Package 'DAIME'

June 11, 2019

Type Package

Title Effects of Changing Deposition Rates

Version 1.1

Date 2019-05-16

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Description Reverse and model the effects of changing deposition rates on geological data and rates. Based on Hohmann (2018) <doi:10.13140/RG.2.2.23372.51841> .

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Depends stats, utils

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

Repository CRAN

Date/Publication 2019-06-11 04:10:03 UTC

R topics documented:

DAIME-package *Effects of Changing Deposition Rates*

Description

Reverse and model the effects of changing deposition rates on geological data and rates. Based on Hohmann (2018) <doi:10.13140/RG.2.2.23372.51841> .

Details

The DESCRIPTION file:

Package:	DAIME
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Author:	Niklas Hohmann
Maintainer:	Niklas Hohmann <Niklas.Hohmann@fau.de>
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VignetteBuilder:	knitr

Index of help topics:

Author(s)

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References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

`strattotimepointbin` *Transform Points and Isotope Ratios from Stratigraphic Height into Time (Binned)*

Description

This function takes a binned deposition rate and reconstructs at what time a given stratigraphic height was deposited.

This can be used to create age models, determine the time of deposition of single samples in the outcrop, and transform isotope ratios from stratigraphic height into time (see examples).

Usage

```
strattotimepointbin(x, binborder, depoval, hiatuslist = list(),
  unit = "sediment per time")
```

Arguments

`x`	Vector containing the stratigraphic heights whose time of deposition are to be determined
`binborder`	Vector of strictly increasing numerical values. Defines the borders of the bins in stratigraphic height
`depoval`	Strictly positive vector of length `length(binborder)-1`. Defines the deposition rate in the bins, i.e. `depoval[i]` is the deposition rate between the stratigraphic heights `binborder[i]` and `binborder[i+1]`
`hiatuslist`	OPTIONAL, default is an empty list. A list of hiatuses to insert. Every entry in the list corresponds to a hiatus, which is given as a vector of length two. The first entry of the vector is the stratigraphic height of the hiatus, the second entry is the duration of the hiatus.
`unit`	OPTIONAL, default is "sediment per time". Either "sediment per time" or "time per sediment". Determines the unit that is assumed for the input given by `depoval`.

Value

Returns a list containing

`time`	vector containing times of deposition of the stratigraphic heights given by the input `x`
`height`	vector containing the heights that were deposited at the times given by `time`. Essentially a duplicate of the input `x`

Output of `NA` in `time` indicates that some values coincide with a hiatus or are located at places where the deposition rate is undefined.

Author(s)

Niklas Hohmann

References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

See Also

For an overview of the functions in the DAIME package, see its vignette (available via `vignette("DAIME")`)

Examples

```
##define deposition rate
binborder=1:6 #bins in tratigraphic height
depoval=c(1,4,5,2,2)
usedunit="sediment per time" #unit of deposition rate is sediment per time unit (default setting)
#Plot deposition rate
plot(approx(binborder,c(depoval,tail(depoval,1)),method='constant',xout=seq(min(binborder),
  max(binborder),length.out=100)),type='l',main='Deposition Rate',xlab='Stratigraphic Height',
   ylab=usedunit,ylim=c(0,max(depoval)))

##at what time was the point with tratigraphic height 3.5 deposited?
strattotimepointbin(3.5,binborder,depoval)

##create an age model
stratheight=seq(min(binborder),max(binborder),length.out=100)
reslist=strattotimepointbin(stratheight,binborder,depoval,unit=usedunit)
#plot age model
usedunit="sediment per time"
plot(reslist$time,reslist$height,xlab='Time',ylab='Stratigraphic Height',
  main=paste('Age model with unit',usedunit))
#create age model but with other units for sedimentn input
usedunit='time per sediment'
reslist=strattotimepointbin(stratheight,binborder,depoval,unit=usedunit)
#plot age model (note the difference this setting makes)
plot(reslist$time,reslist$height,xlab='Time',ylab='Stratigraphic Height',
```

```
  main=paste('Age model with unit',usedunit))

##create age model with a hiatus
stratigraphicheight=5 #strat. height of the hiatus
duration=2 #duration of the hiatus
hiatuslist=list(c(stratigraphicheight,duration)) #required input format for hiatuses
reslist=strattotimepointbin(stratheight,binborder,depoval,hiatuslist=hiatuslist)
#!using default setting for units again!
plot(reslist$time,reslist$height,xlab='Time',ylab='stratigraphic height')

##Transform isotope ratios
depoval=c(1,4,0.1,2,2)
#create fake oxygen isotope curves
samplelocation=sort(runif(20,min=min(binborder),max=max(binborder))) #where the samples are taken
isotoperatio=sin(samplelocation)*rnorm(length(samplelocation)) #isotope ratios of the samples
plot(samplelocation,isotoperatio,type='l',xlab='Stratigraphic Height',ylab='Isotope Ratio')
#transform only (!) sample locations, NOT values
reslist=strattotimepointbin(samplelocation,binborder,depoval)
#Isotope ratios in time
plot(reslist$time,isotoperatio,type='l',xlab='Time',ylab='Isotope Ratio')
```

`strattotimepointcont` *Transform Points and Isotope Ratios from Stratigraphic Height into Time (Continuos)*

Description

This function takes a continuous deposition rate and reconstructs at what time a given stratigraphic height was deposited.

This can be used to create age models, determine the time of deposition of single samples in the outcrop, and transform isotope ratios from stratigraphic height into time (see examples).

Usage

```
strattotimepointcont(x, xdep, ydep, hiatuslist = list(), unit = "sediment per time")
```

Arguments

`x`	Vector containing the stratigraphic heights whose time of deposition are to be determined
`xdep`	Vector of strictly increasing real numbers
`ydep`	Vector of the same length of `xdep`, containing strictly positive real numbers. `xdep` and `ydep` define the deposition rate in the sense that `depositionrate=approxfun(xdep,ydep)`. The units of te deposition rate are by default `"sediment per time"` and can be changed using the optional input `unit`

`hiatuslist`	OPTIONAL, default is an empty list. A list of hiatuses to insert. Every entry in the list corresponds to a hiatus, which is given as a vector of length two. The first entry of the vector is the stratigraphic height of the hiatus, the second entry is the duration of the hiatus.
`unit`	OPTIONAL, default is "sediment per time". Either "sediment per time" or "time per sediment". Determines the unit that is assumed for the deposition rate.

Value

Returns a list containing

`time`	vector containing times of deposition of the stratigraphic heights given by the input `x`
`height`	vector containing the heights that were deposited at the times given by `time`. Essentially a duplicate of the input `x`

Output of `NA` in `time` indicates that some values coincide with a hiatus or are located at places where the deposition rate is undefined.

Author(s)

Niklas Hohmann

References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

See Also

`strattotimeratecont` for the transformation of rates from stratigraphic height into time, `timetostratpointcont` for the transformation of single samples or isotope ratios from time into stratigraphic height.

For an overview of the functions in the DAIME package, see its vignette (available via `vignette("DAIME")`)

Examples

```
##define deposition rate
xdep=seq(0,12,length.out=100)
ydep=splinefunH(x=c(0,2,4,6,8,10,12),y=c(1,5,6,1,0.5,1,6),m=c(0,1.5,-0.5,-0.5,0,0.5,0))(xdep)
#unit of deposition rate is sediment per time unit (default setting)
usedunit="sediment per time" #unit of deposition rate is sediment per time unit (default setting)
#Plot deposition rate
plot(xdep,ydep,type='l',main='Deposition Rate',xlab='Stratigraphic Height',ylab=usedunit)

##at what time was the point with tratigraphic height 9 deposited?
strattotimepointcont(9,xdep,ydep)

##create an age model
stratheight=seq(min(xdep),max(xdep),length.out=100)
```

```
usedunit="sediment per time"
reslist=strattotimepointcont(stratheight,xdep,ydep,unit=usedunit)
#plot age model
plot(reslist$time,reslist$height,xlab='Time',ylab='Stratigraphic Height',
  main=paste('Age model with unit',usedunit))
#create age model but with other units for sedimentn input
usedunit='time per sediment'
reslist=strattotimepointcont(stratheight,xdep,ydep,unit=usedunit)
#plot age model (note the difference this setting makes)
plot(reslist$time,reslist$height,xlab='Time',ylab='Stratigraphic Height',
  main=paste('Age model with unit',usedunit))

##create age model with a hiatus
stratigraphicheight=5 #strat. height of the hiatus
duration=2 #duration of the hiatus
hiatuslist=list(c(stratigraphicheight,duration)) #required input format for hiatuses
reslist=strattotimepointcont(stratheight,xdep,ydep,hiatuslist=hiatuslist)
#!using default setting for units again!
plot(reslist$time,reslist$height,xlab='Time',ylab='stratigraphic height')

##Transform isotope ratios
#create fake oxygen isotope curves
samplelocation=sort(runif(20,min=min(xdep),max=max(xdep))) #where the samples are taken
isotoperatio=sin(samplelocation)*rnorm(length(samplelocation)) #isotope ratios of the samples
plot(samplelocation,isotoperatio,type='l',xlab='Stratigraphic Height',ylab='Isotope Ratio')
#transform only (!) sample locations, NOT values
reslist=strattotimepointcont(samplelocation,xdep,ydep)
#Isotope ratios in time
plot(reslist$time,isotoperatio,type='l',xlab='Time',ylab='Isotope Ratio')
```

`strattotimeratebin` *Transform Rates from Stratigraphic Height into Time (Binned)*

Description

This function transforms a given binned stratigraphic rate/signal into the corresponding temporal rate/signal. The transformation is based on the age model constructed from the deposition rate.

This can for example be used to reconstruct the patterns of (first/last) fossil occurrences in time, given a given depositional environment.

Usage

```
strattotimeratebin(binborder, depoval, signalval, pos = NULL, hiatuslist = list(),
  unit = "sediment per time")
```

Arguments

`binborder`	Vector of strictly increasing numerical values. Defines the borders of the bins in stratigraphic height

depoval	Strictly positive vector of length length(binborder)-1. Defines the deposition rate in the bins, i.e. depoval[i] is the deposition rate between the stratigraphic heights binborder[i] and binborder[i+1]
signalval	Positive vector of length length(binborder)-1. Defines the stratigraphic rate/signal in the bins, i.e. signalval[i] is the stratigraphic between the stratigraphic heights binborder[i] and binborder[i+1]
pos	OPTIONAL. Vector of points in stratigrapic height that will be transformed into time, and where the temporal rate will evaluated. Default setting is a vector spanning the interval of interest with evenly spaced points (no. is chosen by the code)
hiatuslist	OPTIONAL, default is an empty list. A list of hiatuses to insert. Every entry in the list corresponds to a hiatus, which is given as a vector of length two. The first entry of the vector is the stratigraphic height of the hiatus, the second entry is the duration of the hiatus.
unit	OPTIONAL, default is "sediment per time". Either "sediment per time" or "time per sediment". Determines the unit that is assumed for the input given by depoval.

Value

Returns a list containing

time	vector containing times
val	vector containign the values of the temporal rate/signal at the times given by the first entry of the list

The temporal rate is then approximated by approxfun(output$time,output$val). Output of NA indicates that some values coincide with a hiatus or are located at places where the deposition rate/stratigraphic rate are undefined.

Author(s)

Niklas Hohmann

References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

See Also

For an overview of the functions in the DAIME package, see its vignette (available via vignette("DAIME"))

Examples

```
##define deposition rate and stratigraphic rate
binborder=1:6 #bins in tratigraphic height
depoval=c(1,4,0.1,2,2)
usedunit="sediment per time" #unit of deposition rate is sediment per time unit (default setting)
#Plot deposition rate
plot(approx(binborder,c(depoval,tail(depoval,1)),method='constant',
  xout=seq(min(binborder),max(binborder),length.out=100)),type='l',main='Deposition Rate',
   xlab='Stratigraphic Height',ylab=usedunit,ylim=c(0,max(depoval)))
#define stratigraphic rate
signalval=c(runif(5))
#plot stratigraphic rate
plot(approx(binborder,c(signalval,tail(signalval,1)),method='constant',
  xout=seq(min(binborder),max(binborder),length.out=100)),type='l',main='Deposition Rate',
   xlab='Stratigraphic Height', ylab='Stratigraphic Rate',ylim=c(0,max(signalval)))

##transform stratigraphic rate into temporal rate
usedunit="sediment per time" #unit of deposition rate is sediment per time unit (default setting)
reslist=strattotimeratebin(binborder,depoval, signalval,unit=usedunit)
#plot results
plot(reslist$time,reslist$val,xlab='time',ylab='temporal rate',
  main=paste('depoval interpreted as',usedunit))
usedunit="time per sediment" #use other input interpretation
reslist=strattotimeratebin(binborder,depoval, signalval,unit=usedunit)
#note how different the results look!!
plot(reslist$time,reslist$val,xlab='time',ylab='temporal rate',
  main=paste('depoval interpreted as',usedunit))

##insert a hiatus
stratigraphicheight=3.5 #strat. height of the hiatus
duration=2 #duration of the hiatus
hiatuslist=list(c(stratigraphicheight,duration)) #required input format for hiatuses
#usedunit is back to default setting!
reslist=strattotimeratebin(binborder,depoval, signalval,hiatuslist=hiatuslist)
#the hiatus corresponds to the gap  in the middle of the temporal rate
plot(reslist$time,reslist$val,xlab='time',ylab='temporal rate')
```

---

strattotimeratecont *Transform Rates from Stratigraphic Height into Time (Continuous)*

Description

This function transforms a given continuous stratigraphic rate/signal into the corresponding temporal rate/signal. The transformation is based on the age model constructed from the deposition rate.

This can for example be used to reconstruct the patterns of (first/last) fossil occurrences in time, given a given depositional environment.

Usage

```
strattotimeratecont(xdep, ydep, xsig, ysig, pos = NULL,   hiatuslist = list(),
  unit = "sediment per time")
```

Arguments

xdep	Vector of strictly increasing real numbers
ydep	Vector of the same length of xdep, containing strictly positive real numbers. xdep and ydep define the deposition rate in the sense that depositionrate=approxfun(xdep,ydep). The units of te deposition rate are by default "sediment per time" and can be changed using the optional input unit
xsig	Vector of strictly increasing real numbers
ysig	Vector of the same length of xsig, containing positive real numbers. xsig and ysig define the stratigraphic rate in the sense that stratigraphicrate=approxfun(xsig,ysig).
pos	OPTIONAL. Vector of points in stratigrapic height that will be transformed into time, and determine where the temporal rate is evaluated. Default setting is a vector spanning the interval of interest with evenly spaced points (no. is chosen by the code)
hiatuslist	OPTIONAL, default is an empty list. A list of hiatuses to insert. Every entry in the list corresponds to a hiatus, which is given as a vector of length two. The first entry of the vector is the stratigraphic height of the hiatus, the second entry is the duration of the hiatus.
unit	OPTIONAL, default is "sediment per time". Either "sediment per time" or "time per sediment". Determines the unit that is assumed for the deposition rate.

Value

Returns a list containing

time	vector containing times
val	vector containign the values of the temporal rate/signal at the times given by the first entry of the list

The temporal rate is then approximated by approxfun(output$time,output$val). Output of NA indicates that some values coincide with a hiatus or are located at places where the deposition rate/stratigraphic rate are undefined.

Author(s)

Niklas Hohmann

References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

See Also

timetostratratecont for the transformation of rates from time into stratigraphic height, strattotimepointcont for the transformation of single samples or isotope ratios from stratigraphic height into time.

For an overview of the functions in the DAIME package, see its vignette (available via `vignette("DAIME")`)

Examples

```
##define deposition rate and stratigraphic rate
xdep=seq(0,12,length.out=100)
ydep=splinefunH(x=c(0,2,4,6,8,10,12),y=c(1,5,6,1,0.5,1,6),m=c(0,1.5,-0.5,-0.5,0,0.5,0))(xdep)
usedunit="sediment per time" #unit of deposition rate is sediment per time unit (default setting)
#Plot deposition rate
plot(xdep,ydep,type='l',main='Deposition Rate',xlab='Stratigraphic Height',
  ylab=usedunit)
#define a rate ("signal")
xsig= seq(from=min(xdep),to=max(xdep),length.out=100)
ysig=splinefunH(x=c(0,4,12),y=c(0.5,2,0.5),m=c(0,0,0))(xsig) #function values of the signal
plot(xsig,ysig,type='l',main='Stratigraphic Signal/Rate',
  xlab='Stratigraphic Height',ylab='Stratigraphic Rate')

##transform stratigraphic rate into temporal rate
usedunit="sediment per time" #unit of deposition rate is sediment per time unit (default setting)
reslist=strattotimeratecont(xdep,ydep,xsig,ysig,unit=usedunit)
#plot temporal rate (transformed stratigrapic rate)
plot(reslist$time,reslist$val,type='l',xlab='Time',ylab='temporal rate',
  main=paste('deposition rate interpreted as',usedunit))
#now using same input, but different interpretation of units
usedunit="time per sediment" #now interpret the deposition rate in different units
reslist=strattotimeratecont(xdep,ydep,xsig,ysig,unit=usedunit)
#plot temporal rate (transformed stratigrapic rate)
plot(reslist$time,reslist$val,type='l',xlab='Time',ylab='temporal rate',
  main=paste('deposition rate interpreted as',usedunit))
#note how different the results look!!

#Insert hiatus
stratigraphicheight=5 #strat. height of the hiatus
duration=4 #duration of the hiatus
hiatuslist=list(c(stratigraphicheight,duration)) #required input format for hiatuses
reslist=strattotimeratecont(xdep,ydep,xsig,ysig,hiatuslist=hiatuslist) #unit is back to default
plot(reslist$time,reslist$val,xlab='Time',ylab='Intensity',main='Temporal Rate/Signal')
#hiatus is approx between 2 and 5
```

`timetostratpointbin` *Transform Points and Isotope Ratios from Time into Stratigraphic Height (Binned)*

Description

This function takes a binned deposition rate to determined what stratigraphic height of a section was deposited at a given time.

This can be used to create age models, determine the location of single samples in the outcrop that were deposited at a given time, and transform isotope ratios from time into stratigraphic height (see examples).

Usage

```
timetostratpointbin(x, binborder, depoval)
```

Arguments

`x`	Vector containing the times whose stratigraphic heights are to be determined
`binborder`	Vector of strictly increasing numerical values. Defines the borders of the bins in time
`depoval`	Strictly positive vector of length `length(binborder)-1`. Defines the deposition rate in the bins, i.e. `depoval[i]` is the deposition rate in the time interval between `binborder[i]` and `binborder[i+1]`

Value

Returns a list containing

`height`	vector containing the stratigraphic heights that were deposited at the times given by the input `x`
`time`	vector containing the times at which the stratigraphic heights given by `height` were deposited. Essentially a duplicate of the input `x`

Output of `NA` in `height` indicates that some values coincide with a hiatus or are located at places where the deposition rate is undefined.

Author(s)

Niklas Hohmann

References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

See Also

For an overview of the functions in the DAIME package, see its vignette (available via `vignette("DAIME")`)

Examples

```
##Define deposition rate
binborder=1:6 #temporal bins for the deposition rate
depoval=c(5,4,3,1,2) #deposition rate in the bins
#plot deposition rate
depositionrate=approxfun(binborder,c(depoval,tail(depoval,1)),method="constant",yleft=NA,yright=NA)
plot(depositionrate(seq(from=min(binborder),to=max(binborder),length.out=100)),xlab='time',
  ylab='deposition rate', main='Deposition rate')

##at what stratigraphic height can an object be found that was deposited in the
##sediment after 5 time units?
timetostratpointbin(5,binborder,depoval)

##create age model
#points that will be transformed into stratigraphic height
time=seq(from=min(binborder),to=max(binborder),length.out=100)
reslist=timetostratpointbin(time,binborder,depoval)
#plot age model
plot(reslist$height,reslist$time,type='l',ylab='Time',xlab='Stratigraphic Height',main='Age model')

## Age model with removal of sediment (hiatus)
depoval=c(5,4,-3,1,2) #in the midle time bin, erosion rate is 3
reslist=timetostratpointbin(time,binborder,depoval)
#plot age model. the gap represents the hiatus
plot(reslist$height,reslist$time,type='l',ylab='Time',xlab='Stratigraphic Height',
  main='Age model with erosion')
#A object deposited in the sediment after 3.5 time units is destroyed due to the hiatus:
timetostratpointbin(3.5,binborder,depoval)

##transform isotope ratio curves
depoval=c(5,4,2,1,0.1)
#create fake ratios and sample locations
sampletime=sort(runif(20,min=min(binborder),max=max(binborder))) #times where the samples were taken
isotoperatio=sin(sampletime)*rnorm(length(sampletime)) #isotope ratios
plot(sampletime,isotoperatio,type='l',xlab='Time',ylab='Isotope Ratio')
#!!transform only (!) sample times, NOT isotope values!!
reslist=timetostratpointbin(sampletime,binborder,depoval)
#this is the resulting isotope ratio curve in stratigraphic height
plot(reslist$height,isotoperatio,type='l',xlab='Stratigraphic Height',ylab='Isotope Ratio')
```

---

timetostratpointcont *Transform Points and Isotope Ratios from Time into Stratigraphic Height (Continuous)*

Description

This function takes a continuous deposition rate to determined what stratigraphic height of a section was deposited at a given time.

This can be used to create age models, determine the location of single samples in the outcrop that were deposited at a given time, and transform isotope ratios from time into stratigraphic height (see examples).

Usage

```
timetostratpointcont(x, xdep, ydep)
```

Arguments

x	Vector containing the times whose stratigraphic heights are to be determined
xdep	Vector of strictly increasing real numbers
ydep	Vector of the same length of xdep, containing strictly positive real numbers. xdep and ydep define the deposition rate in the sense that depositionrate=approxfun(xdep,ydep).

Value

Returns a list containing

height	vector containing the stratigraphic heights that were deposited at the times given by the input x
time	vector containing the times at which the stratigraphic heights given by height were deposited. Essentially a duplicate of the input x

Output of NA in height indicates that some values coincide with a hiatus or are located at places where the deposition rate is undefined.

Author(s)

Niklas Hohmann

References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

See Also

timetostratratecont for the transformation of rates from time into stratigraphic height, strattotimepointcont for the transformation of single samples or isotope ratios from stratigraphic height into time.

For an overview of the functions in the DAIME package, see its vignette (available via vignette("DAIME"))

Examples

```
##define deposition rate
xdep=seq(0,12,length.out=100)
ydep=splinefunH(x=c(0,2,4,6,8,10,12),y=c(1,5,6,1,0.5,1,6),m=c(0,1.5,-0.5,-0.5,0,0.5,0))(xdep)
#Plot deposition rate
plot(xdep,ydep,type='l',main='Deposition Rate',xlab='Time',ylab='Deposition Rate')
```

```
##at what stratigraphic height can an object be found that was deposited in the
#sediment after 9 time units?
timetostratpointcont(9,xdep,ydep)

##create age model
#points that will be transformed into stratigraphic height
time=seq(min(xdep),max(xdep),length.out=100)
reslist=timetostratpointcont(time,xdep,ydep)
#plot age model
plot(reslist$height,reslist$time,type='l',ylab='Time',xlab='Stratigraphic Height',main='Age model')
#age model with Removal of sediment
#define deposition rate with negative deposition rate, e.g. removal of sediment
xdep=seq(0,12,length.out=100)
ydep=splinefunH(x=c(0,2,4,6,8,10,12),y=c(1,5,6,0,-2,1,6),m=c(0,1.5,-0.5,-0.5,0,0.5,0))(xdep)
#Plot deposition rate
plot(xdep,ydep,main='Deposition Rate',xlab='Time',ylab='Deposition Rate')
#sediment removal is done automatically. e.g. create age model as before:
reslist=timetostratpointcont(time,xdep,ydep)
#plot age model
plot(reslist$height,reslist$time,type='l',ylab='Time',xlab='Stratigraphic Height',main='Age model')


#transform isotope ratio curves
ydep=splinefunH(x=c(0,2,4,6,8,10,12),y=c(1,5,6,1,0.5,1,6),m=c(0,1.5,-0.5,-0.5,0,0.5,0))(xdep)
##create fake ratios and sample locations
sampletime=sort(runif(20,min=min(xdep),max=max(xdep))) #times where the samples were taken
isotoperatio=sin(sampletime)*rnorm(length(sampletime)) #isotope ratios
plot(sampletime,isotoperatio,type='l',xlab='Time',ylab='Isotope Ratio')
#transform only (!) sample times, NOT values
reslist=timetostratpointcont(sampletime,xdep,ydep)
#this is the resulting isotope ratio curve in stratigraphic height
plot(reslist$height,isotoperatio,type='l',xlab='Stratigraphic Height',ylab='Isotope Ratio')
```

`timetostratratebin` *Transform Rates from Time into Stratigraphic Height (Binned)*

Description

This function transforms a given binned temporal rate/signal into the corresponding stratigraphic rate/signal. The transformation is based on the age model constructed from the deposition rate.

This can for example be used to predict the patterns of (first/last) fossil occurrences in the outcrop under a given depositional environment.

Usage

```
timetostratratebin(binborder, depoval, signalval, pos = NULL)
```

Arguments

binborder	Vector of strictly increasing numerical values. Defines the borders of the bins in time
depoval	Strictly positive vector of length length(binborder)-1. Defines the deposition rate in the bins, i.e. depoval[i] is the deposition rate in the time interval between binborder[i] and binborder[i+1]
signalval	Positive vector of length length(binborder)-1. Defines the temporal rate/signal in the bins, i.e. signalval[i] is the temporal rate between the times binborder[i] and binborder[i+1]
pos	OPTIONAL. Vector of points in time that will be transformed into stratigraphic rate, and where the stratigraphic rate will evaluated. Default setting is a vector spanning the interval of interest with evenly spaced points (no. is chosen by the code)

Value

A list containing the following entries

x	x values, corresponding to the locations of pos, transformed into stratigraphic height
y	function values of the transformed rate at x

The results return NA if the values coincide with a hiatus or both deposition rate and temporal rate are undefined

Author(s)

Niklas Hohmann

References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

See Also

For an overview of the functions in the DAIME package, see its vignette (available via vignette("DAIME"))

Examples

```
## Define deposition rate
binborder=1:6 #temporal bins for the deposition rate
depoval=c(5,4,3,1,2) #deposition rate in the bins
#plot deposition rate
depositionrate=approxfun(binborder,c(depoval,tail(depoval,1)),method="constant",yleft=NA,yright=NA)
plot(depositionrate(seq(from=min(binborder),to=max(binborder),length.out=100)),xlab='time',
  ylab='deposition rate', main='Deposition rate')
## Define temporal rate
```

```
signalval=c(1,0,5,2,1)
#plot temporal rate
temporalrate=approxfun(binborder,c(signalval,tail(signalval,1)),method="constant",
  yleft=NA,yright=NA)
plot(temporalrate(seq(from=min(binborder),to=max(binborder),length.out=100)),xlab='time',
  ylab='temporal rate', main='Temporal rate')

## Transform temporal rate into stratigraphic rate
reslist=timetostratratebin(binborder,depoval,signalval)
#plot resulting stratigraphic rate
plot(reslist$height,reslist$val,xlab='Stratigraphic Height',ylab='Intensity',
  main='Stratigraphic Rate')
## With removal of sediment (hiatus)
depoval=c(5,4,-3,1,2) #erosion rate is 3 in the middle time bin
reslist=timetostratratebin(binborder,depoval,signalval)
#plot resulting stratigraphic rate
plot(reslist$height,reslist$val,xlab='Stratigraphic Height',ylab='Intensity',
  main='Stratigraphic Rate')
```

`timetostratratecont` *Transform Rates from Time into Stratigraphic Height (Continuous)*

Description

This function transforms a given continuous temporal rate/signal into the corresponding stratigraphic rate/signal. The transformation is based on the age model constructed from the deposition rate.

This can for example be used to predict the patterns of (first/last) fossil occurrences in the outcrop under a given depositional environment.

Usage

```
timetostratratecont(xdep, ydep, xsig, ysig, pos = NULL)
```

Arguments

`xdep`	Vector of strictly increasing real numbers
`ydep`	Vector of the same length of `xdep`, containing strictly positive real numbers. `xdep` and `ydep` define the deposition rate in the sense that `depositionrate=approxfun(xdep,ydep)`
`xsig`	Vector of strictly increasing real numbers
`ysig`	Vector of the same length of `xsig`, containing positive real numbers. `xsig` and `ysig` define the temporal rate in the sense that `stratigraphicrate=approxfun(xsig,ysig)`.
`pos`	OPTIONAL. Vector of points in time height that will be transformed into stratigraphic height, and determine where the stratigraphic rate is evaluated. Default setting is a vector spanning the interval of interest with evenly spaced points (no. is chosen by the code)

Value

Returns a list containing

x	vector containing stratigraphic heights (that are deposited at times xdep (pos if used))
y	vector containign the values of the stratigraphic rate/signal at x

x and y define the stratigraphic rate/signal in the sense that `stratsig=approxfun(x,y)`

Author(s)

Niklas Hohmann

References

Hohmann, Niklas. 2018. Quantifying the Effects of Changing Deposition Rates and Hiatii on the Stratigraphic Distribution of Fossils. <doi:10.13140/RG.2.2.23372.51841>

See Also

strattotimeratecont for the transformation of rates from stratigraphic height into time, timetostratpointcont for the transformation of sigle samples or isotope ratios from time into stratigraphic height.

For an overview of the functions in the DAIME package, see its vignette (available via `vignette("DAIME")`)

Examples

```
##define deposition rate
xdep=seq(0,12,length.out=100)
ydep=splinefunH(x=c(0,2,4,6,8,10,12),y=c(1,5,6,1,0.5,1,6),m=c(0,1.5,-0.5,-0.5,0,0.5,0))(xdep)
#Plot deposition rate
plot(xdep,ydep,type='l',main='Deposition Rate',xlab='Time',ylab='Sediment per Time Unit')

#define a temporal rate ("signal")
xsig= seq(0,12,length.out=100)
ysig=splinefunH(x=c(0,4,12),y=c(0.5,2,0.5),m=c(0,0,0))(xsig)
plot(xsig,ysig,type='l',main='Temporal Signal/Rate',xlab='Time',ylab='Signal Intensity')

##transform temporal rate into stratigraphic rate (signal observable in the section)
reslist=timetostratratecont(xdep,ydep,xsig,ysig)
plot(reslist$height,reslist$val,type='l',xlab='Stratigraphic Height',
  ylab='Signal Intensity',main='Stratigraphic Rate/Signal')

##with removal of sediment
ydep=splinefunH(x=c(0,2,4,6,8,10,12),y=c(1,5,6,-2,5,1,6),m=c(0,1.5,-0.5,-0.5,0,0.5,0))(xdep)
#Plot deposition rate
plot(xdep,ydep,type='l',main='Deposition Rate',xlab='Time',ylab='Sediment per Time Unit')
reslist=timetostratratecont(xdep,ydep,xsig,ysig)
plot(reslist$height,reslist$val,type='l',xlab='Stratigraphic Height',
  ylab='Signal Intensity',main='Stratigraphic Rate/Signal',ylim=c(0,1))
#the spike is because the deposition rate is very small when it transitions from
```

```
    #negative to positive, generating a punctual extreme condensation
```

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