ratio***Description**

This function calculates the initial 208Pb/204Pb for a sample with a known age (t), measured 206Pb/204Pb (x), measured 207Pb/204Pb (y) and measured 208Pb/204Pb ratios.

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model
Calc84in(t, x, y, z, ...)

# Advanced usage with optional arguments
Calc84in(t, x, y, z, T1, X1, Y1, Z1, U8U5, L5, L8, L2)
```

Arguments

t	sample age or time (Ma)
x	sample 206Pb/204Pb ratio
y	sample 207Pb/204Pb ratio
z	sample 208Pb/204Pb ratio
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Y1	207Pb/204Pb model starting composition. Default is 12.998
Z1	208Pb/204Pb model starting composition. Default is 31.23
U8U5	Present-day 238U/235U ratio. Default is 137.88
L2	232Th decay constant. Default is 0.49475×10^{-10}
L5	235U decay constant. Default is 9.8485×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma, measured
# 206Pb/204Pb = 13.5, measured 207Pb/204Pb = 14.5 and measured 208Pb/204Pb = 33
Calc84in(2700, 13.5, 14.5, 33)

# Example of using additional optional arguments based on Stacey & Kramers (1975) 1st stage model
Calc84in(2700, 13.5, 14.5, 33, T1 = 4570, X1 = 9.307, Y1 = 10.294, Z1 = 31.23)
```

CalcKa

Calculate the time-integrated kappa

Description

This function calculates the time-integrated kappa

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model
CalcKa(t, z, x, ...)

# Advanced usage with optional arguments
CalcKa(t, z, x, T1, X1, Z1, L2, L8)
```

Arguments

t	sample age or time (Ma)
z	sample 208Pb/204Pb ratio
x	sample 206Pb/204Pb ratio
...	optional arguments

T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Z1	208Pb/204Pb model starting composition. Default is 31.23
L2	232Th decay constant. Default is 0.49475×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma, measured
# 208Pb/204Pb = 33 and measured 206Pb/204Pb = 13.5
CalcKa(2700, 33, 13.5)

# Example of using optional arguments based on Stacey & Kramers (1975) 1st stage model
CalcKa(2700, 33, 13.5, T1 = 4570, X1 = 9.307, Z1 = 31.23)
```

CalcModAge	<i>Calculates the model age</i>
------------	---------------------------------

Description

This function calculates the model age for given 206Pb/204Pb and 207Pb/204Pb ratios

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model
CalcModAge(x, y, ...)

# Advanced usage with optional arguments
CalcModAge(x, y, T1, X1, Y1, U8U5, L5, L8)
```

Arguments

x	sample 206Pb/204Pb ratio
y	sample 207Pb/204Pb ratio
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Y1	207Pb/204Pb model starting composition. Default is 12.998
U8U5	Present-day 238U/235U ratio. Default is 137.88
L5	235U decay constant. Default is 9.8485×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample with measured 206Pb/204Pb = 13.5
# and 207Pb/204Pb = 14.5
CalcModAge(13.5, 14.5)

# Example of using optional arguments based on Stacey & Kramers (1975) 1st stage model
CalcModAge(13.5, 14.5, T1 = 4570, X1 = 9.307, Y1 = 10.294)
```

CalcMu	<i>Calculates the model source mu</i>
--------	---------------------------------------

Description

This function calculates the model source Mu

Usage

```
# Basic usage accepting default model parameters for Stacey & Kramers (1975) 2nd stage model
CalcMu(t, x, y, ...)

# Advanced usage with optional arguments
CalcMu(t, x, y, T1, X1, Y1, U8U5, L5, L8)
```

Arguments

t	sample age or time (Ma)
x	sample 206Pb/204Pb ratio
y	sample 207Pb/204Pb ratio
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Y1	207Pb/204Pb model starting composition. Default is 12.998
U8U5	Present-day 238U/235U ratio. Default is 137.88
L5	235U decay constant. Default is 9.8485×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma, measured
# 206Pb/204Pb = 13.5 and 207Pb/204Pb = 14.5
CalcMu(2700, 13.5, 14.5)

# Example of using optional arguments based on Stacey & Kramers (1975) 1st stage model
CalcMu(2700, 33, 13.5, T1 = 4570, X1 = 9.307, Z1 = 31.23)
```

geochron76slope	<i>Slope of a geochron line on a 206Pb/204Pb vs 207Pb/204Pb plot for time (t)</i>
-----------------	---

Description

This function calculates the geochron slope on a 206Pb/204Pb vs 207Pb/204Pb plot for a given time (t)

Usage

```
# Calculate the geochron on a 206Pb/204Pb vs 207Pb/204Pb plot for time = 2700 Ma
geochron76slope(2700)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Y1	207Pb/204Pb model starting composition. Default is 12.998
Mu1	238U/204Pb model. Default is 9.74
U8U5	Present-day 238U/235U ratio. Default is 137.88
L5	235U decay constant. Default is 9.8485×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Calculate the geochron on a 206Pb/204Pb vs 207Pb/204Pb plot for time = 2700 Ma
geochron76slope(2700)
```

geochron76yint	<i>Y-intercept of a geochron line on a 206Pb/204Pb vs 207Pb/204Pb plot for time (t)</i>
----------------	---

Description

This function calculates the y-intercept of a geochron line on a 206Pb/204Pb vs 207Pb/204Pb plot for a given time (t)

Usage

```
# Calculate the geochron on a 206Pb/204Pb vs 207Pb/204Pb plot for time = 2700 Ma
geochron76slope(2700)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Y1	207Pb/204Pb model starting composition. Default is 12.998
Mu1	238U/204Pb model. Default is 9.74
U8U5	Present-day 238U/235U ratio. Default is 137.88
L5	235U decay constant. Default is 9.8485×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Calculate the geochron on a 206Pb/204Pb vs 207Pb/204Pb plot for time = 2700 Ma
geochron76slope(2700)
```

geochron86slope	<i>Slope of a geochron line on a 206Pb/204Pb vs 208Pb/204Pb plot for time (t)</i>
-----------------	---

Description

This function calculates the geochron slope on a 206Pb/204Pb vs 208Pb/204Pb plot for a given time (t)

Usage

```
# Calculate the geochron on a 206Pb/204Pb vs 207Pb/204Pb plot for time = 2700 Ma
geochron86slope(2700)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Z1	208Pb/204Pb model starting composition. Default is 31.23
Mu1	238U/204Pb model. Default is 9.74
W1	232Th/204Pb model. Default is 36.84
L8	238U decay constant. Default is 1.55125×10^{-10}
L2	232Th decay constant. Default is 0.49475×10^{-10}

Examples

```
# Calculate the geochron on a 206Pb/204Pb vs 207Pb/204Pb plot for time = 2700 Ma
geochron86slope(2700)
```

geochron86yint	<i>Y-intercept of a geochron line on a 206Pb/204Pb vs 208Pb/204Pb plot for time (t)</i>
----------------	---

Description

This function calculates the y-intercept of a geochron line on a 206Pb/204Pb vs 208Pb/204Pb plot for a given time (t)

Usage

```
# Calculate the geochron on a 206Pb/204Pb vs 207Pb/204Pb plot for time = 2700 Ma
geochron76slope(2700)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Z1	208Pb/204Pb model starting composition. Default is 31.23
Mu1	238U/204Pb model. Default is 9.74
W1	232Th/204Pb model. Default is 36.84
L8	238U decay constant. Default is 1.55125×10^{-10}
L2	232Th decay constant. Default is 0.49475×10^{-10}

Examples

```
# Calculate the geochron on a 206Pb/204Pb vs 207Pb/204Pb plot for time = 2700 Ma
geochron76slope(2700)
```

modelcurve

Create a dataframe with values to produce model curves

Description

This function creates a dataframe with four columns (time, 206Pb/204Pb, 207Pb/204Pb and 208Pb/204Pb ratios). These can be used for plotting model curves.

Usage

```
# Basic method accepting default model parameters for Stacey & Kramers (1975)
# 2nd stage model
modelcurve(t, ...)

# Advanced method using other values for optional parameters
modelcurve(t, T1, X1, Y1, Z1, Mu1, W1, U8U5, L5, L8, L2)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
T1	model start time (Ma). Default is 3700
X1	206Pb/204Pb model starting composition. Default is 11.152
Y1	207Pb/204Pb model starting composition. Default is 12.998
Z1	208Pb/204Pb model starting composition. Default is 31.23
Mu1	238U/204Pb model. Default is 9.74
W1	232Th/204Pb model. Default is 36.84
U8U5	Present-day 238U/235U ratio. Default is 137.88
L5	235U decay constant. Default is 9.8485×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}
L2	232Th decay constant. Default is 0.49475×10^{-10}

Examples

```
# Create a dataframe 'df' with the default Stacey & Kramers (1975) 2nd stage values
# for the time period 3700-0 Ma; which can then be used to plot a model curve
df <- modelcurve(0:3700)

# Create a dataframe 'df' with the Stacey & Kramers (1975) 1st stage model values
# over the time period 3700-0 Ma.
df <- modelcurve(0:3700, T1 = 4570, X1 = 9.307, Mu1 = 7.19)

# Create a dataframe 'df' for a model source Mu value of 8, over the time period
# 3700-0 Ma.
df <- modelcurve(0:3700, Mu1 = 8)
```

mslope

*Calculate the slope for a given sample age (t)***Description**

This function calculates the slope of a line from which samples from the same reservoir, at the same time, will fall along

Usage

```
mslope(t, ..., U8U5 = 137.88, L5 = 9.8485 * 10^-10, L8 = 1.55125 * 10^-10)
```

Arguments

t	sample age or time (Ma)
...	optional arguments
U8U5	Present-day 238U/235U ratio. Default is 137.88
L5	235U decay constant. Default is 9.8485×10^{-10}
L8	238U decay constant. Default is 1.55125×10^{-10}

Examples

```
# Example of basic method using a hypothetical sample age of 2700 Ma
mslope(2700)
```

Index

Calc64, [2](#)
Calc64in, [2](#)
Calc74, [3](#)
Calc74in, [4](#)
Calc84, [5](#)
Calc84in, [5](#)
CalcKa, [6](#)
CalcModAge, [7](#)
CalcMu, [8](#)

geochron76slope, [8](#)
geochron76yint, [9](#)
geochron86slope, [10](#)
geochron86yint, [10](#)

modelcurve, [11](#)
mslope, [12](#)