Ancient TL

www.ancienttl.org · ISSN: 2693-0935

Issue 36(2) - December 2018
https://doi.org/10.26034/la.atl.v36.i2

ISSN 0735-1348

Ancient TL

A periodical devoted to Luminescence and ESR dating

Department of Physics, East Carolina University, 1000 East 5th Street, Greenville, NC 27858, USA
http://ancienttl.org

December 2018, Volume 36 No.2

Ancient TL

Started by the late David Zimmerman in 1977

Ancient TL

Enhancing *Analyst* by integrating the R package 'Luminescence'

G.A.T. Duller

Aberystwyth Luminescence Research Laboratory (ALRL), Department of Geography and Earth Sciences, Aberystwyth University, Ceredigion, United Kingdom SY23 3DB

*Corresponding Author: ggd@aber.ac.uk

Received: November 29, 2018; in final form: December 18, 2018

Abstract

A new facility within the software package *Analyst* is described, allowing users to run R scripts with little or no need to interact directly with the R language themselves. This tight integration of R within *Analyst* provides users with a much more powerful platform in which to undertake selection and analysis of their data than is currently available. The current implementation focusses on the use of the R 'Luminescence' package for visualisation and statistical modelling of equivalent dose distributions, but the wide variety of other capabilities of the R statistical language can also be accessed using this new system. For users with more experience of using R, this new version of *Analyst* allows them to tailor their analysis in a way that is specific to their application, whilst retaining the simplicity of the *Analyst* interface. The ability to exploit the complex statistical methods available in R from within the *Analyst* environment provides a powerful new approach to data analysis in luminescence research.

Keywords: Analyst, Data analysis, R

1. Introduction

The number of steps involved in protocols being used for dose reconstruction using luminescence is expanding (e.g. the multiple elevated temperature (MET) IR protocol of Li & Li (2011), and the violet stimulated luminescence (VSL) SAR protocol of Ankjærgaard et al. 2013), as is the range of luminescence signals being measured (thermoluminescence (TL), isothermal luminescence, optically stimulated luminescence (OSL), pulsed OSL, spatially resolved TL or OSL etc.).

The *Analyst* software package provides a simple user interface allowing researchers to process their data (Duller, 2015). The aims of *Analyst* have been fourfold: (1) to allow users to select which parts of a sequence of data measurements should be used for analysis; (2) to allow users to visualise each measurement in a simple manner; (3) to undertake analyses such as dose response curve fitting and equivalent dose determination, OSL curve fitting, and *g*-value determination; and (4) to make it simple to export data from *Analyst* so that it can be analysed in other software. The approach used in *Analyst* is to make interaction with data a very visual and direct process. Changes are made using the mouse or keystrokes, and the impact of these is immediately seen. However, a major disadvantage of *Analyst* is that it cannot be configured by users to undertake new calculations, new methods of analysis, or new types of display.

In recent years a highly flexible package, 'Luminescence' (Kreutzer et al., 2012), for the language **R** specifically aimed at assisting research in luminescence has been developed. **R** is an open source statistical language (R Core Team, 2018) that has become extremely widely used, especially in scientific work (e.g., Tippmann, 2014). One of the most powerful aspects of the language is the ability of users to write their own functions, and collect these together to create a package, and to make this package available to users around the world via CRAN, the Comprehensive R Archive Network (`https://cran.r-project.org`). Documentation is always provided with these functions, so that users can obtain information about the purpose of a function and how to use it.

A common reason why many luminescence researchers may have begun to use the statistical language **R** is to run some of the age models described by Galbraith et al. (1999)

such as the central age model (CAM) or the minimum age model (MAM). These were originally written in the language **S**, but the models run with little modification in **R** which is freely available. New models such as the IEU model are also now available (Thomsen et al., 2007; Smedley, 2015). The `'Luminescence'` package (Kreutzer et al., 2012) provides a wide range of analytical capabilities specifically dedicated to the analysis of luminescence data, especially its use in dating. Since its launch in 2012 the package has undergone rapid expansion in the range of functions that it provides.

However, using the `'Luminescence'` package requires at least some understanding of the **R** language, and while detailed examples of how to use the package for analysis of data for dating have been published (e.g., Dietze et al., 2013; Fuchs et al., 2015), the need to learn some elements of the **R** language has been an impediment to some researchers adopting this new approach. Burow et al. (2016) provide an alternative route with the software `'RLumShiny'`, that creates a simple graphical user interface (GUI), but here the functionality is fixed by the designer, and not by the user, and so only part of the power of the `'Luminescence'` package and the **R** language are available. This paper describes changes made in the latest version (v4.57) of *Analyst* which allows users either to exploit the power of the `'Luminescence'` package without having to write any **R** code of their own, or allows users to write simple scripts (or modify existing scripts). All of this is achieved from within the *Analyst* package, to simplify access to the power of **R**.

2. Implementation within *Analyst*

Analyst runs scripts (sets of commands written in the **R** language) using the programme *RScript* that is a core part of **R** itself. *Analyst* writes the script chosen by the user to a file, calls *RScript* with the name of this file as an argument, and then collects the output from *RScript* to present it within *Analyst* (Fig. 1). Currently, the part of *Analyst* where **R** can be accessed with data is the single aliquot regeneration section. *Analyst* provides the opportunity to analyse many single aliquots, or single grains, to generate many equivalent dose (D_e) values. These D_e values are written to a file and then read by the **R** script. As well as the D_e and its uncertainty, parameters such as the intensity of the luminescence signals, the L_x/T_x ratios and their uncertainties, the recycling ratio, recuperation, the fitting parameters for the equation used to fit the dose response curve, and many others are exported and hence are available for further analysis within the **R** script.

The range of parameters exported to the **R** script is substantially larger than was available in the summary table of earlier versions of *Analyst*. The most important enhancement has been to export the dose response data for each aliquot. For each point in a regenerative dose measurement sequence, the dose, the signal from the regenerative dose (L_x), its background, the signal from the test dose (T_x), its background, the ratio of L_x/T_x (and its uncertainty) are all exported. This opens up many possibilities for data analysis in **R**. For instance, it makes it possible to plot multiple dose response curves (Fig. 2). An **R** script can be run using a single click of a mouse, and any text results are presented within a window that is part of the *Analyst* programme (Figure 2). Graphical output produced by the **R** script is also shown within the *Analyst* programme, and can be copied to other packages via the *Windows*^{TM} clipboard.

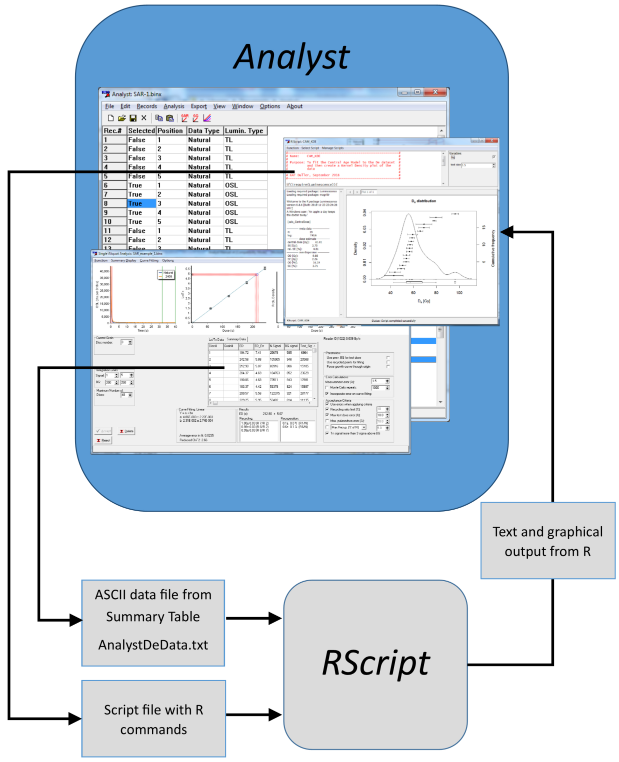

Figure 1. Schematic of how **R** has been integrated within *Analyst*. Data from the summary table produced in the SAR data analysis section is saved to an ASCII data file. An **R** script file is automatically generated by *Analyst*. *RScript* is a programme called by *Analyst* that runs the **R** script. The script then imports the ASCII data file and undertakes whatever analysis the user wishes. *Analyst* collects any text or graphical output from **R** and displays this within *Analyst*. Throughout this process the user remains within *Analyst* (the section in the dark blue box). The parts of this process shown in grey boxes are not visible to the user

3. Scripts and variables

A number of scripts are automatically available when *Analyst* is installed, and can be seen as soon as **R** is detected (the user is responsible for installing **R** on their computer). These scripts are simple sets of **R** commands. There is no limit to the length of the scripts. The scripts consist of a series of lines of commands and comments. Extensive use of comments is encouraged in order to make the intention of the

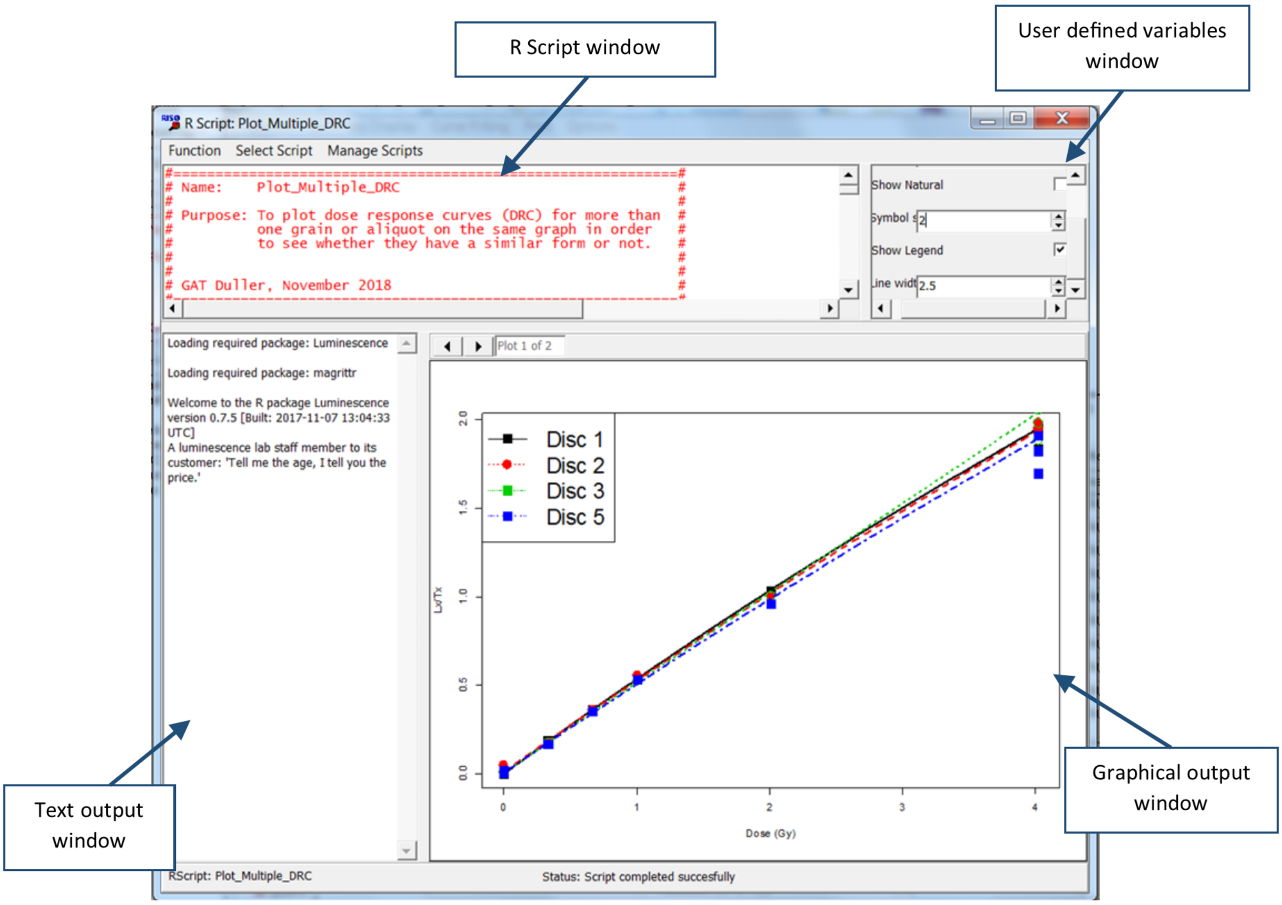

Figure 2. Output from running an **R** in *Analyst* script to plot multiple dose response curves for different aliquots of a single sample. The user interface shown here is within the *Analyst* program. The four different sections of this interface are labelled. The **R** script to be run is shown in the upper left hand panel. Any variables defined by the user (see later in the text) are listed in the upper right hand panel, and the values of these variables can be changed when the user runs the script. Once the script is run (from the *Analyst* Function Menu item), any text output from **R** is shown in the left hand panel, and any graphical output is shown in the bottom right hand panel.

code clear. An example of a script is given in Listing 1. To make it simpler to discuss the script in this article, line numbers have been added in Listing 1, but these are not part of the script itself.

Lines 1 to 10 are simply comments, and give the name of the script (line 2) and its purpose (lines 4 to 7). The script first ensures that the `'Luminescence'` library is activated (lines 12 to 14), and then reads the data file (lines 18–19) that has automatically been created by *Analyst* from the single aliquot analyses. Line 20 removes any results that do not contain finite D_e values and uncertainties on the D_e. The table of results is stored in the variable `LumData`, and by attaching this object (line 24) the various fields within the structure (the different columns of data within the *Analyst* table) can be accessed just by writing their name. For instance, the list of D_e values and their uncertainty can be accessed simply using `ED` and `ED_Err` (line 28). To see a list of the names of the columns of data in the file written by *Analyst*, users can run the script `List_SAR_data_fields` which is included with *Analyst*.

Listing 1. RAN-file example - MAM_Abanico

```
1  #=========================================#
2  # Name: MAM_Abanico                       #
3  #                                         #
4  # Purpose: To fit the Minimum Age Model   #
5  #  to the De dataset and then create      #
6  #  an Abanico plot of the data            #
7  #  showing the derived MAM De             #
8  #                                         #
9  # GAT Duller, August 2017                 #
10 #=========================================#
11
12 if(!require(Luminescence)){
13  library("Luminescence")
14 }
15
16 #Remove any incomplete rows of
17 #data where ED or ED_Err are not present
18 LumData <- read.delim("AnalystDedata.txt",
19  sep="\t",header=TRUE)
20 LumData <- LumData[is.finite(LumData$ED) & is.
      ↪ finite(LumData$ED_Err), ]
21
```

```
22 #Attach the data so that it
23 #is easier to access
24 attach(LumData)
25
26 #Write a dataframe with just the
27 #De and De error
28 AnData <- data.frame(ED,ED_Err)
29
30 #Calculate the MAM. Variables allow one to
31 # choose whether it is the logged or
32 # unlogged model, what value of sigmab
33 # to use and whether it is the
34 # 3 parameter or 4 parameter MAM
35
36 #NB: When using the logged model sigmab is in %
37 # When using the unlogged model sigmab
38 # is in dose units (Gy or seconds)
39 MinAge <- calc_MinDose(AnData,
40  sigmab=$1, log=$2, par=$3)
41
42 #Create a plot of the data showing the MAM De
43 if ($4) {
44 plot_AbanicoPlot(AnData, log.z=TRUE,
45    z.0 = MinAge$summary$de,
46    main=as.character(Filename[1]))
47
48 } else {
49 plot_AbanicoPlot(AnData, log.z=TRUE,
50   z.0 = MinAge$summary$de, cex = 1.2)
51 }
```

The minimum age model of Galbraith et al. (1999) is run in lines 39–40 using the function `calc_MinDose()` which is part of the `'Luminescence'` package. This function requires a list of D_e values and their uncertainties, and these are in the variable `AnData` that was created in line 28 from the list generated by *Analyst*. The function also requires users to specify a value of `sigmab`, the overdispersion exhibited by a well bleached population of D_e values. The correct choice of `sigmab` is critical to the running of the minimum age model, and the subject of much research (Galbraith & Roberts, 2012). It would be possible to write a script where the value of `sigmab` was fixed, but if the user wished to see the impact of using a different value then they would have to edit the script, save it, and then rerun it. A more flexible approach is to use a variable. In the script shown in Listing 1 the user can change the value of `sigmab` without having to edit and save the script.

Analyst allows users to define as many variables are they like, and these are numbered from 1 upwards. A variable is shown by preceding it with a dollar symbol (e.g., variable 3 is `$3`). In the script (line 40) the value of `sigmab` is variable 1 (`$1`). When the script is ready to be run, *Analyst* shows a list of variables (right hand side of Fig. 3), and whatever value a user types into this box will be used to replace any occurrence of the variable `$1`. In this example, variables are also used so that users can select whether the logged or unlogged MAM is used (variable 2, `$2`), and whether the 3 parameter or 4 parameter MAM is used (variable 3, `$3`). Variables give users a very rapid method of exploring the impact of changing a value, and allows scripts to be more flexible than if all the parameters were fixed. Variables can also be used to alter the size of symbols in plots, the text displayed on axes, and many other aspects of the script.

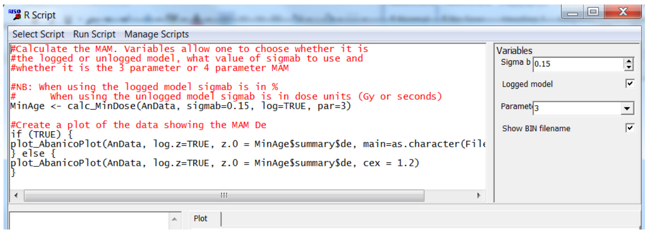

Figure 3. The view of the script in *Analyst*, showing how the values for variables are inserted automatically into the **R** code. The panel on the right hand side lists the four variables defined by the user for this script. Before the script is run, the user can change the values of any of these variables. The panel on the left hand side shows the script that will be run. Note how line 39–40 in Listing 1 (`MinAge <- calc_MinDose()`) has had the variables `$1`, `$2` and `$3` replaced by the values specified here (`$1 = 0.15`; `$2 = TRUE` and `$3 = 3`).

As an example of using **R** within *Analyst*, Fig. 4 shows the results of running the script shown in Listing 1 for a single grain quartz data set for a fluvial sample from central southern Africa (Larkin et al., 2017).

As well as providing access to functions that have been included in existing packages (such as `'Luminescence'`), the ability to write ones own **R** scripts opens up enormous opportunities for data exploration, and for adopting novel methods of analysis. A good example is provided by the suggestion of Thomsen et al. (2016) to analyse single grain D_e distributions by taking into account the characteristic saturation dose (D_0) of each individual grain. All of the information needed to undertake the procedure described in that paper is available within *Analyst*, and the ability to write **R** scripts allows the user to develop a script that could automate this analysis whilst the user remains within the *Analyst* GUI environment.

4. Limitations of implementing R in *Analyst*

The ability to run **R** scripts from within *Analyst* is designed to allow users to benefit from the power of **R** (and especially the `'Luminescence'` package) without having to have a deep understanding of the **R** language and syntax. While the implementation in *Analyst* provides a great simplification compared with running in the **R** terminal itself, there are a number of limitations and drawbacks.

The most important of these is that if researchers wish to write new scripts or edit existing ones, there is no help within *Analyst* about the **R** language, or about the parameters needed for different functions. One of the benefits of the system of packages in **R** is that they all provide documentation of how to use the functions, along with examples. Although *Analyst* does not provide access to this help, the site https://www.rdocumentation.org/ provides a very convenient interface to all of the help files for **R** packages.

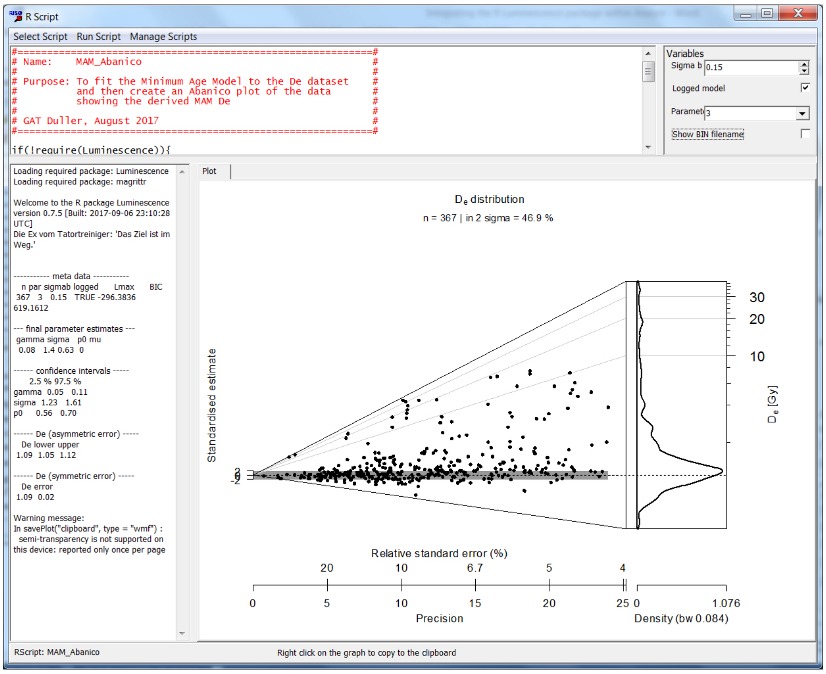

Figure 4. Output from running the **R** in *Analyst* script `MAM_Abanico` provided with *Analyst*, applied to a set of 367 D_e values for individual quartz grains. The MAM D_e value is given in the panel on the left (1.09 $\pm$ 0.02 Gy), along with other parameters fitted by the MAM. The data are plotted on an Abanico plot, and the grey bar shows the MAM D_e value. The graphical output can be copied to the *Windows*^{TM} clipboard so that it can be exported easily.

Typing `'Luminescence'` or the name of a specific function (e.g., `calc_MinDose()`) into this search tool will bring up help associated with that topic, and this will normally include example scripts demonstrating how to use a function.

A second disadvantage is that programming environments such as *RStudio*® (`https://www.rstudio.com`), provide a lot of assistance when writing **R** code, such as autocomplete (similar to predictive text on a mobile phone), but this type of help is not available within *Analyst*. An effective solution to these limitations for more experienced users is to work both within *RStudio*® and *Analyst* when developing scripts, then to use copy and paste so that scripts developed in *RStudio*® can be run in *Analyst*.

5. Conclusions and future developments

This new functionality in *Analyst* was first demonstrated at a workshop that preceded the 15th International Luminescence and Electron Spin Resonance Dating conference held in Cape Town in September 2017. In the 4 hour afternoon session dedicated to *Analyst*, delegates whose previous experience of *Analyst* varied from almost zero to many years, and whose experience of **R** varied from none to very experienced, all managed to successfully run **R** scripts within *Analyst* to run the MAM on a set of D_e values, and to use **R** to plot these on an Abanico plot (Dietze et al., 2016). The feedback from that session has been used to improve the current version, especially to overcome some of the issues with permissions within Windows for installing the software. It is hoped that other colleagues will find this new facility relatively simple to use, and that it will provide a great deal of power to analyse luminescence data. *Analyst* (v4.57) can be downloaded for free from `http://users.aber.ac.uk/ggd`.

While the scripts automatically installed with this latest version of *Analyst* have been designed to utilise the functions within the `'Luminescence'` package, other parts of the **R** language, and other **R** packages can also be used (e.g., `'numOSL'`, Peng et al. 2013).

Scripts written for **R** within *Analyst* can be saved as so-called RAN-files. These files can then be imported into *Analyst* at a later date, or into *Analyst* installed on a different computer. The ability to save these scripts is so that users can archive the scripts, or so they may make the scripts available to other researchers. In this way it is hoped that the types of analyses that can be undertaken on luminescence data can be expanded, and that where authors show results from novel types of analysis they are able to make the scripts available as RAN-files so that other colleagues are able to use these new methods. A website where RAN-files can be shared is under construction and the author welcomes contributions of RAN-files from colleagues.

Acknowledgments

I would like to thank the **R** `'Luminescence'` package development team for inviting me to their development meeting in 2016 where the ideas for this integration with *Analyst* took shape. I would also like to specifically thank Sebastian Kreutzer for his assistance and his feedback on this new aspect of *Analyst*.

References

Ankjærgaard, C., Jain, M., and Wallinga, J. *Towards dating Quaternary sediments using the quartz Violet Stimulated Luminescence (VSL) signal*. Quaternary Geochronology, 18: 99–109, 2013. URL https://doi.org/10.1016/j.quageo.2013.06.001.

Burow, C., Kreutzer, S., Dietze, M., Fuchs, M. C., Fischer, M., Schmidt, C., and Brückner, H. *RLumShiny - A graphical user interface for the R Package 'Luminescence'*. Ancient TL, 34: 22–32, 2016. URL http://author.ecu.edu/cs-cas/physics/Ancient-Timeline/upload/ATL_34-2_Burow_p22-32.pdf.

Dietze, M., Kreutzer, S., Fuchs, M. C., Burow, C., Fischer, M., and Schmidt, C. *A practical guide to the R package Luminescence*. Ancient TL, 31(1): 11–18, 2013. URL http://www.ecu.edu/cs-cas/physics/Ancient-Timeline/upload/ATL_31-1_Dietze.pdf.

Dietze, M., Kreutzer, S., Burow, C., Fuchs, M. C., Fischer, M., and Schmidt, C. *The abanico plot: visualising chronometric data with individual standard errors*. Quaternary Geochronology, 31: 12–18, 2016. URL https://doi.org/10.1016/j.quageo.2015.09.003.

Duller, G. A. T. *The Analyst software package for luminescence data: overview and recent improvements*. Ancient TL, 33(1): 35–42, 2015. URL http://www.ecu.edu/cs-cas/physics/Ancient-Timeline/upload/ATL_33-1_Duller_p35-42.pdf.

Fuchs, M. C., Kreutzer, S., Burow, C., Dietze, M., Fischer, M., Schmidt, C., and Fuchs, M. *Data processing in luminescence dating analysis: An exemplary workflow using the R package 'Luminescence'*. Quaternary International, 362: 8–13, 2015. URL https://doi.org/10.1016/j.quaint.2014.06.034.

Galbraith, R. F. and Roberts, R. G. *Statistical aspects of equivalent dose and error calculation and display in OSL dating: An overview and some recommendations*. Quaternary Geochronology, 11: 1–27, 2012. URL https://doi.org/10.1016/j.quageo.2012.04.020.

Galbraith, R. F., Roberts, R. G., Laslett, G. M., Yoshida, H., and Olley, J. M. *Optical dating of single and multiple grains of Quartz from Jinmium Rock Shelter, Northern Australia: Part I, Experimental design and statistical models*. Archaeometry, 41(2): 339–364, 1999. URL https://doi.org/10.1111/j.1475-4754.1999.tb00987.x.

Kreutzer, S., Schmidt, C., Fuchs, M. C., Dietze, M., Fischer, M., and Fuchs, M. *Introducing an R package for luminescence dating analysis*. Ancient TL, 30(1): 1–8, 2012. URL http://ancienttl.org/ATL_30-1_2012/ATL_30-1_Kreutzer_p1-8.pdf.

Larkin, Z. T., Tooth, S., Ralph, T. J., Duller, G. A. T., McCarthy, T., Keen-Zebert, A., and Humphries, M. S. *Timescales, mechanisms, and controls of incisional avulsions in floodplain wetlands: Insights from the Tshwane River, semiarid South Africa*. Geomorphology, 283: 158–172, 2017. URL https://doi.org/10.1016/j.geomorph.2017.01.021.

Li, B. and Li, S.-H. *Luminescence dating of K-feldspar from sediments: A protocol without anomalous fading correction*. Quaternary Geochronology, 6(5): 468–479, 2011. URL https://doi.org/10.1016/j.quageo.2011.05.001.

Peng, J., Dong, Z., Han, F., Long, H., and Liu, X. *R package numOSL: numeric routines for optically stimulated luminescence dating*. Ancient TL, 31(2): 41–48, 2013. URL http://ancienttl.org/ATL_31-2_2013/ATL_31-2_Peng_p41-48.pdf.

R Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria, 2018. URL https://r-project.org.

Smedley, R. K. *A new R function for the Internal External Uncertainty (IEU) model* . Ancient TL, 33(1): 16–21, 2015. URL http://www.ecu.edu/cs-cas/physics/Ancient-Timeline/upload/ATL_33-1_Smedley.pdf.

Thomsen, K. J., Murray, A. S., Bøtter-Jensen, L., and Kinahan, J. *Determination of burial dose in incompletely bleached fluvial samples using single grains of quartz*. Radiation Measurements, 42(3): 370–379, 2007. URL https://doi.org/10.1016/j.radmeas.2007.01.041.

Thomsen, K. J., Murray, A. S., Buylaert, J. P., Jain, M., Hansen, J. H., and Aubry, T. *Testing single-grain quartz OSL methods using sediment samples with independent age control from the Bordes-Fitte rockshelter (Roches d'Abilly site, Central France)*. Quaternary Geochronology, 31(C): 77–96, 2016. URL https://doi.org/10.1016/j.quageo.2015.11.002.

Tippmann, S. *Programming tools: Adventures with R*. Nature, 517 (7532): 109–110, 2014. URL https://doi.org/10.1038/517109a.

Reviewer

Sebastian Kreutzer

Reviewer's comment: What drives the success of chronological methods in Earth Sciences? Doubtless, of paramount importance are methodological advances allowing a flexible and broad application. However, likewise significant are technological developments, both hardware and software. While their price tags value hardware improvements, free of charge community software developments are probably less recognized. As I started ten years ago with luminescence dating, in my former lab *Analyst* stood synonymously for 'luminescence data analysis.' Later I moved to **R**, but not because I disliked the *Analyst*. I still use it today, and I always recommend it over **R** for analysing routine measurements. The here presented contribution, interfacing **R**, is not just another point in the software menu of *Analyst*. It opens the door to a software universe of its own with more than 13,500 packages; `'Luminescence'` is only one of them. Moreover, the here presented work is the consistent continuation of an outstanding community contribution by a single person for already more than two decades.

Ancient TL

White Paper: Summary of the New World Luminescence Dating Workshop 2018

Harrison Gray[1*], Regina DeWitt[2], Shannon Mahan[1], Jose Luis Antinao[3], Nathan Brown[4], James Feathers[5], Michelle Nelson[6], Joel Spencer[7]

[1] Geosciences and Environmental Change Science Center, U.S. Geological Survey, Denver, CO

[2] Department of Physics, East Carolina University, Greenville, NC

[3] Indiana Geological Survey, Indiana University, Bloomington, IL

[4] Department of Earth, Planetary, and Space Sciences, University of California, Los Angeles, CA

[5] Department of Anthropology, University of Washington, Seattle, WA

[6] USU Luminescence Laboratory, Utah State University, North Logan, UT

[7] Department of Geology, Kansas State University, Manhattan, KS

*Corresponding Author: hgray@usgs.gov

Received: October 25, 2018

Introduction

The 12th annual New World Luminescence Dating Workshop (NWLDW) was hosted by Dr. Regina DeWitt of East Carolina University in Greenville, North Carolina from June 27-30, 2018. This workshop is annually attended by researchers and practitioners from across North and South America (Table 1). Attendees presented current research initiatives and discussed new scientific advances in luminescence dating via oral and poster presentations followed by question and answer sessions. In addition, attendees participated in multiple panel and working group discussions concerning future scientific research, community development, and scientific infrastructure.

Executive Summary

The NWLDW forum serves to gather scientists concerned with luminescence and ESR geochronology and technique development to discuss recent scientific advancements, establish collaborations, further educate students in the field of luminescence dating, and discuss initiatives relevant for the community. As the luminescence or "trapped charge" community expands, and a new generation of enthusiastic scientists enters the field, it has become necessary to formally collect and present the consensus of this community to the wider research community as is done in other fields (e.g., Huntington & Klepeis, 2017). As such, we wish to begin the publication of community-authored white papers, such as this one, stemming from the panel discussions at the 12th NWLDW. The purpose is to secure future educational requirements, and ensure community priorities are communicated to funding agencies, research groups abroad, and the general public. These initiatives include: (1) the development of a trapped-charge professional society, (2) the development of an open-source database to house luminescence age data, (3) a formal laboratory inter-comparison study, and (4) the development of calibration standards for various methods in luminescence dating. These discussions were constructive and fruitful with the conclusions being described in the following sections.

Intellectual Merit

Our knowledge of the scientific basis for luminescence dating, and the insights arising from its application, are expanding at an exponential pace (Nelson et al., 2015). Luminescence dating methods are being applied to a wide array of geologic environments, cultural sites and materials. Resulting ages are used to solve a variety of scientific problems (Rhodes, 2011; Smedley, 2018), and serve as an independent variable in studies requiring multi-level geochronology. Geologic and archaeologic problems in which luminescence dating has been applied range from quantifying rates and timing of surface processes (Rittenour, 2018) to constraining our evolution and origin as a species (Roberts & Jacobs, 2018). In addition to dating, novel applications of

Attendee Name	Title	Institution
Regina DeWitt	Associate Professor	East Carolina University
David Mallinson	Professor	East Carolina University
Zhengye Xiong:	Professor	Guangdong Ocean University
Joel Spencer	Associate Professor	Kansas State University
Vasilis Pagonis	Professor	McDaniel College
William Amidon	Associate Professor	Middlebury College
Michel Lamothe	Professor	University of Quebec - Montreal
James Feathers	Research Professor	University of Washington
Sebastian Huot	Research Scientist	Illinois State Geological Survey
Jose Luis Antinao	Research Scientist	Indiana Geological Survey
Shannon Mahan	Research Scientist	U.S. Geological Survey
Michelle Nelson	Laboratory Manager	Utah State University
Harrison Gray	Post-doctoral Researcher	U.S. Geological Survey
Nathan Brown	Post-doctoral Researcher	U. of California, Los Angeles
Kathleen Rodrigues	Ph.D Graduate Student	Desert Research Institute
Christopher Garcia	Ph.D Graduate Student	East Carolina University
Joel Pogue	Ph.D Graduate Student	East Carolina University
Laurence Forget Brisson	Ph.D Graduate Student	University of Quebec - Montreal
Marisa Schorr	M.S Graduate Student	Indiana University
Amy Cressman	M.S. Graduate Student	East Carolina University
Nina Ataee	M.S. Graduate Student	Kansas State University
Nicholas Kowalski	Undergraduate Student	East Carolina University
Mikaela Rader	Undergraduate Student	Kansas State University

Table 1. Attendee list for the 12th NWLDW meeting.

luminescence physics continue to develop at a rapid pace (Smedley, 2018). Some of these applications arising in the recent decade include thermoluminescence thermometry (Spencer & Sanderson, 2012; Spencer, 2012; Sanderson et al., 2014) low-temperature thermochronology (Brown et al., 2017; Herman & King, 2018), surface exposure dating and hard rock erosion rates (Sohbati et al., 2018; Gliganic et al., 2019), sediment tracing and provenance (Sawakuchi et al., 2018; Gray et al., 2018), and in-situ field measurements of natural luminescence characteristics (Sanderson & Murphy, 2010).

Broader Impacts

Luminescence shows excellent promise as a multi-purpose research tool, but further research and support is needed to maintain this momentum into the coming decade. The NWLDW community identifies the following areas as critical and cutting-edge research fronts:

- Advancement of novel applications of luminescence dating such as Martian deposits;
- An exploration of luminescence dating to new natural materials such as plant phytoliths and evaporites;
- Application of luminescence dating to new problems in geomorphology, climate change, and neotectonics;
- Investigations of the physical mechanisms for luminescence, including tunneling behavior of electrons, effects of impurities in crystal structures, and the effects of light attenuation through solid matter;
- Benchmarking of new luminescence thermochronology against established thermochronometric methods and improving applications to soils and crystalline bedrock;
- Development of theoretical models and collection of field data concerning the application of luminescence as a sediment tracer;
- Application of luminescence properties within soil profiles and at the soil-bedrock interface among other critical zone science matters;
- Utilizing thermoluminescence techniques to understand paleo-wildfires;
- Experimentation of luminescence and luminescence characteristics with doped synthetic quartz.

These topics are of importance to the community in terms of continuing progress and maintaining the momentum of the scientific progress displayed by luminescence science.

Luminescence beyond dating: Broader research goals

The above research fronts have been identified as high-priority by the NWLDW community for their relevance to broader research goals and for improving and expanding the capabilities of luminescence dating. First, the advancement of novel applications of luminescence dating is a logical expansion that builds on the previous successes of the method. One of the key benefits of luminescence is its broad applicability. For example, luminescence dating of Martian sediments (Kalchgruber, 2007), could help answer a broad array of unanswered questions relating to planetary formation and planetary climate change. On a similar note, plant phytoliths could potentially directly date preserved plant matter beyond radiocarbon dating (Rader & Spencer, 2018), and luminescence dating of evaporites could allow direct dating of playa sediments and associated landforms (Fitzgerald et al., 2017), which can act as key climate indicators. Recent dating work on historic attic dust contaminated with heavy metals (Alghamdi & Presley, 2016) is demonstrating the utility of luminescence chronology to very young sedimentary deposits of mm-thickness and is opening up potential application to areas such as environmental hazards, standing buildings, and forensic science (Spencer et al., 2017). Luminescence dating is also well suited to solve problems in climate change and tectonics, two fields of study that encompass a substantial research community. Finally, luminescence dating has been and continues to be a versatile and robust tool for archeological research over the past 20+ years (Feathers, 1997, 2003).

Beyond dating, luminescence is proving to be a useful research tool to directly quantify processes that shape the Earth's surface. Luminescence thermochronometry (Herman et al., 2010; Brown, 2017) allows us to constrain the thermal histories of quartz and feldspar crystals (Spencer, 2012). Luminescence thermochronometry is particularly useful in that luminescence measures a lower temperature range than other thermochronometers (Guralnik et al., 2013; Brown et al., 2017). This has opened the door for exploring new frontiers such as quantifying landscape exhumation rates (Herman & King, 2018), examining the heating of soil by wildfire (Rengers et al., 2017), and evaluating prospects for geothermal energy (Sanderson et al., 2014). However, luminescence thermochronometry is still a new technique and further cutting-edge research is needed benchmarking the technique against other thermochronometric methods. Likewise, luminescence sediment tracing and fingerprinting (Reimann et al., 2017; Portenga et al., 2017; Sawakuchi et al., 2018; Gray et al., 2018; Furbish et al., 2018) is developing as a new method that can quantify the provenance and rates of travel of sand grains in geomorphic environments such as rivers, hillslopes, and mixing soils. Together, luminescence thermochronology and luminescence sediment tracing can reveal information spanning from deep sources in the Earth to final sedimentary sinks on the surface. However, like luminescence thermochronology, luminescence sediment tracing is new and further studies exploring how specific geomorphic processes affect the luminescence of sand grains are needed.

Luminescence phenomena may also be utilized to better constrain events and quantify processes taking place in the soil profile or critical zone. One such example is wildfires, which are becoming more prevalent and covering ever-expanding areas. Cultural sites and materials in these fire-prone areas are at risk of losing their luminescence history if overrun by wildfire (Ideker et al., 2017). Big questions remain regarding wildfire temperature at the soil surface and at depth (Rengers et al., 2017). In general, luminescence is currently underutilized in soil science, and basic research in this unique application is needed to aid the quantification of soil mixing and soil production (Heimsath et al., 2002; Stockmann et al., 2013). These new applications of luminescence show promise but require a solid theoretical grounding. As such, further research on fundamental luminescence physics, such as tunneling of electrons, effects of impurities in crystal structures, and the effects of light attenuation in solid matter is needed.

Overall, the NWLDW community feels that there is significant and exciting potential within luminescence science. The topics above serve as key focal points for future research and the community desires to see progress on these fronts.

Laboratory Inter-comparison, Calibration, and Reporting Standards

The NWLDW community considers the development and execution of a laboratory inter-comparison study to be a key goal. This inter-comparison will help improve the reliability, accuracy, and precision of luminescence dating across the NWLDW community by allowing us to identify sources of dispersion in age estimates that do not appear during analysis by individual laboratories.

Recently, Murray et al. (2015) performed one of the first laboratory intercomparison studies. They noted larger than expected dispersions in ages estimated between laboratories (18% relative standard deviation) than the dispersion expected based on a "well behaved" sample (5-10% relative standard deviation). This additional dispersion arises from the dispersion found for equivalent dose and dose rate from individual laboratories. However, the exact causes of the dispersions in equivalent dose and dose rate determinations (particularly measurements of radiogenic isotope concentrations and water content) remain a rich topic for research.

A North American community wide inter-comparison would provide a robust method to compare individual laboratory results against community averages, which would identify sources of dispersions and help reduce the statistical dispersion in luminescence results between laboratories to that expected from intrinsic sample characteristics. We propose to do this through standardization of method reporting, establishment of community best-practices, and inter-laboratory comparison. Participation in this project would provide funding to obtain lab standardization and community-wide endorsement of luminescence laboratory products. A community wide effort combined with transparent and open access to data used to generate results from a wide set of users as explained below are the key components of building trust between scientists, practitioners and end-users of the technique.

Luminescence database

The rapid expansion of luminescence dating has led to an exponential increase in the number of ages and associated data. An unfortunate consequence of this rapid expansion is the risk of data loss or unavailability due to various factors including non-publication of data or publication behind journal paywalls. One solution is to create an open access luminescence database containing luminescence ages and dose rate chemistry data used to calculate these ages. Discussion by the NWLDW community is in favor of a database. However, it appears that questions remain as to whether the community prefers to develop a new database or to utilize existing web-based infrastructure, such as the new OCTOPUS: Open Cosmogenic Isotope and Luminescence Database (Codilean et al., 2018) or the Utah Geochronology Database (hosted by the Utah Geological Survey, UGS) as a repository for luminescence data. Currently, the OCTOPUS database is under peer review. The USGS has expressed interest in working with our community to make luminescence data available outside the state of Utah. The community is currently monitoring the development of these databases to see which may provide the service the community desires.

Trapped Charge Dating Association

The NWLDW community is in favor of a trapped charge professional association, proposed by the international luminescence community at the Luminescence and Electron Spin Resonance Dating (LED) meeting in South Africa (September 2017). Our community sees the development of the association as a welcome venue to: increase professional recognition and visibility of luminescence science, to develop credibility with large funding bodies such as NSF and NERC, to generate funds that support student research, and to increase interaction and collaboration with the broader international luminescence community. These topics should be incorporated into the mission of such an association. The NWLDW community is in general agreement with conclusions from previous discussions at the international level and with the minutes from the German LED meeting (October, 2017). Our only significant disagreement is that the NWLDW participants are largely in favor of Ancient TL serving as the primary journal for the association. Detailed minutes from the meeting discussions can be downloaded from http://ancienttl.org/TCDA/TCDA.htm.

Conclusions and Recommendations for the Future

We strongly encourage other North and South American luminescence laboratories to attend the NWLDW meetings when possible. Participation at these meetings allows for input on community white papers such as this one, which in turn help inform funding agencies on community priorities. Additionally, the NWLDW community strongly encourages student attendance and presentation at our meetings to foster educational growth for future luminescence specialists. As luminescence science is on the verge of a rapid expansion, funding support needs to be directed towards research areas which the community deems impactful. In addition, the creation of scientific infrastructure such as a luminescence database and calibration standards, is needed to streamline research efforts and to ensure maximum impact per research dollar. Finally, continued professional development of the community, through meetings and the creation of a trapped charge association, promotes collaborative and scientific outcomes.

References

Alghamdi, A.G., Spencer J.Q.G. and Presley, D. *Dating of Attic Dust at an Abandoned Mine in Central USA.* In *11th New World Luminescence Dating Workshop*, Lincoln, NE, USA., 2016. University of Nebraska.

Brown, N. D. *Using luminescence signals from bedrock feldspars for low-temperature thermochronology (Doctoral dissertation).* UCLA, 2017.

Brown, N. D., Rhodes, E. J., and Harrison, T. M. *Using thermoluminescence signals from feldspars for low-temperature thermochronology*. Quaternary Geochronology, 42: 31–41, 2017.

Codilean, A. T., Munack, H., Cohen, T. J., Saktura, W. M., Gray, A., and Mudd, S. M. *Octopus: An Open Cosmogenic Isotope and Luminescence Database*. Earth Syst. Sci. Data Discuss, 2018. URL https://doi.org/10.5194/essd-2018-32.

Feathers, J. K. *The application of luminescence dating in American archaeology*. Journal of Archaeological Method and Theory, 4 (1): 1–66, 1997.

Feathers, J. K. *Use of luminescence dating in archaeology*. Measurement Science and Technology, 14(9): 1493, 2003.

Fitzgerald, V. T., Spencer, J. Q. G., and Oviatt, C. G. *Development of gypsum dating methods: refining the timing of late regression of Lake Bonneville.* In *15th International Conference on Luminescence and Electron Spin Resonance Dating*, Capetown, South Africa, 2017.

Furbish, D. J., Roering, J. J., KeenZebert, A., Almond, P., Doane, T. H., and Schumer, R. *Soil particle transport and mixing near a hillslope crest: 2. Cosmogenic nuclide and optically stimulated luminescence tracers*. Journal of Geophysical Research: Earth Surface, 123(5): 1078–1093, 2018.

Gliganic, L. A., Meyer, M. C., Sohbati, R., Jain, M., and Barrett, S. *OSL surface exposure dating of a lithic quarry in Tibet: Laboratory validation and application*. Quaternary Geochronology, 49: 199–204, 2019.

Gray, H. J., Tucker, G. E., and Mahan, S. A. *Application of a luminescencebased sediment transport model*. Geophysical Research Letters, 45: 6071–6080, 2018.

Guralnik, B., Jain, M., Herman, F., Paris, R. B., Harrison, T. M., Murray, A. S., Valla, P. G., and Rhodes, E. J. *Effective closure temperature in leaky and/or saturating thermochronometers*. Earth and Planetary Science Letters, 384: 209–218, 2013.

Heimsath, A. M., Chappell, J., Spooner, N. A., and Questiaux, D. G. *Creeping Soil*. Geology, 30: 111–114, 2002.

Herman, F. and King, G. E. *Luminescence Thermochronometry: Investigating the Link between Mountain Erosion, Tectonics and Climate*. Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology, 14(1): 33–38, 2018.

Herman, F., Rhodes, E. J., Braun, J., and Heiniger, L. *Uniform erosion rates and relief amplitude during glacial cycles in the Southern Alps of New Zealand, as revealed from OSL-thermochronology*. Earth and Planetary Science Letters, 297: 183–189, 2010.

Huntington, K. W. and Klepeis, K. A. *Challenges and opportunities for research in tectonics: Understanding deformation and the processes that link Earth systems, from geologic time to human time*. A community vision document submitted to the US National Science Foundation. University of Washington, 2017. URL https://doi.org/10.6069/H52R3PQ5.

Ideker, C. J., Finley, J. B., Rittenour, T. M., and Nelson, M. S. *Single-grain optically stimulated luminescence dating of quartz temper from prehistoric Intermountain Ware ceramics, northwestern Wyoming, USA*. Quaternary Geochronology, 42: 42–55, 2017.

Kalchgruber, R., Blair M.W. McKeever S. W. S. Benton E.R. Reust D.K. *Progress towards robotic in-situ dating of martian sediments using optically stimulated luminescence*. Planetary and Space Science, 55: 2203–2217, 2007.

Murray, A., Buylaert, J. P., and Thiel, C. *A luminescence dating intercomparison based on a Danish beach-ridge sand*. Radiation Measurements, 81: 32–38, 2015.

Nelson, M. S., Gray, H. J., Johnson, J. A., Rittenour, T. M., Feathers, J. K., and Mahan, S. A. *User guide for luminescence sampling in archaeological and geological contexts*. Advances in Archaeological Practice, 3(2): 166–177, 2015.

Portenga, E. W., Bishop, P., Rood, D. H., and Bierman, P. R. *Combining bulk sediment OSL and meteoric 10Be fingerprinting techniques to identify gully initiation sites and erosion depths*. Journal of Geophysical Research: Earth Surface, 122(2): 513–527, 2017.

Rader, M. and Spencer, J. Q. G. *Plant Phytoliths as OSL Chronometers*. In *12th New World Luminescence Dating Workshop*, Greenville, NC, USA, 2018.

Reimann, Tony, Román-Sánchez, Andrea, Vanwalleghem, Tom, and Wallinga, Jakob. *Getting a grip on soil reworking–Single-grain feldspar luminescence as a novel tool to quantify soil reworking rates*. Quaternary Geochronology, 42: 1–14, 2017.

Rengers, F. K., Pagonis, V., and Mahan, S. A. *Can thermoluminescence be used to determine soil heating from a wildfire?* Radiation Measurements, 107: 119–127, 2017.

Rhodes, E. J. *Optically stimulated luminescence dating of sediments over the past 200,000 years*. Annual Review of Earth and Planetary Sciences, 39: 461–488, 2011.

Rittenour, T. M. *Dates and Rates of Earth-Surface Processes Revealed using Luminescence Dating*. Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology, 14(1): 21–26, 2018.

Roberts, R. G. and Jacobs, Z. *Timelines for Human Evolution and Dispersals*. Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology, 14(1): 27–32, 2018.

Sanderson, D. C. W. and Murphy, S. *Using simple portable OSL measurements and laboratory characterization to help understand complex and heterogeneous sediment sequences for luminescence dating*. Quaternary Geochronology, 5: 299–305, 2010.

Sanderson, D. C. W., Kinnaird, T. C., Turner, C., Stephens, W. E., Kukkonen, I. T., and Spencer, J. Q. G. *TL methods for geothermal resource evaluation: appraising onset temperature methods for recovering thermal histories. 14th International Conference on Luminescence and Electron Spin Resonance Dating*. In *July 2014*, pp. 7–11, Canada, 2014. Montral.

Sawakuchi, A. O., Jain, M., Mineli, T. D., Nogueira, L., Bertassoli, D. J., Hggi C., and Zabel, M. *Luminescence of quartz and feldspar fingerprints provenance and correlates with the source area denudation in the Amazon River basin*. Earth and Planetary Science Letters, 492: 152–162, 2018.

Smedley, R. K. *Telling the time with dust, sand and rocks*. Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology, 14(1): 9–14, 2018.

Sohbati, R., Liu, J., Jain, M., Murray, A., Egholm, D., Paris, R., and Guralnik, B. *Centennial-to millennial-scale hard rock erosion rates deduced from luminescence-depth profiles*. Earth and Planetary Science Letters, 493: 218–230, 2018.

Spencer, J. Q. G. *What can feldspar TL tell us about thermal history?* In *Eighth New World Luminescence Dating Workshop*, UCLA, 2012.

Spencer, J. Q. G. and Sanderson, D. C. W. *Decline in firing technology or poorer fuel resources? High-temperature thermoluminescence (HTTL) archaeothermometry of Neolithic ceramics from Orkney, Scotland*. Journal of Archaeological Science, 39: 3542–3552, 2012.

Spencer, J. Q. G., Alghamdi, A. G., Presley, D., Huot, S., Martin, L., and Mercier, N. *Attic dust from historic buildings: progress dating young mm-thick layers.* In *15th International Conference on Luminescence and Electron Spin Resonance Datingr*, Capetown, South Africa, 2017.

Stockmann, U., Minasny, B., Pietsch, T. J., and McBratney, A. B. *Quantifying processes of pedogenesis using optically stimulated luminescence*. European Journal of Soil Science, 64: 145–160, 2013.

Editor's Note:

This manuscript is not a research article. It is a white paper based on consense of the New World community. Instead of a peer review, the white paper has been revised based on suggestions by the Editor.

Thesis Abstracts

Index

John Christodoulakis

Paleoenvironmental reconstruction of southwestern Peloponnesus using luminescence dating techniques

June 2018

Section of Environmental Physics and Meteorology, Faculty of Physics, National and Kapodistrian University of Athens
in collaboration with
Laboratory of Archaeometry, Institute of Nanoscience and Nanotechnology, National Centre for Scientific Research "Demokritos", Athens, Greece

Degree: Ph.D.
Supervisors: Costas Varotsos, Yannis Bassiakos, Despoina Deligiorgi

In this thesis are presented the findings of the paleoenvironmental research performed in the wider region of the southwestern Peloponnesus, Greece, and more precisely at the coastal areas of Mani peninsula, Ormos Dyrou and the greater area of Areopoli. This region was chosen as it combines two distinct features. Firstly, the terrestrial and coastal sedimentary deposits formed there comprise a unique natural "archive" which offers the opportunity for detailed investigations on regional paleoenvironmental changes, extended back to hundreds of thousands of years. Secondly, because of its great paleoanthropological importance as it is evident by the relevant findings of many researches.

A significant part of this study was aimed in defining the chronological framework of the paleoenvironmental changes "recorded" in sedimentary deposits. For this reason, Optically Stimulated Luminescence (OSL) dating technique was used. In total, 24 sedimentary samples were collected from 4 different areas, within the studied region. These samples were originated from fluvial, colluvial and coastal depositional environments. The estimated ages cover specific parts of the total period from 200 ka to 0.35 ka. During this research, OSL dating technique was, for first time at the specific region, evaluated against radiocarbon dating. The obtained results indicated that OSL age estimations agree within a range of about 13% with radiocarbon age estimations, a finding which confirmed that OSL dating technique can be used for further research. It was also revealed that stratigraphic layers which have experienced geological processes, such as calcification, exhibit overestimated OSL ages.

In the context of this research, paleotemperature and paleoprecipitation estimations were made by applying appropriate empirical functions, available in literature. These functions make use of geochemical composition and some other physico-chemical characteristics of paleosols. According to the obtained results, at 35 ka the mean temperature and annual precipitation at the studied region were about $12 \pm 4°C$ and 256 ± 181 mmy^{-1}, respectively. Another finding is that during the period 2.5 to 0.35 ka the mean temperature was constant at about $15 \pm 4°C$ while the annual precipitation was also constant at about 1200 ± 181 mmy^{-1}.

Another part of the research was dedicated to the Ionian Sea sea-level reconstruction for the period of the last 250 ka and its association with other paleoenvironmental findings. For the reconstruction were used benthic foraminifera isotopic records available in literature. The obtained sea-level estimation at 190 to 200 ka denotes that sea-level was about the same position as today. This conclusion agrees with the age of modern marine terrace, 184 ± 17 ka, which was dated during the research. Another interesting finding is that sea-level at about 125 ka was around the same position to 1 m higher than today. This finding also agrees with other paleoenvironmental findings, like the ages of fluvial samples collected from the area.

During this study, two Java software tools, DRc (Dose Rate calculator) and AMc (Age Models calculator), were also developed. Both tools are freely available on the web. DRc facilitates the calculation of dose rates and age determinations of materials, for use in palaeodosimetric dating methods. The software runs in a user-friendly interface and provides a number of user controllable features. Dose rates are calculated using updated conversion and attenuation factors. AMc brings together the majority of the available age models (Common, Central, Minimum, Maximum Age Models, Finite Mixture Model and others) and it has also the ability to implement the age model decision procedure developed by R.M. Bailey and L.J. Arnold.

Those who are interested in this thesis (available only in Greek language) can ask Dr J. Christodoulakis ichristodoulakis@inn.demokritos.gr for a copy.

Nina Dörschner

Optically stimulated luminescence dating of Palaeolithic cave sites and their environmental context in the western Mediterranean

May 2018

Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany
and
Leiden University, Faculty of Archaeology, Leiden, Netherlands

Degree: Ph.D.
Supervisors:K.E. Fitzsimmons and J.-J. Hublin

The western Mediterranean is a key region to understand human dispersal events within and out of the African continent as well as for the eventual replacement of Neanderthals by anatomically modern humans during the Pleistocene. Palaeolithic cave sites safely store records of hominin presence and lifestyle at a certain time in a certain region and can, furthermore, yield useful information about past environmental conditions. Central to any conclusive interpretation of archaeological and palaeoclimatic datasets is the establishment of a reliable chronostratigraphic framework for the investigated site.

Optically stimulated luminescence (OSL) dating provides an estimate of the time elapsed since quartz or feldspar minerals were last exposed to sunlight. The technique, therefore, enables determination of the burial age of sediments at geoscientific and archaeological sites. Single-grain OSL dating is of particular importance in the latter context, as stratigraphical layers at those sites are regularly affected by e.g. post-depositional mixing due to natural or anthropogenic processes, which can result in significant over- or underestimation of the true burial age when using multiple-grain dating approaches.

In this thesis, single-grain OSL dating was used to investigate the general luminescence characteristics of the sedimentary deposits at three Palaeolithic cave sites in the western Mediterranean - the Thomas Quarries and Rhafas, both Morocco, and Vanguard Cave, Gibraltar - and to identify potential factors that might falsely alter their determined burial ages to eventually provide reliable chronologies for those sites. Dating results were coupled with archaeological, sedimentological and geological proxy data to allow conclusive statements regarding the timing of human occupation phases and the appearance of technological innovations at the sites, local site formation processes and palaeoenvironmental conditions in the region in the past.

Individual grains from all three sites generally exhibit bright and fast component dominated luminescence signals. Challenges for OSL dating of the samples primarily arise from i) single grains affected by signal saturation, ii) individual grains unable to recover known laboratory doses with sufficient accuracy, iii) heterogeneous dose rates or changes in dose rates over time, and iv) post-depositional mixing of sediment layers.

OSL chronologies were developed for stratigraphical sequences at Rhafas and Vanguard Cave, while single-grain dating turned out to be an inadequate technique for age determination of the Thomas Quarries sediments. Rhafas covers a time period from >135 ka to the Neolithic, including a technological shift from classical MSA to Aterian after 123 ka, LSA industries dated to ∼21 ka and ∼15 ka and evidence of climatic conditions that favoured intensive carbonate formation during MIS 3 and MIS 2 at the site. Vanguard Cave preserves a record of rapid aeolian sedimentation between MIS 5 and ∼43 ka with evidence for repeated occupation by Neanderthals. The sedimentary record of the site suggests that relatively stable mild and sub-humid Mediterranean climatic conditions persisted in the area throughout its entire depositional history.

The thesis is available for download from https://openaccess.leidenuniv.nl/handle/1887/62212

Johannes Friedrich

Modelling quartz luminescence signal dynamics relevant for dating and dosimetry

June 2018

Chair of Geomorphology, University of Bayreuth, Germany

Degree: Dr. rer. nat.
Supervisor: Dr. Christoph Schmidt

Thermoluminescence (TL) and optically stimulated luminescence (OSL) are well-established methods in geoscience, e.g., used to date archaeological sites or quaternary sediments. Quartz is well suited for that purpose because it is the second most abundant mineral in Earth's continental crust. Numerical simulations, especially coupled differential equations, can help to understand the complex system of charge carrier transport in the quartz crystal because the solutions of these differential equations describe the charge carrier movement by time. In 2001 a comprehensive quartz model was published which was able to describe many known effects and phenomena concerning quartz luminescence in the UV spectrum (ultra-violet). This publication is the foundation of many more published models in recent years. Nevertheless, the luminescence emitted while irradiating quartz with ionising radiation, known as radiofluorescence (RF), was not well implemented in the model, because even basic observations are not reproducible. Radiofluorescence offers some key advantages, e.g., direct and real-time observation of temperature-driven effects on luminescence production.

This thesis presents fundamental experimental UV-RF investigations and the qualitatively successful simulation of RF and other luminescence signals and phenomena. Published quartz models and parameters had been gathered in an open-source software package called RLumModel. The software has been designed for simplicity to allow use without deep knowledge of programming or physical understanding of the model. Fundamental behaviour of UV-RF signals was tested by annealing to different temperatures before UV-RF measurement. The maximum signal intensity was measured after annealing to $\sim$550°C. Numerical simulations are able to reproduce this characteristic after some modifications of charge carrier concentrations in the model parameters. Further investigations on the dose rate dependence of the UV-RF signal fulfill theoretical findings that the signal intensity is linearly-dependent on the dose rate and the slope of the initial UV-RF signal is linearly-dependent on the squared dose rate. Again, after some parameter modifications the numerical simulations are able to mimic this behaviour. It was remarkable that in all numerical investigations a simple three-energy-level model was able to simulate the main characteristics of the observed effects. Due to this, analytical solutions for the UV-RF signal dynamic were derived. The finding from these analytical solutions is a fitting function for UV-RF signals which is a composite of two exponential functions: an increasing and a decreasing exponential. This behaviour is not restricted to the UV band and can also be transferred to other emission bands.

Investigating quenching mechanisms in quartz yield the power of RF for further applications because RF offers the possibility to measure, e.g., thermal-quenching more directly. With these measurements it is possible to directly calculate thermal quenching parameters which can be implemented in the numerical model. Another phenomenon, called dose-quenching, can also be measured more directly. Comparisons with other methods measuring quenching effects show the possibilities of RF as analysis tool in quartz luminescence. Both quenching effects were also simulated and are again in accordance with experimental results. In addition to that, long-known effects such as the UV-reversal were also analysed more directly via UV-RF and confirm the idea of reversibility of annealing and UV illumination. Another application is the determination of absorbed doses with UV-RF, which was first found by numerical simulations. Further experimental data confirm that the new developed measurement protocol is able to recover doses up to $\sim$300 Gy with an accuracy of $\pm$ 10% with UV-RF. Possible applications of this method range from source calibration to dating of annealed material, e.g., ceramics.

Generating predictions from simulations (forward modelling) needs appropriate parameters. To get these parameters, sensitivity analysis of the used parameter sets was applied to extract parameters influencing the outcome of the simulations most. Subsequently these parameters were adjusted by fitting them to luminescence signals (inverse modelling). This method was used to fit the model with TL and OSL signals. Sensitivity analysis and inverse modelling are also included in the software package RLumModel. This will help saving measurement time because users can first simulate their sequences. To develop further methods to calculate RF signals from models, the first ideas and results from Monte-Carlo simulations for quartz RF are presented and compared to established numerical methods. This thesis shows that the interaction of experiments and simulations offers a comprehensive understanding of luminescence. Furthermore, it has been shown that radiofluorescence of quartz has a wide range of applications and provides important insights into charge carrier distributions in quartz crystals. Different radiofluorescence phenomena can be explained with the energy-band-model and can be implemented seamlessly in existing models by adjusting model parameters.

Harrison J. Gray

Traveling at the speed of light: luminescence as a means to quantify sediment transport rates

July, 2018

University of Colorado - Boulder

Degree: Ph.D.
Supervisor: Professor Gregory E. Tucker

Sediment tracing over long timescales (10,000 - 100,000's of years) is difficult because of a lack of applicable methods. This is a problem because quantifying the movement of sediment over long timescales is needed to answer questions about landscape evolution and sediment transport. Luminescence, a property of minerals such as quartz and feldspar, has potential as a sediment tracing tool. Luminescence is a dynamic property that decreases while in sunlight and increases while buried in sedimentary deposits. As grains of quartz and feldspar sand are transported across landscapes, they experience varying intervals of sunlight exposure and burial. This can be exploited to uncover new information on sediment transport.

This dissertation explores and develops the use of luminescence as a sediment tracer in geomorphic environments. First, I describe a new theoretical model for luminescence as a sediment tracer in fluvial environments. This model is derived from a combined conservation of sediment mass and absorbed radiative energy as luminescence. I show that predictions from the model match previously published data and I show that by fitting the model to field data, the model can be used to estimate parameters relevant to sediment transport. Next, I describe a field-based study applying the theoretical model to new field data obtained from the mid-Atlantic region of the United States. I show that in rivers where the model assumptions are applicable, the model can reproduce sediment transport information obtained from non-luminescence methods. Changes in lithology, hillslope sediment flux, or anthropogenic modification, requires a greater collection of field data and can preclude the use of the simplified form of the model. To expand luminescence up to the landscape scale, I introduce a theoretical model of luminescence in hillslope soils and compare the model with previously published data to quantify new soil mixing rates. Both the river and hillslope applications of luminescence show significant potential for uncovering new information on sediment transport.

A PDF of this thesis can be requested from the author at:
harrison.gray@colorado.edu

Brice Lebrun

Defining the chronology of prehistoric sequences in the Falémé valley (Sénégal); contribution of new micro-dosimetry techniques to luminescence dating

January 2018
IRAMAT-CRP2A, Bordeaux Montaigne University, France

Degree: Ph.D.
Supervisors: Norbert Mercier, Chantal Tribolo

Our work is part of a West African Prehistory documentation dynamic. Compared to other regions of this continent, research in this area is still scarce. Our aim was to establish a chrono-cultural framework of the Falémé Valley archaeological sites located in Eastern Senegal by applying the OSL dating method. For this purpose, 86 samples were taken and dated from around 20 sites throughout the valley.

Thanks to relatively continuous sedimentary records, a chronology of different lithic techno-complexes has been established. Acheulean industries date back to at least 90 ka while the bifacial-shaped pieces that typically characterize the Middle Stone Age can be dated to MIS3. Meanwhile, Late Stone Age industries (microlithic and geometric microlithic) are dated circa 15 to 10 ka.

The need to document the chronology of prehistoric cultures has led us to carry out some methodological developments. To properly assess the micro-dosimetry of our samples, we used several techniques such as an imaging system (β autoradiography) and a numerical simulation (DosiVox-2D). These methodological developments have inter alia shown that classical models tend to bias the dose rate and thus the dates.

On the basis of our work, the Falémé Valley is therefore presented as the new sequence of reference for West African Prehistory, alongside the work that has been done in the Ounjougou complex in Mali.

Junjie Zhang

Applications of optically stimulated luminescence dating in the Chinese Loess Plateau

November 2018
Department of Earth Sciences, The University of Hong Kong, Hong Kong, China

Degree: Ph.D.
Supervisor: Dr. Sheng-Hua Li

Dose recovery studies with K-feldspar samples show that the electron trapping probability change of low-temperature IRSL signals caused by the first preheat treatment could result in age underestimation, with the single-aliquot regenerative-dose (SAR) dating protocol. However, the multi-elevated-temperature post-IR IRSL (MET-pIRIR) signal at 250°C does not have this problem. With the multiple-aliquot regenerative-dose (MAR) protocol or the modified SAR protocol with solar bleaching behind each cycle, this kind of age underestimation could also be avoided.

Standard growth curves (SGCs) for K-feldspar, plagioclase and polymineral fractions of northern China have been constructed, to improve the dating efficiency. For coarse grains (63-180 μm), the SGCs are quite similar between K-feldspar, plagioclase and polymineral fractions. But the fine-grain fraction (4-11 μm) has a distinct SGC, which is supposed to be a result of alpha irradiation. With the SGCs, the time used to measure the equivalent dose is only one third of the time needed before.

The loess-paleosol sequence in the Chines Loess Plateau (CLP) is an important paleoclimate archive. However, the assumption of continuous loess deposition has been questioned in recent years. Several studies proposed that loess was of high mobility, with frequent wind erosion and dust recycling. Huge age hiatuses of $\sim$60 ka were also identified in the north margin of CLP. In this study, high-resolution OSL dating is performed from S1 layer to L4 layer in Luochuan section, central CLP. With the up-to-date dating protocol, the loess has been successfully dated back to $\sim$350 ka. An age hiatus of $\sim$10 ka is discovered at the top of L2 layer. But, it is proved to be a fake age one resulted from the wrongly estimated dose rates, due to the carbonate leaching and accumulation process. The continuity of loess deposition in Luochuan section has been confirmed for the last three glacial-interglacial cycles. And it further indicates that loess deposition should be continuous over the whole Quaternary period in the central CLP. Previous paleoclimate reconstructions based on astronomically tuned ages are of high reliability.

Quartz OSL sensitivity variation has been studied in Luochuan and Jingyuan sections. The OSL sensitivity in Luochuan section is overall higher than that in Jingyuan section. Particularly, the sensitivity in paleosol layers could be 20 times higher than that of loess layers in Luochuan section, which cannot be explained by different provenances or deposition/transportation cycles, but can be reasonably explained by wildfire heating. Quartz OSL sensitivity can be applied as a new proxy for paleo-wildfires.

Bibliography

Compiled by Sebastien Huot

From 15th May 2018 to 30th November 2018

Various geological applications

- aeolian

Bernhardson, M., Alexanderson, H., 2018. Early Holocene NW-W winds reconstructed from small dune fields, central Sweden. Boreas 47, 869-883, http://doi.org/10.1111/bor.12307

Bosq, M., Bertran, P., Degeai, J.-P., Kreutzer, S., Queffelec, A., Moine, O., Morin, E., 2018. Last Glacial aeolian landforms and deposits in the Rhône Valley (SE France): Spatial distribution and grain-size characterization. Geomorphology 318, 250-269, http://doi.org/10.1016/j.geomorph.2018.06.010

Breuning-Madsen, H., Bird, K.L., Balstrøm, T., Elberling, B., Kroon, A., Lei, E.B., 2018. Development of plateau dunes controlled by iron pan formation and changes in land use and climate. CATENA 171, 580-587, http://doi.org/10.1016/j.catena.2018.07.011

Ellwein, A., McFadden, L., McAuliffe, J., Mahan, S., 2018. Late Quaternary Soil Development Enhances Aeolian Landform Stability, Moenkopi Plateau, Southern Colorado Plateau, USA. Geosciences 8, 146, http://www.mdpi.com/2076-3263/8/5/146

Kasse, C., Tebbens, L.A., Tump, M., Deeben, J., Derese, C., De Grave, J., Vandenberghe, D., 2018. Late Glacial and Holocene aeolian deposition and soil formation in relation to the Late Palaeolithic Ahrensburg occupation, site Geldrop-A2, the Netherlands. 97, 3-29, http://doi.org/10.1017/njg.2018.1

Pilote, L.-M., Garneau, M., Van Bellen, S., Lamothe, M., 2018. Multiproxy analysis of inception and development of the Lac-à-la-Tortue peatland complex, St Lawrence Lowlands, eastern Canada. Boreas 47, 1084-1101, http://doi.org/10.1111/bor.12337

White, J.L., Lindsey, K.O., Morgan, M.L., Mahan, S.A., 2017. OF-17-05 Geologic Map of the Fountain Quadrangle, El Paso County, Colorado. Open File Reports. Golden, CO: Colorado Geological Survey, https://store.coloradogeologicalsurvey.org/product/geologic-map-fountain-quadrangle-el-paso-colorado/

Zeng, L., Yi, S., Lu, H., Chen, Y., Lei, F., Xu, Z., Wang, X., Zhang, W., 2018. Response of dune mobility and pedogenesis to fluctuations in monsoon precipitation and human activity in the Hulunbuir dune field, northeastern China, since the last deglaciation. Global and Planetary Change 168, 1-14, http://doi.org/10.1016/j.gloplacha.2018.06.001

- alluvial fan

An, F., Liu, X., Zhang, Q., Wang, Y., Chen, T., Yu, L., Lu, B., Chang, Q., 2018. Drainage geomorphic evolution in response to paleoclimatic changes since 12.8 ka in the eastern Kunlun Mountains, NE Qinghai-Tibetan Plateau. Geomorphology 319, 117-132, http://doi.org/10.1016/j.geomorph.2018.07.016

Dosseto, A., May, J.-H., Choi, J.-H., Swander, Z.J., Fink, D., Korup, O., Hesse, P., Singh, T., Mifsud, C., Srivastava, P., 2018. Late quaternary fluvial incision and aggradation in the Lesser Himalaya, India. Quaternary Science Reviews 197, 112-128, http://doi.org/10.1016/j.quascirev.2018.07.035

Li, Y., Armitage, S.J., Stevens, T., Meng, X., 2018. Alluvial fan aggradation/incision history of the eastern Tibetan plateau margin and implications for debris flow/debris-charged flood hazard. Geomorphology 318, 203-216, http://doi.org/10.1016/j.geomorph.2018.06.016

- cave

Bacon, A.-M., Duringer, P., Westaway, K., Joannes-Boyau, R., Zhao, J.-x., Bourgon, N., Dufour, E., Pheng, S., Tep, S., Ponche, J.-L., Barnes, L., Blin, A., Patole-Edoumba, E., Demeter, F., 2018. Testing the savannah corridor hypothesis during MIS2: The Boh Dambang hyena site in southern Cambodia. Quaternary International 464, 417-439, http://doi.org/10.1016/j.quaint.2017.10.047

Klasen, N., Kehl, M., Mikdad, A., Brückner, H., Weniger, G.-C., 2018. Chronology and formation processes of the Middle to Upper Palaeolithic deposits of Ifri n'Ammar using multi-method luminescence dating and micromorphology. Quaternary International 485, 89-102, http://doi.org/10.1016/j.quaint.2017.10.043

Veres, D., Cosac, M., Schmidt, C., Murătoreanu, G., Hambach, U., Hubay, K., Wulf, S., Karátson, D., 2018. New chronological constraints for Middle Palaeolithic (MIS 6/5-3) cave sequences in Eastern Transylvania, Romania. Quaternary International 485, 103-114, http://doi.org/10.1016/j.quaint.2017.07.015

- coastal

Bitinas, A., Dobrotin, N., Buynevich, I.V., Molodkov, A., Damušytė, A., Pupienis, D., 2018. Coastal dune dynamics along the northern Curonian Spit, Lithuania: toward an integrated database. Geological Quarterly 62, http://doi.org/10.7306/gq.1435

Clemmensen, L.B., Hougaard, I.W., Murray, A.S., Pedersen, S.S., 2018. A high-resolution sea-level proxy dated using quartz OSL from the Holocene Skagen Odde spit system, Denmark. Boreas 47, 1184-1198, http://doi.org/10.1111/bor.12319

Lampe, M., Lampe, R., 2018. Evolution of a large Baltic beach ridge plain (Neudarss, NE Germany): A continuous record of sea-level and wind-field variation since the Homeric Minimum. Earth Surface Processes and Landforms 43, 3042-3056, http://doi.org/10.1002/esp.4468

Li, Y., Shang, Z., Tsukamoto, S., Tamura, T., Yi, L., Wang, H., Frechen, M., Li, J., Jiang, X., 2018. Quartz and K-feldspar luminescence dating of sedimentation in the North Bohai coastal area (NE China) since the late pleistocene. Journal of Asian Earth Sciences 152, 103-115, http://doi.org/10.1016/j.jseaes.2017.10.036

Lüthgens, C., Ho, L.-D., Clemenz, N., Chen, J.-H., Jen, C.-H., Yen, J.-Y., Chyi, S.-J., 2018. The Holocene paleo-environmental history of the Gangkou River estuary, Hengchun Peninsula, Taiwan. Terrestrial, Atmospheric and Oceanic Sciences 29, 547-576, http://doi.org/10.3319/TAO.2018.05.07.01

Raff, J.L., Shawler, J.L., Ciarletta, D.J., Hein, E.A., Lorenzo-Trueba, J., Hein, C.J., 2018. Insights into barrier-island stability derived from transgressive/regressive state changes of Parramore Island, Virginia. Marine Geology 403, 1-19, http://doi.org/10.1016/j.margeo.2018.04.007

Tarı, U., Tüysüz, O., Blackwell, B.A.B., Mahmud, Z., Florentin, J.A., Qi, J., Genç, Ş.C., Skinner, A.R., 2018. Sealevel change and tectonic uplift from dated marine terraces along the eastern Mediterranean coast, southeastern Turkey. Palaeogeography, Palaeoclimatology, Palaeoecology 511, 80-102, http://doi.org/10.1016/j.palaeo.2018.07.003

Tõnisson, H., Suursaar, Ü., Kont, A., Muru, M., Rivis, R., Rosentau, A., Tamura, T., Vilumaa, K., 2018. Rhythmic Patterns of Coastal Formations as Signs of Past Climate Fluctuations on Uplifting Coasts of Estonia, the Baltic Sea. Journal of Coastal Research 85, 611-615, http://doi.org/10.2112/si85-123.1

Zular, A., Utida, G., Cruz, F.W., Sawakuchi, A.O., Wang, H., Bícego, M., Giannini, P.C.F., Rodrigues, S.I., Garcia, G.P.B., Vuille, M., Sifeddine, A., Zocatelli, R., Turcq, B., Mendes, V.R., 2018. The effects of mid-Holocene fluvio-eolian interplay and coastal dynamics on the formation of dune-dammed lakes in NE Brazil. Quaternary Science Reviews 196, 137-153, http://doi.org/10.1016/j.quascirev.2018.07.022

- coastal (estuary)

Botha, G.A., Porat, N., Haldorsen, S., Duller, G.A.T., Taylor, R., Roberts, H.M., 2018. Beach ridge sets reflect the late Holocene evolution of the St Lucia estuarine lake system, South Africa. Geomorphology 318, 112-127, http://doi.org/10.1016/j.geomorph.2018.06.001

- coastal (fluvial)

De Clercq, M., Missiaen, T., Wallinga, J., Zurita Hurtado, O., Versendaal, A., Mathys, M., De Batist, M., 2018. A well-preserved Eemian incised-valley fill in the southern North Sea Basin, Belgian Continental Shelf - Coastal Plain: Implications for northwest European landscape evolution. Earth Surface Processes and Landforms 43, 1913-1942, http://doi.org/10.1002/esp.4365

- earthquake (and fault related)

Bennett, S.E.K., DuRoss, C.B., Gold, R.D., Briggs, R.W., Personius, S.F., Reitman, N.G., Devore, J.R., Hiscock, A.I., Mahan, S.A., Gray, H.J., Gunnarson, S., Stephenson, W.J., Pettinger, E., Odum, J.K., 2018. Paleoseismic Results from the Alpine Site, Wasatch Fault Zone: Timing and Displacement Data for Six

Holocene Earthquakes at the Salt Lake City–Provo Segment Boundary. Bulletin of the Seismological Society of America 108, 3202-3224, http://doi.org/10.1785/0120160358
Carlson, B.M., Schermer, E.R., Amos, C.B., Stephenson, W.J., Sherrod, B.L., Mahan, S.A., 2018. Holocene Fault Reactivation in the Eastern Cascades, Washington. Bulletin of the Seismological Society of America 108, 2614-2633, http://doi.org/10.1785/0120170228
Charreau, J., Saint-Carlier, D., Lavé, J., Dominguez, S., Blard, P.-H., Avouac, J.-P., Brown, N.D., Malatesta, L.C., Wang, S., Rhodes, E.J., 2018. Late Pleistocene acceleration of deformation across the northern Tianshan piedmont (China) evidenced from the morpho-tectonic evolution of the Dushanzi anticline. Tectonophysics 730, 132-140, http://doi.org/10.1016/j.tecto.2018.02.016
Deev, E., Turova, I., Borodovskiy, A., Zolnikov, I., Pozdnyakova, N., Molodkov, A., 2019. Large earthquakes in the Katun Fault zone (Gorny Altai): Paleoseismological and archaeoseismological evidence. Quaternary Science Reviews 203, 68-89, http://doi.org/10.1016/j.quascirev.2018.11.009
Dong, S., Zhang, P., Zheng, W., Yu, Z., Lei, Q., Yang, H., Liu, J., Gong, H., 2018. Paleoseismic observations along the Langshan range-front fault, Hetao Basin, China: Tectonic and seismic implications. Tectonophysics 730, 63-80, http://doi.org/10.1016/j.tecto.2018.02.012
DuRoss, C.B., Bennett, S.E.K., Briggs, R.W., Personius, S.F., Gold, R.D., Reitman, N.G., Hiscock, A.I., Mahan, S.A., 2018. Combining Conflicting Bayesian Models to Develop Paleoseismic Records: An Example from the Wasatch Fault Zone, Utah. Bulletin of the Seismological Society of America 108, 3180-3201, http://doi.org/10.1785/0120170302
DuRoss, C.B., Hylland, M.D., Hiscock, A.I., Personius, S.F., Briggs, R.W., Gold, R.D., Beukelman, G.S., McDonald, G.N., Erickson, B.A., McKean, A.P., Angster, S.J., King, R., Crone, A.J., Mahan, S.A., 2017. Holocene Surface-Faulting Earthquakes at the Spring Lake and North Creek Sites on the Wasatch Fault Zone: Evidence for Complex rupture of the Nephi Segment Utah Geological Survey Special Study 159, https://ugspub.nr.utah.gov/publications/special_studies/ss-159/ss-159.pdf
Elliott, A.J., Oskin, M.E., Liu-zeng, J., Shao, Y.X., 2018. Persistent rupture terminations at a restraining bend from slip rates on the eastern Altyn Tagh fault. Tectonophysics 733, 57-72, http://doi.org/10.1016/j.tecto.2018.01.004
Gellman, Y., Matmon, A., Mushkin, A., Porat, N., 2018. Drainage system reorganization and late Quaternary tectonic deformation along the southern Dead Sea Transform. Quaternary Research 90, 380-393, http://doi.org/10.1017/qua.2018.53
Le Béon, M., Tseng, Y.-C., Klinger, Y., Elias, A., Kunz, A., Sursock, A., Daëron, M., Tapponnier, P., Jomaa, R., 2018. High-resolution stratigraphy and multiple luminescence dating techniques to reveal the paleoseismic history of the central Dead Sea fault (Yammouneh fault, Lebanon). Tectonophysics 738-739, 1-15, http://doi.org/10.1016/j.tecto.2018.04.009
Piety, L.A., Redwine, J.R., Derouin, S.A., Prentice, C.S., Kelson, K.I., Klinger, R.E., Mahan, S., 2018. Holocene Surface Ruptures on the Salinas Fault and Southeastern Great Southern Puerto Rico Fault Zone, South Coastal Plain of Puerto Rico. Bulletin of the Seismological Society of America 108, 619-638, http://doi.org/10.1785/0120170182
Qiu, D., Liu, Q., Yun, J., Jin, Z., Zhu, D., Li, T., Sun, D., 2018. Electron spin resonance (ESR) dating of pre-Quaternary faults in the Sichuan basin, SW China. Journal of Asian Earth Sciences 163, 142-151, http://doi.org/10.1016/j.jseaes.2018.06.011
Salisbury, J.B., Arrowsmith, J.R., Brown, N., Rockwell, T., Akciz, S., Ludwig, L.G., 2018. The Age and Origin of Small Offsets at Van Matre Ranch along the San Andreas Fault in the Carrizo Plain, California. Bulletin of the Seismological Society of America 108, 639-653, http://doi.org/10.1785/0120170162
Srivastava, V., Mukul, M., Barnes, J.B., Mukul, M., 2018. Geometry and kinematics of Main Frontal thrust-related fault propagation folding in the Mohand Range, northwest Himalaya. Journal of Structural Geology 115, 1-18, http://doi.org/10.1016/j.jsg.2018.06.022

- fluvial

Cloete, G., Benito, G., Grodek, T., Porat, N., Enzel, Y., 2018. Analyses of the magnitude and frequency of a 400-year flood record in the Fish River Basin, Namibia. Geomorphology 320, 1-17, http://doi.org/10.1016/j.geomorph.2018.07.025
Daley, J., Cohen, T., 2018. Climatically-Controlled River Terraces in Eastern Australia. Quaternary 1, 23, http://doi.org/10.3390/quat1030023
De Clercq, M., Missiaen, T., Wallinga, J., Zurita Hurtado, O., Versendaal, A., Mathys, M., De Batist, M., 2018. A well-preserved Eemian incised-valley fill in the southern North Sea Basin, Belgian Continental Shelf - Coastal Plain: Implications for northwest European landscape evolution. Earth Surface Processes and Landforms 43, 1913-1942, http://doi.org/10.1002/esp.4365

De La Garza, R.G., González, J.L., Shen, Z., 2018. Luminescence chronology of a Mass Grave of Giant Gopher Tortoises (Gopherus hexagonatus), Willacy County, TX. Bulletin of the South Texas Geological Society 59, 20-33,

Delmas, M., Calvet, M., Gunnell, Y., Voinchet, P., Manel, C., Braucher, R., Tissoux, H., Bahain, J.-J., Perrenoud, C., Saos, T., 2018. Terrestrial 10Be and electron spin resonance dating of fluvial terraces quantifies quaternary tectonic uplift gradients in the eastern Pyrenees. Quaternary Science Reviews 193, 188-211, http://doi.org/10.1016/j.quascirev.2018.06.001

Gadot, Y., Elgart-Sharon, Y., Ben-Melech, N., Davidovich, U., Avni, G., Avni, Y., Porat, N., 2018. OSL dating of pre-terraced and terraced landscape: Land transformation in Jerusalem's rural hinterland. Journal of Archaeological Science: Reports 21, 575-583, http://doi.org/10.1016/j.jasrep.2018.08.036

Gellman, Y., Matmon, A., Mushkin, A., Porat, N., 2018. Drainage system reorganization and late Quaternary tectonic deformation along the southern Dead Sea Transform. Quaternary Research 90, 380-393, http://doi.org/10.1017/qua.2018.53

Gray, H.J., Tucker, G.E., Mahan, S.A., 2018. Application of a Luminescence-Based Sediment Transport Model. Geophysical Research Letters 45, 6071-6080, http://doi.org/10.1029/2018GL078210

Guo, X., Forman, S.L., Marin, L., Li, X., 2018. Assessing tectonic and climatic controls for Late Quaternary fluvial terraces in Guide, Jianzha, and Xunhua Basins along the Yellow River on the northeastern Tibetan Plateau. Quaternary Science Reviews 195, 109-121, http://doi.org/10.1016/j.quascirev.2018.07.005

Hesse, P.P., Williams, R., Ralph, T.J., Larkin, Z.T., Fryirs, K.A., Westaway, K.E., Yonge, D., 2018. Dramatic reduction in size of the lowland Macquarie River in response to Late Quaternary climate-driven hydrologic change. Quaternary Research 90, 360-379, http://doi.org/10.1017/qua.2018.48

Hošek, M., Matys Grygar, T., Elznicová, J., Faměra, M., Popelka, J., Matkovič, J., Kiss, T., 2018. Geochemical mapping in polluted floodplains using in situ X-ray fluorescence analysis, geophysical imaging, and statistics: Surprising complexity of floodplain pollution hotspot. CATENA 171, 632-644, http://doi.org/10.1016/j.catena.2018.07.037

Knight, J., Evans, M., 2018. Luminescence dating, sediment analysis, and flood dynamics on the Sabie River, South Africa. Geomorphology 319, 1-14, http://doi.org/10.1016/j.geomorph.2018.07.011

Kolb, T., Fuchs, M., 2018. Luminescence dating of pre-Eemian (pre-MIS 5e) fluvial terraces in Northern Bavaria (Germany) – Benefits and limitations of applying a pIRIR225-approach. Geomorphology 321, 16-32, http://doi.org/10.1016/j.geomorph.2018.08.009

Lal, R., Saini, H.S., Pant, N.C., Mujtaba, S.A.I., 2019. Tectonics induced switching of provenance during the Late Quaternary aggradation of the Indus River Valley, Ladakh, India. Geoscience Frontiers 10, 285-297, http://doi.org/10.1016/j.gsf.2017.12.016

Lauer, T., Weiss, M., 2018. Timing of the Saalian- and Elsterian glacial cycles and the implications for Middle – Pleistocene hominin presence in central Europe. Scientific Reports 8, 5111, http://doi.org/10.1038/s41598-018-23541-w

Li, F., Pan, B., Lai, Z., Gao, H., Ou, X., 2018. Identifying the degree of luminescence signal bleaching in fluvial sediments from the Inner Mongolian reaches of the Yellow River. Geochronometria 45, 82-96, http://doi.org/10.1515/geochr-2015-0087

Liu, W., Cui, P., Ge, Y., Yi, Z., 2018. Paleosols identified by rock magnetic properties indicate dam-outburst events of the Min River, eastern Tibetan Plateau. Palaeogeography, Palaeoclimatology, Palaeoecology 508, 139-147, http://doi.org/10.1016/j.palaeo.2018.07.029

Lv, C., Li, X., Han, Z., Wang, Y., Zhou, Y., Jiang, M., Yang, Q., Xu, Z., Yi, S., Lu, H., 2018. Fluvial response to precipitation variations since 36 ka in the Hunshandake Sandy Land in North China. Geomorphology 317, 128-138, http://doi.org/10.1016/j.geomorph.2018.05.016

Mueller, D., Jacobs, Z., Cohen, T.J., Price, D.M., Reinfelds, I.V., Shulmeister, J., 2018. Revisiting an arid LGM using fluvial archives: a luminescence chronology for palaeochannels of the Murrumbidgee River, south-eastern Australia. Journal of Quaternary Science 33, 777-793, http://doi.org/10.1002/jqs.3059

Munoz, S.E., Giosan, L., Therrell, M.D., Remo, J.W.F., Shen, Z., Sullivan, R.M., Wiman, C., O'Donnell, M., Donnelly, J.P., 2018. Climatic control of Mississippi River flood hazard amplified by river engineering. Nature 556, 95-98, http://doi.org/10.1038/nature26145

Polenz, M., Vermeer, J.L., Paulín, G.L., Tepper, J.H., Mahan, S.A., Cakir, R., 2017. Geologic map of the littlerock 7.5-minute quadrangle, Thurston county, Washington. Washington geological survey map series 2017-01, http://www.dnr.wa.gov/publications/ger_ms2017-01_geol_map_littlerock_24k.zip

Pravkin, S.A., Bolshiyanov, D.Y., Pomortsev, O.A., Savelieva, L.A., Molodkov, A.N., Grigoryev, M.N., Arslanov, K.A., 2018. The relief, structure and age of Quaternary deposits of the valley of the Lena River in the Yakutian bend. Vestnik of Saint Petersburg University: Earth Sciences 63, 209-229, http://doi.org/10.21638/11701/spbu07.2018.206

Quik, C., Wallinga, J., 2018. Reconstructing lateral migration rates in meandering systems – a novel Bayesian approach combining optically stimulated luminescence (OSL) dating and historical maps. Earth Surface Dynamics 6, 705-721, http://doi.org/10.5194/esurf-6-705-2018

Suther, B.E., Leigh, D.S., Brook, G.A., Yang, L., 2018. Mega-meander paleochannels of the southeastern Atlantic Coastal Plain, USA. Palaeogeography, Palaeoclimatology, Palaeoecology 511, 52-79, http://doi.org/10.1016/j.palaeo.2018.07.002

von Suchodoletz, H., Gärtner, A., Zielhofer, C., Faust, D., 2018. Eemian and post-Eemian fluvial dynamics in the Lesser Caucasus. Quaternary Science Reviews 191, 189-203, http://doi.org/10.1016/j.quascirev.2018.05.012

White, J.L., Lindsey, K.O., Morgan, M.L., Mahan, S.A., 2017. OF-17-05 Geologic Map of the Fountain Quadrangle, El Paso County, Colorado. Open File Reports. Golden, CO: Colorado Geological Survey, https://store.coloradogeologicalsurvey.org/product/geologic-map-fountain-quadrangle-el-paso-colorado/

- glacial and periglacial

Alexanderson, H., Henriksen, M., Ryen, H.T., Landvik, J.Y., Peterson, G., 2018. 200 ka of glacial events in NW Svalbard: an emergence cycle facies model and regional correlations. arktos 4, 3, http://doi.org/10.1007/s41063-018-0037-z

Allen, M.D., Mavor, S.P., Tepper, J.H., Nesbitt, E.A., Mahan, S.A., Cakir, R., Stoker, B.A., Anderson, M.L., 2017. Geologic map of the Maltby 7.5-minute quadrangle, Snohomish and King counties, Washington. Washington geological survey map series 2017-02 october 2017, http://www.dnr.wa.gov/publications/ger_ms2017-02_geol_map_maltby_24k.zip]

Buechi, M.W., Graf, H.R., Haldimann, P., Lowick, S.E., Anselmetti, F.S., 2018. Multiple Quaternary erosion and infill cycles in overdeepened basins of the northern Alpine foreland. Swiss Journal of Geosciences 111, 133-167, http://doi.org/10.1007/s00015-017-0289-9

Chiverrell, R.C., Smedley, R.K., Small, D., Ballantyne, C.K., Burke, M.J., Callard, S.L., Clark, C.D., Duller, G.A.T., Evans, D.J.A., Fabel, D., van Landeghem, K., Livingstone, S., Ó Cofaigh, C., Thomas, G.S.P., Roberts, D.H., Saher, M., Scourse, J.D., Wilson, P., 2018. Ice margin oscillations during deglaciation of the northern Irish Sea Basin. Journal of Quaternary Science 33, 739-762, http://doi.org/10.1002/jqs.3057

Evans, D.J.A., Roberts, D.H., Bateman, M.D., Medialdea, A., Ely, J., Moreton, S.G., Clark, C.D., Fabel, D., 2018. Sedimentation during Marine Isotope Stage 3 at the eastern margins of the Glacial Lake Humber basin, England. Journal of Quaternary Science 33, 871-891, http://doi.org/10.1002/jqs.3066

Flindt, A.-C., Benediktsson, Í.Ö., Alexanderson, H., Möller, P., 2018. A pre-LGM sandur at Fiskarheden in NW Dalarna, central Sweden – sedimentology and glaciotectonic deformation. Boreas 47, 711-737, http://doi.org/10.1111/bor.12301

Gilbert, G.L., O'Neill, H.B., Nemec, W., Thiel, C., Christiansen, H.H., Buylaert, J.-P., 2018. Late Quaternary sedimentation and permafrost development in a Svalbard fjord-valley, Norwegian high Arctic. Sedimentology 65, 2531-2558, http://doi.org/10.1111/sed.12476

Glasser, N.F., Davies, J.R., Hambrey, M.J., Davies, B.J., Gheorghiu, D.M., Balfour, J., Smedley, R.K., Duller, G.A.T., 2018. Late Devensian deglaciation of south-west Wales from luminescence and cosmogenic isotope dating. Journal of Quaternary Science 33, 804-818, http://doi.org/10.1002/jqs.3061

Gorokhovich, Y., Nelson, M., Eaton, T., Wolk-Stanley, J., Sen, G., 2018. Geochronology and geomorphology of the Jones Point glacial landform in Lower Hudson Valley (New York): Insight into deglaciation processes since the Last Glacial Maximum. Geomorphology 321, 87-102, http://doi.org/10.1016/j.geomorph.2018.08.013

Jenkins, G.T.H., Duller, G.A.T., Roberts, H.M., Chiverrell, R.C., Glasser, N.F., 2018. A new approach for luminescence dating glaciofluvial deposits - High precision optical dating of cobbles. Quaternary Science Reviews 192, 263-273, http://doi.org/10.1016/j.quascirev.2018.05.036

Zhang, Z., Hou, S., Yi, S., 2018. The first luminescence dating of Tibetan glacier basal sediment. The Cryosphere 12, 163-168, http://doi.org/10.5194/tc-12-163-2018

- lacustrine

Ahlborn, M., Haberzettl, T., Wang, J., Fürstenberg, S., Mäusbacher, R., Mazzocco, J., Pierson, J., Zhu, L., Frenzel, P., 2015. Holocene lake level history of the Tangra Yumco lake system, southern-central Tibetan Plateau. The Holocene 26, 176-187, http://doi.org/10.1177/0959683615596840

Ito, K., Tamura, T., Hasebe, N., Nakamura, T., Arai, S., Ogata, M., Itono, T., Kashiwaya, K., 2015. Comparison of Luminescence Dating Methods on Lake Sediments from a Small Catchment: Example from Lake Yogo, Japan, in: Kashiwaya, K., Shen, J., Kim, J.Y. (Eds.), Earth Surface Processes and Environmental Changes in East Asia: Records From Lake-catchment Systems. Springer Japan, Tokyo, pp. 221-238

Lehmkuhl, F., Grunert, J., Hülle, D., Batkhishig, O., Stauch, G., 2018. Paleolakes in the Gobi region of southern Mongolia. Quaternary Science Reviews 179, 1-23, http://doi.org/10.1016/j.quascirev.2017.10.035

Li, G., Madsen, D.B., Jin, M., Stevens, T., Tao, S., She, L., Yang, L., Li, F., Wei, H., Duan, Y., Chen, F., 2018. Orbital scale lake evolution in the Ejina Basin, central Gobi Desert, China revealed by K-feldspar luminescence dating of paleolake shoreline features. Quaternary International 482, 109-121, http://doi.org/10.1016/j.quaint.2018.03.040

Li, G., She, L., Jin, M., Yang, H., Madsen, D., Chun, X., Yang, L., Wei, H., Tao, S., Chen, F., 2018. The spatial extent of the East Asian summer monsoon in arid NW China during the Holocene and Last Interglaciation. Global and Planetary Change 169, 48-65, http://doi.org/10.1016/j.gloplacha.2018.07.008

Liu, W., Hu, K., Carling, P.A., Lai, Z., Cheng, T., Xu, Y., 2018. The establishment and influence of Baimakou paleo-dam in an upstream reach of the Yangtze River, southeastern margin of the Tibetan Plateau. Geomorphology 321, 167-173, http://doi.org/10.1016/j.geomorph.2018.08.028

- loess

Bösken, J., Sümegi, P., Zeeden, C., Klasen, N., Gulyás, S., Lehmkuhl, F., 2018. Investigating the last glacial Gravettian site 'Ságvár Lyukas Hill' (Hungary) and its paleoenvironmental and geochronological context using a multi-proxy approach. Palaeogeography, Palaeoclimatology, Palaeoecology 509, 77-90, http://doi.org/10.1016/j.palaeo.2017.08.010

Costantini, E.A.C., Carnicelli, S., Sauer, D., Priori, S., Andreetta, A., Kadereit, A., Lorenzetti, R., 2018. Loess in Italy: Genesis, characteristics and occurrence. CATENA 168, 14-33, http://doi.org/10.1016/j.catena.2018.02.002

Crouvi, O., Barzilai, O., Goldsmith, Y., Amit, R., Matskevich, Z., Porat, N., Enzel, Y., 2018. Middle to late Pleistocene shift in eolian silts contribution into Mediterranean soils at the fringe of the Negev loess, Israel. Quaternary Science Reviews 191, 101-117, http://doi.org/10.1016/j.quascirev.2018.04.030

Durn, G., Rubinić, V., Wacha, L., Patekar, M., Frechen, M., Tsukamoto, S., Tadej, N., Husnjak, S., 2018. Polygenetic soil formation on Late Glacial Loess on the Susak Island reflects paleo-environmental changes in the Northern Adriatic area. Quaternary International 494, 236-247, http://doi.org/10.1016/j.quaint.2017.06.072

Durn, G., Wacha, L., Bartolin, M., Rolf, C., Frechen, M., Tsukamoto, S., Tadej, N., Husnjak, S., Li, Y., Rubinić, V., 2018. Provenance and formation of the red palaeosol and lithified terra rossa-like infillings on the Island of Susak: A high-resolution and chronological approach. Quaternary International 494, 105-129, http://doi.org/10.1016/j.quaint.2017.11.040

E, C., Sohbati, R., Murray, A.S., Buylaert, J.-P., Liu, X., Yang, L., Yuan, J., Yan, W., 2018. Hebei loess section in the Anyemaqen Mountains, northeast Tibetan Plateau: a high-resolution luminescence chronology. Boreas 47, 1170-1183, http://doi.org/10.1111/bor.12321

Fedorowicz, S., Łanczont, M., Mroczek, P., Bogucki, A., Standzikowski, K., Moska, P., Kusiak, J., Bluszcz, A., 2018. Luminescence dating of the Volochysk section – a key Podolian loess site (Ukraine). Geological Quarterly 62, 729-744, http://doi.org/10.7306/gq.1436

Meyer-Heintze, S., Sprafke, T., Schulte, P., Terhorst, B., Lomax, J., Fuchs, M., Lehmkuhl, F., Neugebauer-Maresch, C., Einwögerer, T., Händel, M., Simon, U., Solís Castillo, B., 2018. The MIS 3/2 transition in a new loess profile at Krems-Wachtberg East – A multi-methodological approach. Quaternary International 464, 370-385, http://doi.org/10.1016/j.quaint.2017.11.048

Moska, P., Adamiec, G., Jary, Z., Bluszcz, A., Poręba, G., Piotrowska, N., Krawczyk, M., Skurzyński, J., 2018. Luminescence chronostratigraphy for the loess deposits in Złota, Poland. Geochronometria 45, 44-55, http://doi.org/10.1515/geochr-2015-0073

Nawrocki, J., Bogucki, A., Łanczont, M., Werner, T., Standzikowski, K., Pańczyk, M., 2018. The Hilina Pali palaeomagnetic excursion and possible self-reversal in the loess from western Ukraine. Boreas 47, 954-966, http://doi.org/10.1111/bor.12305

Song, Y., Luo, D., Du, J., Kang, S., Cheng, P., Fu, C., Guo, X., 2018. Radiometric dating of late Quaternary loess in the northern piedmont of South Tianshan Mountains: Implications for reliable dating. Geological Journal 53, 417-426, http://doi.org/10.1002/gj.3129

Stauch, G., Lai, Z., Lehmkuhl, F., Schulte, P., 2018. Environmental changes during the late Pleistocene and the Holocene in the Gonghe Basin, north-eastern Tibetan Plateau. Palaeogeography, Palaeoclimatology, Palaeoecology 509, 144-155, http://doi.org/10.1016/j.palaeo.2016.12.032

Wacha, L., Matoš, B., Kunz, A., Lužar-Oberiter, B., Tomljenović, B., Banak, A., 2018. First post-IR IRSL dating results of Quaternary deposits from Bilogora (NE Croatia): Implications for the Pleistocene relative uplift and incision rates in the area. Quaternary International 494, 193-210, http://doi.org/10.1016/j.quaint.2017.08.049

White, J.L., Lindsey, K.O., Morgan, M.L., Mahan, S.A., 2017. OF-17-05 Geologic Map of the Fountain Quadrangle, El Paso County, Colorado. Open File Reports. Golden, CO: Colorado Geological Survey, https://store.coloradogeologicalsurvey.org/product/geologic-map-fountain-quadrangle-el-paso-colorado/

Zeeden, C., Hambach, U., Veres, D., Fitzsimmons, K., Obreht, I., Bösken, J., Lehmkuhl, F., 2018. Millennial scale climate oscillations recorded in the Lower Danube loess over the last glacial period. Palaeogeography, Palaeoclimatology, Palaeoecology 509, 164-181, http://doi.org/10.1016/j.palaeo.2016.12.029

Zens, J., Schulte, P., Klasen, N., Krauß, L., Pirson, S., Burow, C., Brill, D., Eckmeier, E., Kels, H., Zeeden, C., Spagna, P., Lehmkuhl, F., 2018. OSL chronologies of paleoenvironmental dynamics recorded by loess-paleosol sequences from Europe: Case studies from the Rhine-Meuse area and the Neckar Basin. Palaeogeography, Palaeoclimatology, Palaeoecology 509, 105-125, http://doi.org/10.1016/j.palaeo.2017.07.019

Zhang, J., Rolf, C., Wacha, L., Tsukamoto, S., Durn, G., Frechen, M., 2018. Luminescence dating and palaeomagnetic age constraint of a last glacial loess-palaeosol sequence from Istria, Croatia. Quaternary International 494, 19-33, http://doi.org/10.1016/j.quaint.2018.05.045

- meteorites

Moska, P., Stankowski, W., Poręba, G., 2018. Optically stimulated luminescence techniques applied to the dating of the fall of meteorites in Morasko. Geochronometria 45, 74-81, http://doi.org/10.1515/geochr-2015-0088

Sears, D.W.G., 2018. Shedding Light: The luminescent glow of meteorites and moon rocks. CreateSpace Independent Publishing Platform, https://www.amazon.com/Shedding-Light-luminescent-meteorites-rocks/dp/1725929643

Sears, D.W.G., Ninagawa, K., Singhvi, A., 2018. Glimmerings of the Past: The Luminescence Properties of Meteorites and Lunar Samples with an Emphasis on Applications. CreateSpace Independent Publishing Platform, https://www.amazon.com/Glimmerings-Past-Luminescence-Properties-Applications/dp/1723236276

- soil

Costantini, E.A.C., Carnicelli, S., Sauer, D., Priori, S., Andreetta, A., Kadereit, A., Lorenzetti, R., 2018. Loess in Italy: Genesis, characteristics and occurrence. CATENA 168, 14-33, http://doi.org/10.1016/j.catena.2018.02.002

Diaz, N., Dietrich, F., Sebag, D., King, G.E., Valla, P.G., Durand, A., Garcin, Y., de Saulieu, G., Deschamps, P., Herman, F., Verrecchia, E.P., 2018. Pedo-sedimentary constituents as paleoenvironmental proxies in the Sudano-Sahelian belt during the Late Quaternary (southwestern Chad Basin). Quaternary Science Reviews 191, 348-362, http://doi.org/10.1016/j.quascirev.2018.05.022

Durn, G., Rubinić, V., Wacha, L., Patekar, M., Frechen, M., Tsukamoto, S., Tadej, N., Husnjak, S., 2018. Polygenetic soil formation on Late Glacial Loess on the Susak Island reflects paleo-environmental changes in the Northern Adriatic area. Quaternary International 494, 236-247, http://doi.org/10.1016/j.quaint.2017.06.072

Gadot, Y., Davidovich, U., Avni, G., Avni, Y., Piasetzky, M., Faershtein, G., Golan, D., Porat, N., 2016. The formation of a Mediterranean terraced landscape: Mount Eitan, Judean Highlands, Israel. Journal of Archaeological Science: Reports 6, 397-417, http://doi.org/10.1016/j.jasrep.2016.02.028

Porat, N., Davidovich, U., Avni, Y., Avni, G., Gadot, Y., 2018. Using OSL Measurements to Decipher Soil History in Archaeological Terraces, Judean Highlands, Israel. Land Degradation & Development 29, 643-650, http://doi.org/10.1002/ldr.2729

- surface exposure dating

Jenkins, G.T.H., Duller, G.A.T., Roberts, H.M., Chiverrell, R.C., Glasser, N.F., 2018. A new approach for luminescence dating glaciofluvial deposits - High precision optical dating of cobbles. Quaternary Science Reviews 192, 263-273, http://doi.org/10.1016/j.quascirev.2018.05.036

- swamp

May, J.H., Marx, S.K., Reynolds, W., Clark-Balzan, L., Jacobsen, G.E., Preusser, F., 2018. Establishing a chronological framework for a late Quaternary seasonal swamp in the Australian 'Top End'. Quaternary Geochronology 47, 81-92, http://doi.org/10.1016/j.quageo.2018.05.010

- thermochronology

Herman, F., King, G.E., 2018. Luminescence Thermochronometry: Investigating the Link between Mountain Erosion, Tectonics and Climate. Elements 14, 33-38, http://doi.org/10.2138/gselements.14.1.33

King, G.E., Herman, F., Guralnik, B., 2016. Northward migration of the eastern Himalayan syntaxis revealed by OSL thermochronometry. Science 353, 800-804, http://doi.org/10.1126/science.aaf2637

- volcanic

Hasebe, N., Nakano, Y., Miyamoto, H., Higashino, T., Tamura, A., Arai, S., Kim, J.Y., 2016. A multi-geochronological study of the Hakusan volcano, central Japan. Island Arc 25, 111-125, http://doi.org/10.1111/iar.12143

Archaeology applications

Bader, G.D., Tribolo, C., Conard, N.J., 2018. A return to Umbeli Belli: New insights of recent excavations and implications for the final MSA of eastern South Africa. Journal of Archaeological Science: Reports 21, 733-757, http://doi.org/10.1016/j.jasrep.2018.08.043

Bajnóczi, B., Nagy, G., Sipos, G., May, Z., Váczi, T., Tóth, M., Boros, I., Pattantyús, M., 2018. Material analysis and TL dating of a Renaissance glazed terracotta Madonna statue kept in the Museum of Fine Arts, Budapest. Journal of Cultural Heritage 33, 60-70, http://doi.org/10.1016/j.culher.2018.03.015

Blackwell, B.A.B., Sakhrani, N., Singh, I.K., Gopalkrishna, K.K., Tourloukis, V., Panagopoulou, E., Karkanas, P., Blickstein, J.I.B., Skinner, A.R., Florentin, J.A., Harvati, K., 2018. ESR Dating Ungulate Teeth and Molluscs from the Paleolithic Site Marathousa 1, Megalopolis Basin, Greece. Quaternary 1, 22, http://doi.org/10.3390/quat1030022

Brumm, A., Hakim, B., Ramli, M., Aubert, M., van den Bergh, G.D., Li, B., Burhan, B., Saiful, A.M., Siagian, L., Sardi, R., Jusdi, A., Abdullah, Mubarak, A.P., Moore, M.W., Roberts, R.G., Zhao, J.-x., McGahan, D., Jones, B.G., Perston, Y., Szabó, K., Mahmud, M.I., Westaway, K., Jatmiko, Saptomo, E.W., van der Kaars, S., Grün, R., Wood, R., Dodson, J., Morwood, M.J., 2018. A reassessment of the early archaeological record at Leang Burung 2, a Late Pleistocene rock-shelter site on the Indonesian island of Sulawesi. PLOS ONE 13, e0193025, http://doi.org/10.1371/journal.pone.0193025

Burrough, S.L., Thomas, D.S.G., Barham, L.S., 2019. Implications of a new chronology for the interpretation of the Middle and Later Stone Age of the upper Zambezi Valley. Journal of Archaeological Science: Reports 23, 376-389, http://doi.org/10.1016/j.jasrep.2018.10.016

Duval, M., Grün, R., Parés, J.M., Martín-Francés, L., Campaña, I., Rosell, J., Shao, Q., Arsuaga, J.L., Carbonell, E., Bermúdez de Castro, J.M., 2018. The first direct ESR dating of a hominin tooth from Atapuerca Gran Dolina TD-6 (Spain) supports the antiquity of Homo antecessor. Quaternary Geochronology 47, 120-137, http://doi.org/10.1016/j.quageo.2018.05.001

Hershkovitz, I., Duval, M., Grün, R., Mercier, N., Valladas, H., Ayalon, A., Bar-Matthews, M., Weber, G.W., Quam, R., Zaidner, Y., Weinstein-Evron, M., 2018. Response to Comment on “The earliest modern humans outside Africa”. Science 362, http://doi.org/10.1126/science.aat8964

Junge, A., Lomax, J., Shahack-Gross, R., Finkelstein, I., Fuchs, M., 2018. Chronology of an ancient water reservoir and the history of human activity in the Negev Highlands, Israel. Geoarchaeology 33, 695-707, http://doi.org/10.1002/gea.21682

Klasen, N., Kehl, M., Mikdad, A., Brückner, H., Weniger, G.-C., 2018. Chronology and formation processes of the Middle to Upper Palaeolithic deposits of Ifri n'Ammar using multi-method luminescence dating and micromorphology. Quaternary International 485, 89-102, http://doi.org/10.1016/j.quaint.2017.10.043

Lauer, T., Weiss, M., 2018. Timing of the Saalian- and Elsterian glacial cycles and the implications for Middle – Pleistocene hominin presence in central Europe. Scientific Reports 8, 5111, http://doi.org/10.1038/s41598-018-23541-w

McDonald, J., Reynen, W., Ditchfield, K., Dortch, J., Leopold, M., Stephenson, B., Whitley, T., Ward, I., Veth, P., 2018. Murujuga Rockshelter: First evidence for Pleistocene occupation on the Burrup Peninsula. Quaternary Science Reviews 193, 266-287, http://doi.org/10.1016/j.quascirev.2018.06.002

Méndez-Quintas, E., Santonja, M., Pérez-González, A., Duval, M., Demuro, M., Arnold, L.J., 2018. First evidence of an extensive Acheulean large cutting tool accumulation in Europe from Porto Maior (Galicia, Spain). Scientific Reports 8, 3082, http://doi.org/10.1038/s41598-018-21320-1

Oddo, M.E., Ricci, P., Angelici, D., Fantino, F., Sibilia, E., Alberghina, M.F., Schiavone, S., Grifa, C., Mercurio, M., Germinario, C., Izzo, F., Langella, A., Massa, E., Bracci, S., Magrini, D., Costa, R., Pelagotti, A., Zuchtriegel, G., Lubritto, C., 2018. Results of diagnostic campaign promoted by AIAr in the deposits of the Archaeological Museum of Paestum. IOP Conference Series: Materials Science and Engineering 364, 012002, http://doi.org/10.1088/1757-899X/364/1/012002

Pereira, A., Nomade, S., Moncel, M.-H., Voinchet, P., Bahain, J.-J., Biddittu, I., Falguères, C., Giaccio, B., Manzi, G., Parenti, F., Scardia, G., Scao, V., Sottili, G., Vietti, A., 2018. Integrated geochronology of Acheulian sites from the southern Latium (central Italy): Insights on human-environment interaction and the technological innovations during the MIS 11-MIS 10 period. Quaternary Science Reviews 187, 112-129, http://doi.org/10.1016/j.quascirev.2018.03.021

Porat, N., Jain, M., Ronen, A., Horwitz, L.K., 2018. A contribution to late Middle Paleolithic chronology of the Levant: New luminescence ages for the Atlit Railway Bridge site, Coastal Plain, Israel. Quaternary International 464, 32-42, http://doi.org/10.1016/j.quaint.2017.06.017

Porraz, G., Val, A., Tribolo, C., Mercier, N., de la Peña, P., Haaland, M.M., Igreja, M., Miller, C.E., Schmid, V.C., 2018. The MIS5 Pietersburg at '28' Bushman Rock Shelter, Limpopo Province, South Africa. PLOS ONE 13, e0202853, http://doi.org/10.1371/journal.pone.0202853

Roberts, R.G., Jacobs, Z., 2018. Timelines for Human Evolution and Dispersals. Elements 14, 27-32, http://doi.org/10.2138/gselements.14.1.27

Scarborough, V.L., Fladd, S.G., Dunning, N.P., Plog, S., Owen, L.A., Carr, C., Tankersley, K.B., McCool, J.-P., Watson, A.S., Haussner, E.A., Crowley, B., Bishop, K.J., Lentz, D.L., Vivian, R.G., 2018. Water uncertainty, ritual predictability and agricultural canals at Chaco Canyon, New Mexico. Antiquity 92, 870-889, http://doi.org/10.15184/aqy.2018.114

Sharp, W.D., Paces, J.B., 2018. Comment on "The earliest modern humans outside Africa". Science 362, http://doi.org/10.1126/science.aat6598

Shimelmitz, R., Friesem, D.E., Clark, J.L., Groman-Yaroslavski, I., Weissbrod, L., Porat, N., Kandel, A.W., 2018. The Upper Paleolithic and Epipaleolithic of Sefunim Cave, Israel. Quaternary International 464, 106-125, http://doi.org/10.1016/j.quaint.2017.05.039

Singh, A., Thomsen, K.J., Sinha, R., Buylaert, J.-P., Carter, A., Mark, D.F., Mason, P.J., Densmore, A.L., Murray, A.S., Jain, M., Paul, D., Gupta, S., 2017. Counter-intuitive influence of Himalayan river morphodynamics on Indus Civilisation urban settlements. Nature Communications 8, 1617, http://doi.org/10.1038/s41467-017-01643-9

Stella, G., Almeida, L., Basílio, L., Pasquale, S., Dinis, J., Almeida, M., Gueli Anna, M., 2018. Historical building dating: A multidisciplinary study of the Convento de São Francisco (Coimbra, Portugal). Geochronometria 45, 119-129, http://doi.org/10.1515/geochr-2015-0089

Tengis, S.S., S., Munkhbayar, L., Bemmann, J., 2018. Luminescence dating of an ancient walled settlement in Orkhon valley, Mongolia Proceedings of the Mongolian Academy of Sciences 57, http://doi.org/10.5564/pmas.v57i4.918

Vardi, J., Marder, O., Bookman, R., Friesem, D.E., Groman-Yeroslavski, I., Edeltin, L., Porat, N., Boaretto, E., Roskin, J., 2018. Middle to Late Epipaleolithic hunter-gatherer encampments at the Ashalim site, on a linear dune-like morphology, along dunefield margin water bodies. Quaternary International 464, 187-205, http://doi.org/10.1016/j.quaint.2017.06.011

Veres, D., Cosac, M., Schmidt, C., Murătoreanu, G., Hambach, U., Hubay, K., Wulf, S., Karátson, D., 2018. New chronological constraints for Middle Palaeolithic (MIS 6/5-3) cave sequences in Eastern Transylvania, Romania. Quaternary International 485, 103-114, http://doi.org/10.1016/j.quaint.2017.07.015

Waters, M.R., Keene, J.L., Forman, S.L., Prewitt, E.R., Carlson, D.L., Wiederhold, J.E., 2018. Pre-Clovis projectile points at the Debra L. Friedkin site, Texas—Implications for the Late Pleistocene peopling of the Americas. Science Advances 4, http://doi.org/10.1126/sciadv.aat4505

Yaroshevich, A., Shemer, M., Porat, N., Roskin, J., 2018. Flint workshop affiliation: Chronology, technology and site-formation processes at Giv'at Rabbi East, Lower Galilee, Israel. Quaternary International 464, 58-80, http://doi.org/10.1016/j.quaint.2017.03.001

Yee, K.P., Mo, R.H., 2018. Thermoluminescence dating of stalactitic calcite from the early Palaeolithic occupation at Tongamdong site. Journal of Archaeological Science: Reports 19, 405-410, http://doi.org/10.1016/j.jasrep.2018.03.022

Zaidner, Y., Porat, N., Zilberman, E., Herzlinger, G., Almogi-Labin, A., Roskin, J., 2018. Geo-chronological context of the open-air Acheulian site at Nahal Hesi, northwestern Negev, Israel. Quaternary International 464, 18-31, http://doi.org/10.1016/j.quaint.2017.08.023

Various ESR applications

Bacon, A.-M., Duringer, P., Westaway, K., Joannes-Boyau, R., Zhao, J.-x., Bourgon, N., Dufour, E., Pheng, S., Tep, S., Ponche, J.-L., Barnes, L., Blin, A., Patole-Edoumba, E., Demeter, F., 2018. Testing the savannah corridor hypothesis during MIS2: The Boh Dambang hyena site in southern Cambodia. Quaternary International 464, 417-439, http://doi.org/10.1016/j.quaint.2017.10.047

Blackwell, B.A.B., Sakhrani, N., Singh, I.K., Gopalkrishna, K.K., Tourloukis, V., Panagopoulou, E., Karkanas, P., Blickstein, J.I.B., Skinner, A.R., Florentin, J.A., Harvati, K., 2018. ESR Dating Ungulate Teeth and Molluscs from the Paleolithic Site Marathousa 1, Megalopolis Basin, Greece. Quaternary 1, 22, http://doi.org/10.3390/quat1030022

Delmas, M., Calvet, M., Gunnell, Y., Voinchet, P., Manel, C., Braucher, R., Tissoux, H., Bahain, J.-J., Perrenoud, C., Saos, T., 2018. Terrestrial 10Be and electron spin resonance dating of fluvial terraces quantifies quaternary tectonic uplift gradients in the eastern Pyrenees. Quaternary Science Reviews 193, 188-211, http://doi.org/10.1016/j.quascirev.2018.06.001

Duval, M., Grün, R., Parés, J.M., Martín-Francés, L., Campaña, I., Rosell, J., Shao, Q., Arsuaga, J.L., Carbonell, E., Bermúdez de Castro, J.M., 2018. The first direct ESR dating of a hominin tooth from Atapuerca Gran Dolina TD-6 (Spain) supports the antiquity of Homo antecessor. Quaternary Geochronology 47, 120-137, http://doi.org/10.1016/j.quageo.2018.05.001

Fan, Y., Mou, X., Wang, Y., Liu, C., Zhao, H., Wang, F., Li, Z., Mao, X., Liu, W., Ma, J., Liu, C., Zhang, F., Zhang, F., 2018. Quaternary paleoenvironmental evolution of the Tengger Desert and its implications for the provenance of the loess of the Chinese Loess Plateau. Quaternary Science Reviews 197, 21-34, http://doi.org/10.1016/j.quascirev.2018.08.002

Harshman, A., Toyoda, S., Johnson, T., 2018. Suitability of Japanese wild boar tooth enamel for use as an Electron Spin Resonance dosimeter. Radiation Measurements 116, 46-50, http://doi.org/10.1016/j.radmeas.2018.07.001

Hershkovitz, I., Duval, M., Grün, R., Mercier, N., Valladas, H., Ayalon, A., Bar-Matthews, M., Weber, G.W., Quam, R., Zaidner, Y., Weinstein-Evron, M., 2018. Response to Comment on "The earliest modern humans outside Africa". Science 362, http://doi.org/10.1126/science.aat8964

Méndez-Quintas, E., Santonja, M., Pérez-González, A., Duval, M., Demuro, M., Arnold, L.J., 2018. First evidence of an extensive Acheulean large cutting tool accumulation in Europe from Porto Maior (Galicia, Spain). Scientific Reports 8, 3082, http://doi.org/10.1038/s41598-018-21320-1

Pereira, A., Nomade, S., Moncel, M.-H., Voinchet, P., Bahain, J.-J., Biddittu, I., Falguères, C., Giaccio, B., Manzi, G., Parenti, F., Scardia, G., Scao, V., Sottili, G., Vietti, A., 2018. Integrated geochronology of Acheulian sites from the southern Latium (central Italy): Insights on human-environment interaction and the technological innovations during the MIS 11-MIS 10 period. Quaternary Science Reviews 187, 112-129, http://doi.org/10.1016/j.quascirev.2018.03.021

Qiu, D., Liu, Q., Yun, J., Jin, Z., Zhu, D., Li, T., Sun, D., 2018. Electron spin resonance (ESR) dating of pre-Quaternary faults in the Sichuan basin, SW China. Journal of Asian Earth Sciences 163, 142-151, http://doi.org/10.1016/j.jseaes.2018.06.011

Sharp, W.D., Paces, J.B., 2018. Comment on "The earliest modern humans outside Africa". Science 362, http://doi.org/10.1126/science.aat6598

Tarı, U., Tüysüz, O., Blackwell, B.A.B., Mahmud, Z., Florentin, J.A., Qi, J., Genç, Ş.C., Skinner, A.R., 2018. Sealevel change and tectonic uplift from dated marine terraces along the eastern Mediterranean coast, southeastern Turkey. Palaeogeography, Palaeoclimatology, Palaeoecology 511, 80-102, http://doi.org/10.1016/j.palaeo.2018.07.003

Toyoda, S., 2019. Recent Issues in X-Band ESR Tooth Enamel Dosimetry, in: Shukla, A.K. (Ed.), Electron Spin Resonance Spectroscopy in Medicine. Springer Singapore, Singapore, pp. 135-151, http://doi.org/10.1007/978-981-13-2230-3_7

Basic research

Amit, G., Datz, H., 2018. Automatic detection of anomalous thermoluminescent dosimeter glow curves using machine learning. Radiation Measurements 117, 80-85, http://doi.org/10.1016/j.radmeas.2018.07.014

Anechitei-Deacu, V., Timar-Gabor, A., Constantin, D., Trandafir-Antohi, O., Valle Laura, D., Fornós Joan, J., Gómez-pujol, L., Wintle Ann, G., 2018. Assessing the maximum limit of SAR-OSL dating using quartz of different grain sizes. Geochronometria 45, 146-159, http://doi.org/10.1515/geochr-2015-0092

Chen, R., Lawless, J.L., Pagonis, V., 2018. Thermoluminescence associated with two-hole recombination centers. Radiation Measurements 115, 1-6, http://doi.org/10.1016/j.radmeas.2018.05.004

Chruścińska, A., Szramowski, A., 2018. Thermally modulated optically stimulated luminescence (TM-OSL) of quartz. Journal of Luminescence 195, 435-440, http://doi.org/10.1016/j.jlumin.2017.12.004

Coleman, A.C., Yukihara, E.G., 2018. On the validity and accuracy of the initial rise method investigated using realistically simulated thermoluminescence curves. Radiation Measurements 117, 70-79, http://doi.org/10.1016/j.radmeas.2018.07.010

Fu, X., Li, S.-H., Cohen, T.J., 2018. Testing the applicability of a partial bleach method for post-IR IRSL dating of Holocene-aged K-feldspar samples. Quaternary Geochronology 47, 1-13, http://doi.org/10.1016/j.quageo.2018.04.003

Gray, H.J., Tucker, G.E., Mahan, S.A., 2018. Application of a Luminescence-Based Sediment Transport Model. Geophysical Research Letters 45, 6071-6080, http://doi.org/10.1029/2018GL078210

Guérin, G., Mihailescu, L.-C., Jain, M., 2018. Photon energy (8–250 keV) response of optically stimulated luminescence: Implications for luminescence geochronology. Journal of Luminescence 204, 135-144, http://doi.org/10.1016/j.jlumin.2018.07.047

Kalita, J.M., Chithambo, M.L., 2019. Phototransferred thermoluminescence and thermally-assisted optically stimulated luminescence dosimetry using α-Al2O3:C,Mg annealed at 1200 °C. Journal of Luminescence 205, 1-6, http://doi.org/10.1016/j.jlumin.2018.08.085

Kim, M.-J., Kim, K.-B., Hong, D.-G., 2018. Optical Sensitivity of TL Glow Peaks Separated Using Computerized Glow Curve Deconvolution for RTL Quartz. Journal of Radiation Protection and Research 43, 114-119, http://doi.org/10.14407/jrpr.2018.43.3.114

Kumar, M., 2017. Comments on 'Derivation of general order kinetics equation using probability theory by Longjam Lovedy Singh'. Radiation Effects and Defects in Solids 172, 695-698, http://doi.org/10.1080/10420150.2017.1371173

Li, F., Pan, B., Lai, Z., Gao, H., Ou, X., 2018. Identifying the degree of luminescence signal bleaching in fluvial sediments from the Inner Mongolian reaches of the Yellow River. Geochronometria 45, 82-96, http://doi.org/10.1515/geochr-2015-0087

Ogata, M., Hasebe, N., Fujii, N., Yamakawa, M., 2017. Measuring apparent dose rate factors using beta and gamma rays, and alpha efficiency for precise thermoluminescence dating of calcite. Journal of Mineralogical and Petrological Sciences 112, 336-345, http://doi.org/10.2465/jmps.161126

Pagonis, V., Kitis, G., Polymeris, G.S., 2018. On the half-life of luminescence signals in dosimetric applications: A unified presentation. Physica B: Condensed Matter 539, 35-43, http://doi.org/10.1016/j.physb.2018.03.054

Pagonis, V., Truong, P., 2018. Thermoluminescence due to tunneling in nanodosimetric materials: A Monte Carlo study. Physica B: Condensed Matter 531, 171-179, http://doi.org/10.1016/j.physb.2017.12.042

Pagonis, V., Vieira, F.M.d.S., Chambers, A., Anthony, L., 2018. Thermoluminescence glow curves in preheated feldspar: A Monte Carlo study. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 436, 249-256, http://doi.org/10.1016/j.nimb.2018.09.036

Prasad, A.K., Jain, M., 2018. Breakdown of Kasha's Rule in a Ubiquitous, Naturally Occurring, Wide Bandgap Aluminosilicate (Feldspar). Scientific Reports 8, 810, http://doi.org/10.1038/s41598-017-17466-z

Prasad, A.K., Jain, M., 2018. Dynamics of the deep red Fe3+ photoluminescence emission in feldspar. Journal of Luminescence 196, 462-469, http://doi.org/10.1016/j.jlumin.2017.11.051

Sadek, A.M., Kitis, G., 2018. Impact of non-fulfillment of the super position principle on the analysis of thermoluminescence glow-curve. Radiation Measurements 116, 14-23, http://doi.org/10.1016/j.radmeas.2018.06.016

Sahai, M.K., Bakshi, A.K., Datta, D., 2018. Revisit to power law decay of luminescence. Journal of Luminescence 195, 240-246, http://doi.org/10.1016/j.jlumin.2017.11.032

Schmidt, C., Bösken, J., Kolb, T., 2018. Is there a common alpha-efficiency in polymineral samples measured by various infrared stimulated luminescence protocols? Geochronometria 45, 160-172, http://doi.org/10.1515/geochr-2015-0095

Schmidt, C., Friedrich, J., Adamiec, G., Chruścińska, A., Fasoli, M., Kreutzer, S., Martini, M., Panzeri, L., Polymeris, G.S., Przegiętka, K., Valla, P.G., King, G.E., Sanderson, D.C.W., 2018. How reproducible are kinetic parameter constraints of quartz luminescence? An interlaboratory comparison for the 110 °C TL peak. Radiation Measurements 110, 14-24, http://doi.org/10.1016/j.radmeas.2018.01.002

Singh, L.L., 2017. Derivation of general order kinetics equation using probability theory. Radiation Effects and Defects in Solids 172, 271-274, http://doi.org/10.1080/10420150.2017.1303836

Singh, L.L., 2017. Reply to the comments of Munish Kumar of "Derivation of general order kinetics equation using probability theory by Longjam Lovedy". Radiation Effects and Defects in Solids 172, 699-701, http://doi.org/10.1080/10420150.2017.1371172

Tailby, N.D., Cherniak, D.J., Watson, E.B., 2018. Al diffusion in quartz. American Mineralogist 103, 839-847, http://doi.org/10.2138/am-2018-5613

Thomas, S., Chithambo, M.L., 2018. General features and kinetic analysis of thermoluminescence from annealed natural quartz. Journal of Luminescence 197, 406-411, http://doi.org/10.1016/j.jlumin.2018.02.003

Vaccaro, G., Panzeri, L., Monti, A.M., Martini, M., Fasoli, M., 2019. Optical bleaching of the 375 °C TL peak, [GeO4/Li+]0 EPR center and OSL signal in irradiated natural quartz. Journal of Luminescence 205, 61-65, http://doi.org/10.1016/j.jlumin.2018.08.046

Yüksel, M., 2017. Thermoluminescence and dosimetric characteristics study of quartz samples from Seyhan Dam Lake Terraces. Canadian Journal of Physics 96, 779-783, http://doi.org/10.1139/cjp-2017-0741

Dose rate issues

Guérin, G., 2018. Innovative Dose Rate Determinations for Luminescence Dating. Elements 14, 15-20, http://doi.org/10.2138/gselements.14.1.15

Kreutzer, S., Martin, L., Guérin, G., Tribolo, C., Selva, P., Mercier, N., 2018. Environmental dose rate determination using a passive dosimeter: Techniques and workflow for α-Al2O3:C chips. Geochronometria 45, 56-67, http://doi.org/10.1515/geochr-2015-0086

Dosimetry

Harshman, A., Toyoda, S., Johnson, T., 2018. Suitability of Japanese wild boar tooth enamel for use as an Electron Spin Resonance dosimeter. Radiation Measurements 116, 46-50, http://doi.org/10.1016/j.radmeas.2018.07.001

Kalita, J.M., Chithambo, M.L., 2019. Phototransferred thermoluminescence and thermally-assisted optically stimulated luminescence dosimetry using α-Al2O3:C,Mg annealed at 1200 °C. Journal of Luminescence 205, 1-6, http://doi.org/10.1016/j.jlumin.2018.08.085

Kandemir, A., Toktamış, H., 2018. Thermoluminescence studies of SIM card chips used in mobile communication providers in Turkey. Radiation Physics and Chemistry 149, 84-89, http://doi.org/10.1016/j.radphyschem.2018.04.002

Singh, A.K., Menon, S.N., Kadam, S.Y., Koul, D.K., Datta, D., 2018. OSL properties of three commonly available salt brands in India for its use in accident dosimetry. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 419, 38-43, http://doi.org/10.1016/j.nimb.2018.01.027

Toyoda, S., 2019. Recent Issues in X-Band ESR Tooth Enamel Dosimetry, in: Shukla, A.K. (Ed.), Electron Spin Resonance Spectroscopy in Medicine. Springer Singapore, Singapore, pp. 135-151, http://doi.org/10.1007/978-981-13-2230-3_7

Beyond quartz and K-feldspar: non-traditional minerals

- calcite

Duller, G.A.T., Roberts, H.M., 2018. Seeing Snails in a New Light. Elements 14, 39-43, http://doi.org/10.2138/gselements.14.1.39

Yee, K.P., Mo, R.H., 2018. Thermoluminescence dating of stalactitic calcite from the early Palaeolithic occupation at Tongamdong site. Journal of Archaeological Science: Reports 19, 405-410, http://doi.org/10.1016/j.jasrep.2018.03.022

- salt

Singh, A.K., Menon, S.N., Kadam, S.Y., Koul, D.K., Datta, D., 2018. OSL properties of three commonly available salt brands in India for its use in accident dosimetry. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 419, 38-43, http://doi.org/10.1016/j.nimb.2018.01.027

Review

Bos, A., 2017. Thermoluminescence as a Research Tool to Investigate Luminescence Mechanisms. Materials 10, 1357, http://www.mdpi.com/1996-1944/10/12/1357

Duller, G.A.T., Roberts, H.M., 2018. Seeing Snails in a New Light. Elements 14, 39-43, http://doi.org/10.2138/gselements.14.1.39
Guérin, G., 2018. Innovative Dose Rate Determinations for Luminescence Dating. Elements 14, 15-20, http://doi.org/10.2138/gselements.14.1.15
Guibert, P., 2018. Dater, une histoire qui date ! ArchéoSciences 42-1, 85-101, https://www.cairn.info/revue-archeosciences-2018-1-page-85.htm
Herman, F., King, G.E., 2018. Luminescence Thermochronometry: Investigating the Link between Mountain Erosion, Tectonics and Climate. Elements 14, 33-38, http://doi.org/10.2138/gselements.14.1.33
Rittenour, T.M., 2018. Dates and Rates of Earth-Surface Processes Revealed using Luminescence Dating. Elements 14, 21-26, http://doi.org/10.2138/gselements.14.1.21
Roberts, R.G., Jacobs, Z., 2018. Timelines for Human Evolution and Dispersals. Elements 14, 27-32, http://doi.org/10.2138/gselements.14.1.27
Sears, D.W.G., 2018. Shedding Light: The luminescent glow of meteorites and moon rocks. CreateSpace Independent Publishing Platform, https://www.amazon.com/Shedding-Light-luminescent-meteorites-rocks/dp/1725929643
Sears, D.W.G., Ninagawa, K., Singhvi, A., 2018. Glimmerings of the Past: The Luminescence Properties of Meteorites and Lunar Samples with an Emphasis on Applications. CreateSpace Independent Publishing Platform, https://www.amazon.com/Glimmerings-Past-Luminescence-Properties-Applications/dp/1723236276
Smedley, R.K., 2018. Telling the Time with Dust, Sand and Rocks. Elements 14, 9-14, http://doi.org/10.2138/gselements.14.1.9
Toyoda, S., 2019. Recent Issues in X-Band ESR Tooth Enamel Dosimetry, in: Shukla, A.K. (Ed.), Electron Spin Resonance Spectroscopy in Medicine. Springer Singapore, Singapore, pp. 135-151, http://doi.org/10.1007/978-981-13-2230-3_7

Conference Announcements: LAIS 2019

Luminescence in Archaeology International Symposium

Institute of Earth and Environmental Sciences
University of Freiburg, Germany
April 3rd to 6th, 2019

The 4th Luminescence in Archaeology International Symposium will be hosted by the Sedimentary Geology and Quaternary Research Group at the University of Freiburg (Germany). LAIS 2018 continues the series of symposia initiated in Delphi 2009, Lisbon 2012 and Paris 2015. It is an international initiative focusing on the use of luminescence for the dating and analysis of materials in archaeological and geoarchaeological context. In addition, it supports archaeological and archaeometrical communities to further develop and expose luminescence methodology.

Topics

- Advances in luminescence methodology
- Dose rate determination
- Innovative materials
- Application in all fields of archaeological sciences
- (Geo-)Archaeological case studies

Local organiser: F. Preusser
International standing committee: I. Liritzis (Chairman, Rhodes, Greece), N. Zacharias, (Kalamata, Greece), A. Zink (Paris, France), Ana Luisa Rodrigues (Lisbon, Portugal).

Deadlines and costs
Registration: November 1st to December 31st 2018
Late registration: January 1st, 2019 to March 31st 2019
Abstract submission: until December 1st 2018
Abstract confirmation: December 15th 2018
Conference fee: EUR 240,-
Student fee: EUR 160,-
Accompanying persons: EUR 100,-

Conference email: LAIS2019@geologie.uni-freiburg.de
Web page: www.sedimentologie.uni-freiburg.de/lais2019

Conference Announcements: 13th MAC

13th International Conference
"Methods of Absolute Chronology", Tarnowskie Góry, Poland
5 -7 June 2019

Organised by the Gliwice Absolute DAting Methods Centre, Institute of Physics – Centre for Science and Education, Silesian University of Technology.

The multidisciplinary conference will concern the following subjects:

1. Methods of absolute chronology and their application in Quaternary geology.
2. Dating methods and creation of absolute time scales for paleoclimatic reconstructions.
3. Isotopic methods in research of paleo- and modern environment.
4. Dating the archaeological objects.

The conference scientific programme includes plenary and poster sessions. The working language of the conference is English. The conference will be accompanied by a workshop for young scientists with lectures covering the basics of isotope and dosimetric dating methods

Deadlines
Early registration and payment: **31 January 2019**
Submission of abstracts: **15 March 2019**
Conference: **5-7 June 2019**

Website: http://www.carbon14.pl/13thMAC/

On behalf of the Local Organizing Committee
Natalia Piotrowska
(Natalia.Piotrowska@polsl.pl)

Conference Announcements: UK LED 2019

At the UK LED Sheffield meeting last September, it was agreed that the next meeting should be held in Roskilde, Denmark. So we would like to take this opportunity to invite you to 'UKLED2019 in Denmark' to be held at the **Risø Campus of the Technical University of Denmark from the 26th to 28th August 2019**.

Further details will be available early in the New Year.

Regards,

Jan-Pieter Buylaert,
for the Organising Committee
(jabu@dtu.dk)

Conference Announcements: 13th NWLDW

13th New World Luminescence Dating Workshop, Champaign (IL)

The 13th New World Luminescence Dating Workshop (NWLDW) will be held in Champaign, Illinois, sometime between late Spring to early Autumn. A final date will be announced at a later time. Both poster and oral presentations are welcomed, with an emphasis on recent development, ongoing work and student projects.

In addition, we will hold a directed discussion around a theme. We have already received interest in holding a workshop on the R luminescence package. Other topics are welcomed.

Details will follow later.

For questions, contact **Sebastien Huot (shuot@illinois.edu)**

We look forward to seeing you!

Ancient TL

ISSN 0735-1348

Aims and Scope

Ancient TL is a journal devoted to Luminescence dating, Electron Spin Resonance (ESR) dating, and related techniques. It aims to publish papers dealing with experimental and theoretical results in this field, with a minimum of delay between submission and publication. Ancient TL also publishes a current bibliography, thesis abstracts, letters, and miscellaneous information, e.g., announcements for meetings.

Frequency

Two issues per annum in June and December

Submission of articles to Ancient TL

Ancient TL has a reviewing system in which direct dialogue is encouraged between reviewers and authors. For instructions to authors and information on how to submit to Ancient TL, please visit the website at:
http://ancienttl.org/TOC1.htm

Journal Enquiries

For enquiries please contact the editor:
Regina DeWitt, Department of Physics, East Carolina University, Howell Science Complex, 1000 E. 5th Street, Greenville, NC 27858, USA; Tel: +252-328-4980; Fax: +252-328-0753 (dewittr@ecu.edu)

Subscriptions to Ancient TL

Ancient TL Vol. 32 No.2 December 2014 was the last issue to be published in print. Past and current issues are available for download free of charge from the Ancient TL website:
http://ancienttl.org/TOC4.htm