

Package ‘RLumModel’

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Type Package

Title Modelling Ordinary Differential Equations Leading to
Luminescence

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Description A collection of function to simulate luminescence signals in the
mineral quartz based on published models.

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License GPL-3

Depends R (>= 3.2.2), utils, Luminescence (>= 0.5.0)

Imports deSolve (>= 1.12)

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RLumModel-package*Modelling Ordinary Differential Equations Leading to Luminescence*

Description

A collection of function to simulate luminescence signals in the mineral quartz based on published models.

Details

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License: GPL-3

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Project source code repository

<https://github.com/R-Lum/RLumModel>

Related projects

<http://www.r-luminescence.de>
<http://cran.r-project.org/package=Luminescence>
<http://shiny.r-luminescence.de>
<http://cran.r-project.org/package=RLumShiny>

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model_LuminescenceSignals

Model Luminescence Signals

Description

This function models luminescence signals for quartz based on published physical models. It is possible to simulate TL, (CW-) OSL, RF measurements in a arbitrary sequence. This sequence is defined as a list of certain abrivations. Furthermore it is possible to load a sequence direct from the Riso Sequence Editor. The output is an RLum.Analysis object and so the plots are done by the plot_RLum.Analysis function. If a SAR sequence is simulated the plot output can be disabled and SAR analyse functions can be used.

Usage

```
model_LuminescenceSignals(model, sequence, lab.doseRate = 1,
  simulate_sample_history = FALSE, plot = TRUE, verbose = TRUE, ...)
```

Arguments

model	character (required) : set model to be used
sequence	list (required) : set sequence to model as list or as *.seq file from the Riso sequence editor. To simulate SAR measurements there is an extra option to set the sequence list (cf. example 3): (required) : RegDose: numeric , TestDose: numeric , PH: numeric , CH: numeric , OSL_temp: numeric . With default are: DoseRate: numeric , Irr_temp: numeric , optical_power: numeric , OSL_duration: numeric , PH_duration: numeric
lab.doseRate	numeric (with default): laboratory dose rate in XXX Gy/s for calculating seconds into Gray in the *.seq file.
simulate_sample_history	logical (with default): FALSE (with default): simulation begins at labour conditions, TRUE: simulations begins at crystallization (all levels 0) process
plot	logical (with default): Enables or disables plot output
verbose	logical (with default): Verbose mode on/off
...	further arguments and graphical parameters passed to <code>plot.default</code> . See details for further information

Details

Defining a sequence

Abrivation	Description	Arguments
TL	thermally stimulated luminescence	'temp begin', 'temp end', 'heating rate'
OSL	optically stimulated luminescence	'temp', 'duration', 'optical power'
LM_OSL	linear modulated OSL	'temp', 'duration'

RL/RF	radioluminescence	'temp','dose','dose_rate'
IRR	irradiation	'temp','dose','dose_rate'
CH	cutheat	'temp','duration'
PH	preheat	'temp','duration'
PAUSE	pause	'temp','duration'

Value

This function returns an `RLum.Analysis` object with all TL, (LM-) OSL and RF/RL steps in the sequence. Every entry is a `RLum.Data.Curve` object and can be plotted, analysed etc. with further `RLum` functions.

Function version

0.1.0

Note

This function can do just nothing at the moment.

Author(s)

Johannes Friedrich, University of Bayreuth (Germany), Sebastian Kreutzer, IRAMAT-CRP2A, Université Bordeaux Montaigne (France)

References

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- Bailey, R.M., 2002. Simulations of variability in the luminescence characteristics of natural quartz and its implications for estimates of absorbed dose. *Radiation Protection Dosimetry* 100, 33-38.
- Bailey, R.M., 2004. Paper I-simulation of dose absorption in quartz over geological timescales and its implications for the precision and accuracy of optical dating. *Radiation Measurements* 38, 299-310.
- Pagonis, V., Chen, R., Wintle, A.G., 2007: Modelling thermal transfer in optically stimulated luminescence of quartz. *Journal of Physics D: Applied Physics* 40, 998-1006.
- Pagonis, V., Wintle, A.G., Chen, R., Wang, X.L., 2008. A theoretical model for a new dating protocol for quartz based on thermally transferred OSL (TT-OSL). *Radiation Measurements* 43, 704-708.

See Also

[plot](#)

Examples

```
## Not run:
##=====##
## Example 1: Simulate sample history of Bailey2001
## (cf. Bailey, 2001, Fig. 1)
##=====##
```

```
##set sequence with the following steps
## (1) Irraditation at 20 deg. C with a dose of 1000 Gy and a dose rate of 1 Gy/s
## (2) Preheat to 350 deg. C and hold for 10 s
## (3) Illumination at 200 deg. C. for 100 s with 100 % optical power
## (4) Irradiation at 220 deg. C with a dose of 20 Gy and a dose rate of 0.01 Gy/s
## (5) Irradiation at 20 deg. C with a dose of 10 Gy and a dose rate of 1 Gy/s
## (6) TL from 20-400 deg. C with a rate of 5 K/s
sequence <-
  list(
    IRR = c(20, 1000, 1),
    PH = c(350, 10),
    ILL = c(200, 100, 100),
    IRR = c(220, 20, 0.01),
    IRR = c(20, 10, 1),
    TL = c(20, 400, 5)
  )

##model sequence
model.output <- model_LuminescenceSignals(
  sequence = sequence,
  model = "Bailey2001",
  simulate_sample_history = TRUE
)
```

```
##=====##
## Example 2: Simulate sequence at labour without sample history
##=====##
```

```
##set sequence with the following steps
## (1) Irraditation at 30 deg. C with a dose of 100 Gy and a dose rate of 1 Gy/s
## (2) Preheat to 2000 deg. C and hold for 10 s
## (3) LM-OSL at 125 deg. C. for 1000 s
## (4) OSL at 20 deg. C for 100 s with 90 % optical power
## (5) Cutheat at 220 deg. C
## (6) Irradiation at 20 deg. C with a dose of 10 Gy and a dose rate of 1 Gy/s
## (7) Pause at 200 deg. C for 100 s
## (8) TL from 20-400 deg. C with a heat rate of 5 K/s
## (9) Radioluminescence at 20 deg. C with a dose of 20 Gy and a dose rate of 1 Gy/s

sequence <-
  list(
    IRR = c(20, 100, 1),
    PH = c(200, 10),
    LM_OSL = c(125, 100),
    CH = c(200),
    IRR = c(20, 10, 1),
    PAUSE = c(200, 100),
    OSL = c(125, 100, 90),
    PAUSE = c(200, 100),
    TL = c(20, 400, 5),
    RF = c(20, 200, 0.01)
  )
```

```
# call function "model_LuminescenceSignals", set sequence = sequence, model = "Pagonis2008" (palaeodose = 200)
# and simulate_sample_history = FALSE (default), because the sample history is not part of the sequence
```

```

model.output <- model_LuminescenceSignals(
  sequence = sequence,
  model = "Pagonis2008"
)

##=====##
## Example 3: Simulate SAR sequence
##=====##

##set SAR sequence with the following steps
## (1) RegDose: set regenerative dose [Gy] as vector
## (2) TestDose: set test dose [Gy]
## (3) PH: set preheat temperature in deg. C
## (4) CH: Set cutheat temperature in deg. C
## (5) OSL_temp: set OSL reading temperature in deg. C
## (6) OSL_duration: set OSL reading duration in s

sequence <- list(
  RegDose = c(0,10,20,50,90,0,10),
  TestDose = 5,
  PH = 240,
  CH = 200,
  OSL_temp = 125,
  OSL_duration = 70)

# call function "model_LuminescenceSignals", set sequence = sequence, model = "Pagonis2007" (palaeodose = 20
# and simulate_sample_history = FALSE (default), because the sample history is not part of the sequence

model.output <- model_LuminescenceSignals(

  sequence = sequence,
  model = "Pagonis2007",
  plot = FALSE
)

# in environment is a new object "model.output" with the results of every step of the given sequence.
# Plots are done at OSL and TL steps and the growth curve

# call "analyse_SAR.CWOSL" from RLum package
results <- analyse_SAR.CWOSL(model.output,
  signal.integral.min = 1,
  signal.integral.max = 15,
  background.integral.min = 601,
  background.integral.max = 701,
  fit.method = "EXP",
  dose.points = c(0,10,20,50,90,0,10))

##=====##
## Example 4: generate sequence from *.seq file and run SAR simulation
##=====##

## call function "model_LuminescenceSignals", load *.seq file for sequence, set model = "Bailey2002" (palaeod
## and simulate_sample_history = FALSE (default), because the sample history is not part of the sequence

```

```

model.output <- model_LuminescenceSignals(
  sequence = "inst/extdata/sample_SAR_cycle.SEQ",
  model = "Bailey2002",
  plot = FALSE
)

## call RLum package function "analyse_SAR.CWOSL" to analyse the simulated SAR cycle

results <- analyse_SAR.CWOSL(model.output,
  signal.integral.min = 1,
  signal.integral.max = 10,
  background.integral.min = 601,
  background.integral.max = 701,
  dose.points = c(0,5,10,20,50,5,0),
  fit.method = "EXP")

print(get_RLum(results))

##=====##
## Example 5: compare different optical powers of stimulation light
##=====##

## call function "model_LuminescenceSignals", model = "Bailey2004"
## and simulate_sample_history = FALSE (default), because the sample history is not part of the sequence
## the optical_power of the LED is varied and then compared.

optical_power <- seq(from = 0,to = 100,by = 20)

model.output <- lapply(1:length(optical_power), function(x){

sequence <- list(IRR = c(20, 50, 1),
  PH = c(220, 10, 5),
  OSL = c(125, 50, optical_power[x])
)

return(model_LuminescenceSignals(
  sequence = sequence,
  model = "Bailey2004",
  plot = FALSE
))
})

##combine output curves
model.output.merged <- merge_RLum(model.output)

##plot
plot_RLum(
  object = model.output.merged,
  xlab = "Illumination time [s]",
  ylab = "OSL signal [a.u.]",
  main = "OSL signal dependency on optical power of stimulation light",
  legend.text = paste("Optical power density", 20*optical_power/100, "mW/cm^2"),
  combine = TRUE)

```

```
## End(Not run)
```


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