BOOK OF ABSTRACTS

13th International Conference on Luminescence and Electron Spin Resonance Dating

10-14 July 2011, Toruń, Poland

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Institute of Physics, Nicolaus Copernicus University
Institute of Physics - Centre for Science and Education, Silesian University of Technology

13th INTERNATIONAL CONFERENCE ON LUMINESCENCE AND ELECTRON SPIN RESONANCE DATING

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Nicolaus Copernicus University, Toruń
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ORAL AND POSTER

PRESENTATIONS

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Statistics of count numbers from a PM tube and its implications for error estimation

G. Adamiec[1,*], A. Heer[2], A. Bluszcz[1]

[1] *GADAM Centre, Institute of Physics, Silesian University of Technology, ul.Krzywoustego 2, 44-100 Gliwice, Poland (grzegorz.adamiec@polsl.pl)*
[2] *Geographisches Institut, Universität Bern, Hallerstrasse 12, 3012 Bern, Switzerland*

** Corresponding author: Grzegorz.Adamiec@polsl.pl*

Here we present investigations of the statistics of the count numbers on a number of different luminescence measuring systems. The investigations concern dark current background as well as the statistics of counts registered by a PM tube under illumination by a constant light source. The standard deviation of the number of counts in all cases where no divider is present in the counting system, exceeds the one predicted by the Poisson distribution (variance of the count number is equal to the number of counts), however to a different degree in different systems. This has implications for the analysis of uncertainties for the estimated equivalent dose estimations. This in turn has consequences for various analyses of luminescence measurements. In the presentation we explore this area and present ways for incorporating modified counting statistics into the analysis of uncertainties in luminescence measurements.

Residual luminescence signals from modern sediments in a glaciated bay, NW Svalbard

H. Alexanderson[1*], A. S. Murray[2]

[1]*Department of Earth and Ecosystem Sciences, Lund University, Sweden & Department of Plant and Environmental Sciences, Norwegian University of Life Sciences, Norway (helena.alexanderson@geol.lu.se)*
[2]*Nordic Laboratory for Luminescence Dating, Aarhus University, Denmark (anmu@risoe.dtu.dk)*

** Corresponding author: helena.alexanderson@geol.lu.se*

The Engelskbukta Bay in northwestern Svalbard is bordered by glaciers, sandurs and lagoons. The Comfortlessbreen Glacier currently crosses the beach and enters the sea directly, while the more distal Uværsbreen Glacier and some small cirque glaciers feed a sandur that debouches into the bay. Surface sediments were sampled along a transect from the margin of the Comfortlessbreen Glacier out into the bay, down to 15 m water depth. The secchi depth in the bay was 0.1 m, which translates into a light extinction coefficient of ~17 m^{-1}. As a non-glacial reference environment, a sample was also taken from a nearby intra-lagoonal delta without glaciers in the catchment area. Quartz optically stimulated luminescence (OSL) and feldspar infrared stimulated luminescence (IRSL) were measured using sand-sized grains from each sample. For quartz OSL the ice-proximal sample showed high doses (~25 Gy) while beach sand on a spit ~500 m in front of the glacier and ice-distal sandur sediments (~3 km from glacier) had doses more than an order of ten lower (1-2 Gy). From 2.5 to 15 m water depth in the bay, doses in sediments near the sediment/water interface increase from ~0.2 Gy to ~5 Gy. For the marine sediments, feldspar IRSL 50°C doses are of the same order as for quartz (1-5 Gy), while post-IR IRSL 290°C doses are higher (10-30 Gy). In this Arctic environment it appears that no or very little bleaching occurs during ~100 m of meltwater transport from the glacier margin, but for material transported at least 3 km bleaching is more or less complete. Given the very limited light penetration through the seawater in the bay, any bleaching must have occurred during subaerial transport to the bay or by wave-reworking on the beach. Apart from the ice-proximal glacifluvial sediments, apparent doses due to incomplete bleaching of quartz OSL and feldspar IRSL (50°C) are negligible for luminescence dating of Pleistocene-aged deposits of ice-distal, littoral and shallow-marine origin. It remains to be seen whether the post-IR IRSL (290°C) is partially bleached, or is fully bleached to an unbleachable residual.

The Infrared Resonances in K-feldspar: Single or Multiple trap origin?

M. T. Andersen[1*], M. Jain[1], P. Tidemand-Lichtenberg[2], K. J. Thomsen[1], A. S. Murray[3]

[1]*Radiation Research Division, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, DK-4000 Roskilde, Denmark (mtha@risoe.dtu.dk)*
[2]*DTU Fotonik, Technical University of Denmark, DK-4000 Roskilde, Denmark*
[3] *Nordic Laboratory for Luminescence Dating, Aarhus University, Risø DTU, DK-4000 Roskilde, Denmark*

** Corresponding author: mtha@risoe.dtu.dk*

Feldspar as a natural dosimeter has drawn increasing attention because of its superior sensitivity and dose-response characteristics compared to quartz. However, it suffers from athermal signal instability (anomalous fading). Development of appropriate dose measurement protocols to avoid this effect requires knowledge of the dosimetric trap (donor) structure, its optical and thermal interactions, and the spatial distribution of acceptors. There has been a significant leap in understanding some of these aspects in the last few years (see Jain and Ankjærgaard, 2011). However, the energy level(s) of the dosimetric traps are still poorly understood. Previously reported excitation spectra show evidence for multiple resonance peaks; one centred around 1.44eV and two weaker resonances at 1.3eV and 1.6eV (Poolton et al., 2009). These peaks could in principal arise either from multiple traps or from a single trap with multiple excited states. Here we investigate the properties/origin of these multiple resonances and their dosimetric potential. Our work is divided into three main experiments carried out using a tunable Ti:Sapphire laser, with a tuning range from 700nm(1.77eV) to 1050nm(1.18eV), as the light source :

a. Excitation Spectra (ES) measured at 50°C, 230°C and 290°C to indicate whether the IRSL signals observed at these different temperatures can be assigned to the same or different traps. The ES are also made after a prior bleach at 50°C at the main resonance (1.44eV) to investigate the origins of the post IR-IRSL signals.
b. Dose-response curves measured at different wavelengths selected to target the different resonance peaks. Since different traps are expected to have different growth and saturation levels, the shape of the dose response curves can give useful information about the origins of these dosimetric signals.
c. Correlation between OSL signals at two of the resonances (for instance 1.3eV and 1.44eV) to understand whether they have a common origin or not. The change in remaining IRSL intensity for one wavelength is monitored, by varying the exposure time to another wavelength.

We conclude that the evidence points towards a single dosimetric trap in our samples; this trap is the main source of both room-temperature and elevated-temperature IRSL, as well as of post-IR IRSL signals.

Reference
1. Jain, M., Ankjærgaard C., "Insights into charge recombination and tunneling in feldspars using time resolved optically stimulated luminescence", Radiation Measurements, In Press. (2011)
2. N R J Poolton, RHKars, J Wallinga and A J J Bos, "Direct evidence for the participation of band-tails and excited-state tunnelling in the luminescence of irradiated feldspars", J. Phys.: Condens. Matter 21 (2009) 485505 (10pp)

Testing the reliability of post-IR $IRSL_{290}$ dating of K-feldspar in a wind-dominated system on Sardinia

S. Andreucci[1*] , J.-P. Buylaert[2,3], L.Sanna[1], A.S. Murray[2], V. Pascucci[1]

[1] *Dipartimento di scienze Botaniche, Ecologiche e Geologiche , Università di Sassari, 07100-Sassari, Italia (sandreucci@uniss.it)*
[2] *Nordic Laboratory for Luminescence dating, Department of Earth Sciences, University of Aarhus, Risø DTU, 4000-Roskilde, Denmark*
[3] *Radiation Research Division, Risø DTU, 4000-Roskilde, Denmark*

* *Corresponding author: sandreucci@uniss.it*

Most luminescence dating studies on Sardinia have used quartz SAR-OSL dating. However, for some samples the natural quartz OSL signal is too close to saturation to be reliable (i.e. $D_e>2*D_0$). In this paper, we test the reliability of a SAR post-IR IRSL (pIRIR) protocol applied to sand-sized (180-250 μm) K-rich feldspar extracts for dating wind-blown material on Sardinia. After a preheat of 320°C for 60s and an IR bleach at 50°C for 200s, the post-IR IRSL signal is measured at 290°C for 200s. Test dose measurements received the same preheat treatment as the natural and regenerative doses. An elevated temperature IRSL clean-out at 325°C for 200s was inserted after every SAR cycle to minimise recuperation. Aeolian samples from three study areas have been selected along the North Sardinia coast (Italy): The Bue Marino cave (Orosei Gulf; NE Sardinia), south Alghero coast and the Alghero bay (NW Sardinia).

The sedimentary succession at Bue Marino cave includes a 10 m thick sandy wind-blown unit at the cave entrance, sandwiched between two 50 cm thick calcareous crusts; U-series dates of these crusts constrain the formation of the aeolianite unit to between ~125 and ~65 ka. Four luminescence samples were collected from the aeolianites. Due to saturation of the dose response curve, standard quartz SAR-OSL dating only gives minimum ages of between 70 ka and 50 ka. In contrast, fading-uncorrected $pIRIR_{290}$ ages on K-feldspar extracts point to a formation between ~100 and ~80 ka, in good agreement with the U-series data.

Along the south Alghero coast a 10-metres thick lithified transgressive dunefield system is widely recognised in the literature to represent the beginning of the last glacial phase (*post* 80 ka). The natural quartz OSL of a single block cut from this deposit lies below $2xD_0$ and the sample passed all the standard laboratory tests (purity test, dominant fast component, dose recovery test (1.02±0.02, n=3) suggesting that the resulting age of 76±6 ka can be considered reliable. The fading-uncorrected post-IR $IRSL_{290}$ age of 73±5 ka is in good agreement with the quartz result.

It is well-known that feldspar IRSL signals bleach at least an order of magnitude slower than the quartz OSL signal. To check the degree of bleaching of the $pIRIR_{290}$ signal and the influence of thermal transfer, a set of Late Holocene to modern samples was selected from a modern coastal dunefield system backing Alghero bay; this dunefield was stabilized by plantation during the 1950s. The quartz OSL ages of 3 samples from the dune system span from 2500±150 years to 60±20 years ago, consistent with the known dunefield stabilization. Preliminary $pIRIR_{290}$ ages indicate an age offset of 1610±140 years, suggesting that the $pIRIR_{290}$ method is most likely to be useful when applied to older (pre-Holocene) samples.

From the results from the Bue Marino cave and the south-Alghero coast, we conclude that the $pIRIR_{290}$ method shows great promise for samples at or beyond the quartz OSL age limit.

Extending the quartz OSL age range using violet (403 nm) stimulation

C. Ankjærgaard[1,2,*], M. Jain[2], J. Wallinga[1]

[1] *Netherlands Centre for Luminescence Dating, Delft University of Technology, The Netherlands*
[2] *Radiation Research Division, Risø National Laboratory for Sustainable Energy, DTU, Denmark*

[*] *Corresponding author: christina.ankjaergaard@gmail.com*

Optical stimulated luminescence (OSL) dating of quartz is widely used in geological and archaeological research to determine the time of deposition of sediments. Unfortunately, the quartz fast component blue light stimulated luminescence signal saturates at relatively low doses, limiting the applicability of quartz OSL dating to the last 150,000 years. In recent years, the use of thermally transferred OSL (TT-OSL) has been suggested to date aeolian quartz deposits up to about 780,000 years, but this method requires relatively bright samples due to the inefficiency of the TT-OSL process (e.g. Wang et al., 2006; Kim et al., 2010, and references therein). Moreover, it is unclear whether TT-OSL signals for non-aeolian samples are adequately re-set during transport.

An alternative approach to extending the age range was suggested by Jain (2009). He used violet (405 nm) light to directly probe deep traps in quartz; each violet stimulation was preceded by blue light bleaching of the fast OSL component. In spite of promising results with dose responses of up to >1.5 kGy, quartz violet stimulated luminescence (VSL) has received no attention from the luminescence dating community so far.

In this study, we investigate the applicability of the VSL signal for dating Quaternary deposits. For this, we investigate multiple samples from a core in the south-central Netherlands which penetrates a 35-m thick sequence of Middle to Late Pleistocene deposits of aeolian and fluvial nature (Boxtel core, Schokker et al., 2005). The samples were previously investigated using quartz OSL (Schokker et al., 2005) and feldspar infrared stimulated luminescence dating (Wallinga et al., 2007). Because dose rates are very low, a reliable quartz OSL chronology is available up to ~300 ka.

Results from one of the younger samples (aeolian, quartz OSL age 13.3 ± 0.8 ka) show extended growth with dose up to 7 kGy, demonstrating the potential to extending the dating range using the VSL signal to ~7 Ma at this site. Preliminary results show that the violet signal is reset to a similar degree as the OSL signal giving an age of ~14 ka. VSL dose recovery results will be presented and VSL ages will be compared against known OSL ages for the last 300,000 years.

Keywords: Quartz, optically stimulated luminescence (OSL), violet stimulated luminescence (VSL), retrospective dosimetry, luminescence dating, extending the age range

References:

Jain, M., 2009. Extending the dose range: Probing deep traps in quartz with 3.06 eV photons. Radiation Measurements 44, 445-452.

Kim, J.C., Duller, G.A.T., Roberts, H.M., Wintle, A.G., Lee, Y.I., Yi, S.B., 2010. Re-evaluation of the chronology of a palaeolithic site at Jeongokri, Korea, using OSL and TT-OSL signals from quartz. Quaternary Geochronology 5, 365-370.

Schokker, J., Cleveringa, P., Murray, A.S., Wallinga, J., Westerhoff, W.E., 2005. An OSL dated Middle and Late Quaternary sedimentary record in the Roer Valley Graben (southeastern Netherlands). Quaternary Science Reviews 24, 2243–2264.

Wallinga, J., Bos, A.J.J., Dorenbos, P., Murray, A.S., Schokker, J., 2007. A test case for anomalous fading correction in IRSL dating. Quaternary Geochronology 2, 216-221.

Wang, X.L., Lu, Y.C., Wintle, A.G., 2006. Recuperated OSL dating of fine-grained quartz in Chinese loess. Quaternary Geochronology 1, 89-100.

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Experience using the Varian VF-50J X-ray source in routine equivalent dose determination

S. J. Armitage*

Department of Geography, Royal Holloway, University of London, Egham, Surrey, TW20 0EX, United Kingdom (simon.armitage@rhul.ac.uk).

** Corresponding author: simon.armitage@rhul.ac.uk*

X-ray irradiation has been identified as offering a range of advantages over the use of conventional radioisotope based sources in luminescence dosimetry. These advantages include the absence of potentially hazardous radioisotopes, high spatial dose rate uniformity and the ability to vary dose rates under computer control. However, for routine equivalent dose determination the principle advantage of X-ray irradiation lies in the high dose rate achievable relative to that from conventional $^{90}Sr/^{90}Y$ beta-sources. These high dose rates potentially allow dramatically enhanced productivity from a luminescence dating system. Unfortunately, recent research indicates that the advantages offered by X-ray irradiation are offset by a number of complicating factors, notably wide variations in apparent dose rates between different dosimeters, and between different samples of the same dosimeter.

This study presents results obtained using a Varian VF-50J X-ray source attached to a Risø TL-DA-20 reader. Investigation of the characteristics of this X-ray source indicate performance consistent with the published literature. Notably, the dose rate varies linearly with tube current, is stable over long periods of time and is up to one order of magnitude greater than that for the beta-source mounted on the same reader. To determine the suitability of this source for routine equivalent dose determination, the luminescence response characteristics of a wide range of quartz samples were determined using the single-aliquot regenerative-dose (SAR) method. As expected from the published literature, some inter-sample variability in dose rate was observed. However, for any individual aliquot, beta and X-ray growth characteristics were identical below 200-300 Gy. Consequently, a low-dose calibration point can readily be incorporated into the standard SAR measurement sequence, thereby removing the deleterious effects of sample specific X-ray dose rates. This approach was applied to a large number of previously dated samples, yielding excellent agreement between beta and X-ray equivalent doses. These results indicate that the Varian VF-50J X-ray source has considerable potential for routing OSL dating of quartz samples.

OSL dating of the Hotel California site, Atapuerca, Spain: A case study of multi-grain averaging effects in mixed sediments

L. J. Arnold [1*], M. Demuro [1], M. N. Ruiz [2], A. Benito-Calvo [3], A. Pérez-González [3].

[1] Programa de Geocronología, Centro Nacional de Investigación sobre la Evolución Humana, CENIEH, Paseo Sierra de Atapuerca s/n, 09002 Burgos, Spain. (lee.arnold@cenieh.es).
[2] Área de Prehistoria, Universidad de Burgos, Edificio I+D+i, Plaza Misael Bañuelos s/n, 09001 Burgos, Spain.
[3] Programa de Geoarqueología, Centro Nacional de Investigación sobre la Evolución Humana, CENIEH, Paseo Sierra de Atapuerca s/n, 09002 Burgos, Spain.

** Corresponding author: lee.arnold@cenieh.es*

Hotel California, located in the south-western foothills of the Sierra de Atapuerca, is among the richest of 31 open-air Middle Palaeolithic sites discovered across a 314 km^2 area of the Duero Cenozoic Basin, north-central Spain. More than 1,800 Mode III tools (cores, flakes, retouched flakes and fragments) have been recovered from 6 archaeological levels within a 23 m^2 survey area of this hunter-gatherer occupation site. We have employed both single-grain and multi-grain aliquot equivalent dose (D_e) estimation procedures to obtain coarse-grained quartz OSL ages for the silt and clay deposits bracketing the main archaeological levels at Hotel California. Analysis of the single-grain D_e distribution characteristics and sedimentological properties of these deposits suggests that they have likely been affected by post-depositional mixing processes such as bioturbation, anthropogenic disturbances and desiccation crack formation. We apply the finite mixture model (FMM) to identify discrete dose populations within these single-grain D_e datasets, and to derive representative burial dose estimates for the archaeological horizons. Recent experiments undertaken by Arnold and Roberts (2009) on simulated D_e datasets suggest that significant problems can be encountered when dating mixed sedimentary samples with multi-grain D_e estimation techniques. In particular, the 'averaging effects' of multi-grain D_e analysis can give rise to apparent discrete dose populations that do not correspond to the original single-grain mixing components ("phantom dose components"). In this study we asses the significance of these modelling predictions for empirical D_e datasets of mixed sediments. We focus on the special case of D_e measurements made on single-grain discs that contain more than one quartz grain in each of the individual grain-hole positions. D_e measurements made in this manner do not provide true single-grain resolution, but, instead, represent very small multi-grain aliquots; thus providing ideal case studies for assessing the extent of averaging effects in mixed sediments. For this purpose, we compare the D_e distributions and FMM results obtained for 90-100 μm quartz grains loaded on to custom-made aluminium discs drilled with 100 μm diameter holes (representing true single-grain analysis) with those obtained for the same-sized grains loaded on to standard aluminium discs drilled with 300 μm diameter holes (representing very small multi-grain aliquots containing >10 grains). Comparative D_e measurements are also made using 125-180, 180-212 and 212-250 μm quartz grains loaded on to standard single-grain discs drilled with 300 μm diameter holes. Our results show that the averaging effects of very small multi-grain aliquots, including 'single-grain' aliquots that contain more than one grain in each of the individual grain-hole positions, can be substantial enough to significantly alter the D_e distribution characteristics and resultant FMM ages of mixed samples. This can have potentially important implications for the accuracy of any such 'single-grain' OSL chronologies derived in complex archaeological settings such as Hotel California.

Reference

Arnold, L.J., Roberts, R.G. 2009: Stochastic modelling of multi-grain equivalent dose (De) distributions: Implications for OSL dating of sediment mixtures. *Quaternary Geochronology* 4, 204-230.

Conventional- and Thermally Transferred-OSL chronology of Paleolithic sites from SW Greece. Reconstruction of Late Pleistocene paleogeography

C. Athanassas[1*], V. Pagonis, [2], Y. Bassiakos[1], G.A. Wagner[3], M.E. Timpson[4]

[1]*Archaeometry Laboratory, Institute of Materials Science, N.C.S.R. 'Demokritos', Aghia Paraskevi, 153 10, Athens, Greece (E-mail: athanassas@ims.demokritos.gr).*
[2] *Physics Department, McDaniel College, Westminester, MD 21157, USA.*
[3] *Institute of Geography, Heidelberg University, D-69120, Heidelberg, Germany.*
[4] *Natural Resource Group, LLC, Portland, OR 97201, USA.*

** Corresponding author: athanassas@ims.demokritos.gr*

This paper employs conventional optically stimulated luminescence (OSL) and Thermally Trasferred OSL dating trechniques on sediments associated with two archaeological sites located in Navarino, southwestern Greece. Archaeological surveys have located at least two Paleolithic sites on preserved Pleistocene fossilised dune and beach deposits that stretch along the modern shoreline (Davis et al., 1997). Chipped stone assemblages were identified eroding out of paleosols incorporated into the dunes and contain artefacts that typologically can be assigned to the Levallois Mousterian (Parkinson and Cherry, 2010). Poor resolution of former luminescence dating attempts in the 1990s restrained the accurate chronology of the sites (Parkinson and Cherry, 2010). The revised OSL chronology we developed for the Mousterian sites achieved greater resolution than previous luminescence dating attempts, but still lower than we initially anticipated. The application of newer developments in optical dating, such as the Single Aliquot Regenerated protocol for quartz (Murray and Wintle, 2000) and the recently introduced Thermally Transferred-OSL dating protocol for quartz by Adamiec et al. (2010), demonstrated the potential to overcome some of the sources of uncertainty that confronted the geochronologists who examined the same sediments in the 1990s. Despite the improvements in luminescence dating procedures, the sediments from SW Greece experience issues which lay beyond current OSL dating capabilities. Non-linear responses of the natural OSL signals were determined to be a major source of uncertainty in the paleodose estimation. Use of criteria recently proposed by other researchers (Wintle and Murray, 2006) was useful in constraining some of the observed uncertainty, but only to a moderate extent. Conversely, our data indicate that TT-OSL signal from quartz would likely provide more accurate results if older samples were involved. Thus, the Paleolithic layers from Navarino stand on the threshold between OSL and TT-OSL methods. Their OSL signals tend toward saturation but, at the same time, their TT-OSL signals are not sufficiently developed to be clearly distinguished from the measurement noise. TT-OSL dose recovery experiments and supportive IRSL measurements lend relatively more credence to the conventional OSL ages we obtained for these sediments. Given the complications described above, the precision of the revised OSL ages for the Paleolithic sites in SW Greece is no greater than 85 %. Provided the current degree of precision, OSL data are further exploited to reconstruct certain phases of regional Paleolithic coastal paleogeography.

Keywords: OSL; TT-OSL; saturation; dose recovery; precision; Mousterian; paleogeography

References

Adamiec, G. et al. 2010. *Radiation Measurements*, 45, 768-777.
Davis, J.L. et al. 1997. *Hesperia*, 66, 391-494.
Murray, A.S. and Wintle, A.G. 2000. *Radiation Measurements*, 32, 57-73.
Parkinson, W.A. and Cherry, J.F. 2010. *Hesperia*, 79, 1-51.
Wintle, A.G. and Murray, A.S. 2006. *Radiation Measurements*, 41, 369 -391.

Electron Spin Resonance Dating of the Late Quaternary Megafauna Fossils from Baixa Grande, Bahia, Brazil

O. Baffa[1*], A. Kinoshita[1,2], A. M. Figueiredo[3], R. da Costa Ribeiro[4], I. de Souza Carvalho[4]

[1]Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Av. Bandeirantes, 3900, 14040-901 Ribeirão Preto, SP, Brazil.
[2]Universidade do Sagrado Coração, Rua Irmã Arminda 10-50,17011-160 Bauru, SP, Brazil,
[3]Instituto de Pesquisas Energéticas e Nucleares (IPEN), 05422-970, São Paulo-SP, Brazil,
[4]Departamento de Geologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil

* *Corresponding author: baffa@usp.br*

Late Quaternary fossils from the extinct South American megafauna are relatively common in Brazilian's Northeast region. There are more than 160 records related to that mammals discovered at carstic deposits, paleolacrustine deposits, and mainly inside depressions in weathered crystalline rocks called "tanque" or "cacimba". Few geochronological studies were conducted in these mammal's fossils from the Brazilian's Northeast deposits, thus dating more samples found in this region will allow a better time and space understanding of that fauna. The fossiliferous deposit, a "tanque" located at Lagoa do Rumo, Baixa Grande, Bahia State, Brazil has two distinct levels. The basal bed, a thick packaged of fossiliferous breccia, supported by very poorly sorted clast and bioclast, were fossils were chaotically arranged in the layer. The superior strata is an organic-rich mudstone, without any presence of macrofossils. In the fossiliferous layer were discovered fossils of *Eremotherium laurillardi*, *Panochthus greslebini*, *Stegomastodon waringi* and Toxodontinae. Teeth of *S. waringi* (AMEPR1) and Toxodontinae (AMEPR2 and AMEPR3) were selected for ESR dating. Enamel and dentin of the tooth AMEPR1 was removed using a carbide disk operating with low rotation and constant water irrigation. This fraction and the other teeth (AMEPR2 and AMEPR3) were submitted to thermal treatment by freezing in liquid nitrogen and defrosting at room temperature. After a few repetitions, the enamel detached from dentine. The enamel were subjected to acid treatment (HCl) 1:5 in ultrasonic bath for extraction of outer layer of both sides of approximately 250μm. After drying, the enamel was ground manually in an agate mortar until the particle diameter φ <0.5mm. Ten aliquots of about 70mg were irradiated with different doses, ranging from 0 to 1.2kGy. The spectra were recorded in a Jeol FA200 X-Band spectrometer. The intensity of peak-to-peak signal dosimetric $g_{\perp}$ was used to construct the dose-response curve. The equivalent dose (De) was determined by fitting with exponential function. The conversion of De into age was made using a software, using the concentrations of U, Th and K found in enamel, dentine and soil through Neutron Activation Analysis (NAA).The results obtained were 50 ± 10 ka B. P. for AMEPR1, 43 ± 8 ka B. P. for AMEPR2 and 9 ± 2 ka B. P. for AMEPR3. These results show a significant time span between 30ka and 50ka years in the fossil assemblage from Lagoa do Rumo. The result obtained in the sample AMPER3, 9 ± 2 ka B. P., is the youngest age obtained directly from a megafauna's fossil from the late Quaternary in the Brazilian's Northeast region.

ESR and ESR/U-series dating study of the Middle Paleolithic site of Piégu (Brittany, France) – a multi-material approach

J.-J. Bahain [1*], C. Falguères [1], M. Laurent [1,2], Q. Shao [1], J.-M. Dolo [3], T. Garcia [4], J.-L. Monnier[5], B. Hallegouet [6], M. Laforge [5], B. Huet [5], J. Gagnepain † [7]

[1] *Département de Préhistoire, Muséum national d'histoire naturelle, UMR7194 du CNRS, 1, rue rené Panhard, 75013, Paris, France. (bahain@mnhn.fr, falguere@mnhn.fr, shao@mnhn.fr)*
[2] *Électrochimie et Synthèse Organique, Institut de Chimie et des Matériaux Paris-Est, ICMPE, UMR 7182 CNRS—Université Paris-Est Créteil, 2-8 rue Henri Dunant, 94320 Thiais, France. (michel.laurent@glvt-cnrs.fr)*
[3] *CEA, I²BM, 91401 Orsay Cedex, France. (jean-michel.dolo@cea.fr)*
[4] *CEA, LIST, Laboratoire National Henri Becquerel, 91191 Gif-sur-Yvette Cedex, France. (tristan.garcia@cea.fr)*
[5] *UMR 6566 (CREAAH), Université de Rennes 1, Campus de Beaulieu, Laboratoire Archéosciences (bât. 24-25), 74205 CS, 35042 Rennes cedex, France. (jean-laurent.monnier@univ-rennes1.fr, laforge.marine@orange.fr, briagellhuet@hotmail.com)*
[6] *Département Géographie Université Bretagne occidentale, 3 rue des Archives - CS93837 - F29238 Brest cedex 3, France. (bernard.hallegouet@univ-brest.fr)*
[7] *Musée de Préhistoire des gorges du Verdon, UMR7194 du CNRS, Route de Montmeyan, 04500, Quinson, France.*

** Corresponding author: bahain@mnhn.fr*

The Middle Palaeolithic site of Piégu is located in the eastern part of Saint-Brieuc Bay, Brittany, France. Located near the present-day sea shoreline along a granodioritic cliff, the site was excavated in 1987. The 15m thick stratigraphic succession is constituted by an alternation of beach, head and dune levels, more or less pedogenetized. It covers several interglacial/glacial cycles and includes some archaeological layers with Mousterian type lithic industry and for some of them palaeontological remains, in spite of such a magmatic acid area. Different kinds of samples were taken for geochonological analyses: mammal bones and teeth, bleached quartz extracted from marine or aeolian deposits and marine mollusc shells. Additional samples were also carried out from the neighbour Mousterian site of Les Vallées, which is stratigraphically connected with Piégu. The results obtained by ESR and ESR/U-series are generally consistent with the regional chronostratigraphic framework. They permit the proposal of a reconstruction of the site geological evolution between 240 and 120 ka and the dating of the archaeological evidences .

Keywords: ESR/U-series, ESR, bones and teeth, mollusc shell, sedimentary quartz, Middle Pleistocene, Mousterian.

Spatially resolved measurement of beta dose rate using external dosemeters

I. Bailiff*

Department of Archaeology, Dawson Building, University of Durham, South Road, Durham DH1 3LE, UK

** Corresponding author: Ian.Bailiff@dur.ac.uk*

The effect on the β dose rate of heterogeneity in the distribution of radionuclides within a sample matrix has become of particular interest in luminescence age calculation where burial dose distributions are derived from measurements with coarse single grains of quartz. This issue has been investigated previously using computational and experimental techniques employing an immersion technique with Al_2O_3:C in granular and chip form. In this paper spatially resolved measurements of the external β dose rate were performed using a dosemeter array with the aim of investigating its suitability for application to dating samples. Following the approach of the β TLD technique, the external β dose rate at the surface of the sample was measured using an array of up to 30 cylindrical compartments each of 1 mm dia. and 0.5 mm depth (~4.10^{-4} cm^3), into which thermally annealed granular (90-106 μm) Al_2O_3:C dosimetry phosphor was placed. Polyester film of 125 μm thickness was fastened to each array to absorb alpha particles emitted by the sample. Following storage, the phosphor grains were extracted from each compartment and the absorbed dose determined using a regenerative procedure (~200 °C TL peak). The results of measurements performed with samples of analysed reference sands indicate that ~20% of the infinite medium dose rate is registered by the external dosemeters, and for ceramic samples the external dose rate is typically between 1 and 2 μGy d^{-1}. Distributions of the dose rate values for each array were obtained for solid and powdered ceramic and untreated sediment samples with the aim of comparing their characteristics and reproducibility; the standard deviation of the distributions ranged from ±5% for homogenised sample to in excess of 25% for material that was visibly heterogeneous. The storage period used in these tests was at least several months, but on the basis of signal intensity of typical aliquots (i.e., the grains extracted from one cell), shorter storage periods (1-2 months) are feasible. While the array system has sufficient sensitivity and the advantage of determining dose rate directly, the experimental procedure is considerably more time consuming than for a single dosemeter system. Hence the extent to which measurements of this type have the potential to quantify the effects of heterogeneity on the dosimetry of quartz grains within an undisturbed matrix are also explored in the paper.

Keywords: luminescence dosimetry, spatially-resolved, beta dose rate, heterogeneity

IRSL chronology of Middle Pleistocene marine shoreline deposits from central and northern Tunisia

S. Balescu[1]*, H. Mejri[1, 2], M. Barré[3], M. Lamothe[3]

[1]*Laboratoire Halma Ipel, UMR 8164 (CNRS), Université des Sciences et Technologies de Lille, 59655 Villeneuve d'Ascq Cedex. (sanda.balescu@univ-lille1.fr)*
[2]*Laboratoire Eau-Energie-Environnement, ENIS, Université de Sfax BP W 3038 Tunisie. (hajerm79@gmail.com)*
[3]*Laboratoire de Luminescence LUX, Département des Sciences de la Terre et de l'Atmosphère, Université du Québec à Montréal, CP 8888 Succ. Centre-Ville, H3C 3P8 Montréal, Canada.; (magali.barre@uqam.ca luxlamothe@yahoo.ca)*

** Corresponding author: sanda.balescu@univ-lille1.fr*

Evidence for Pleistocene sea-level changes and coastal neotectonics occur extensively along the Tunisian coastline. The Pleistocene shoreline deposits show a variability in elevation that is related to both glacio-eustatic change and regional neotectonic deformation. This area is known as a type area for the Tyrrhenian (Last Interglacial) shallow-marine sediments whose chronology relies mostly on biostratigraphic evidence (presence of a Senegalese warm water fauna with *Strombus bubonius*) and independent geochronometric data (U-series dates on molluscs and corals, amino-acid data, quartz OSL dates).

By contrast, the age of the Middle Pleistocene interglacial shoreline deposits (e.g. the "Douira Formation" devoid of *Strombus bubonius*) has not yet been unambiguously established. The chronology of these deposits that are stratigraphically and geomorphologically older than the Tyrrhenian shallow-marine sediments is still a matter of debate.

Recently, Mauz *et al*. (Palaeo.(3) 279 (2009) 137) applied the quartz SAR-OSL dating technique to several Tunisian coastal sites but failed to provide an accurate age for the "Douira Formation", because of the low saturation level (around 60 Gy) for the quartz signal. Application of quartz OSL dating in this area is thus restricted to sediments younger than 100 ka.

The present study is designated to make an independent age assessment of the "Douira Formation" using the IRSL dating method. The latter is applied to alkali feldspar coarse grains (200-250 μm) from shallow-marine sand deposits assigned to the "Douira Formation", using both the multiple aliquot additive γ dose technique and the SAR -IRSL method.

This paper focuses on two key reference sites, El Hajeb and Oued Dar Oufa, from two adjacent areas, the Tunisian Sahel and the Cap Bon, respectively in central and northern Tunisia.

All samples show evidence of anomalous fading. The measured IRSL ages are stratigraphically consistent but systematically underestimate the expected geological ages. Three protocols of age correction for the observed fading have been tested: (1) the correction for anomalous fading of Huntley and Lamothe (Can. J. Earth Sci. 38 (2001); (2) the correction for long-term fading of Mejdahl (Quat. Sci. Rev. 7 (1988) 357) 1093; (3) the dose rate correction developed by Lamothe *et al*. (Radiat. Meas. 37 (2003) 493). The three fading correction protocols yield corrected ages that are in better agreement with the expected ages. This study demonstrates the potential of the IRSL dating method to provide chronological information on Middle Pleistocene (MIS 7 and MIS 9) paleoshorelines of Tunisia.

A comparative study of two luminescence dosimeters from a Middle Stone Age site in South Africa

M. Barré[1*], M. Lamothe[1] , L. Backwell[2,3]

[1]Laboratoire de luminescence Lux, Département des sciences de la Terre et de l'atmosphère, Université du Québec à Montréal, PO 8888, Succ. Centre-Ville, Montréal, Québec, H3C 3P8, Canada.
[2]Bernard Price Institute for Palaeontological Research, and [3]Institute for Human Evolution, University of the Witwatersrand, Private Bag 3, Wits, 2050, Johannesburg, South Africa

**Corresponding author: barre.magali@uqam.ca*

With an ability to determine ages between 300 and 100 ka, luminescence dating (TL and OSL) is a research tool that is increasingly being applied to archaeological contexts. The luminescence dating method can be applied where radiocarbon, often the first choice of archaeologists, cannot, either because of a lack of preservation of organic matter, or because artifacts are in a context beyond the range of radiocarbon dating. Luminescence age errors usually range between 5 and 10%. Different approaches may be applied to improve both accuracy and precision, one of which is taking advantage of the fact that luminescence may be applied to a range of minerals including quartz, feldspars, calcite and zircons. While quartz is the most used dosimeter, it has been shown that feldspars provide many advantages over quartz, essentially in terms of reproducibility and sensitivity. Unfortunately, they also suffer from instability in their luminescence signal, known as anomalous fading, which leads to an underestimation in age if no correction is applied. Over the last 20 years, a great deal of research at the LUX Lab in Montreal has gone into feldspars and how to deal with anomalous fading.

Here we present results from the spring and peat mound site of Wonderkrater, situated in Limpopo Province, South Africa. Measurements were obtained from sediments containing a late Middle Stone Age lithic assemblage and Florisian fauna. We explore the possibility of obtaining a single age for both quartz and feldspar from the same sample. For one of the samples, quartz and feldspar ages were relatively well correlated once we had corrected for fading. In this case, feldspars behaved strangely with regard to anomalous fading, with a barely detectable and measurable fading rate, whatever the protocol applied, suggesting that the solution to anomalous fading might be to find feldspar grains that do not fade. A second sample was interesting because quartz seemed to be less bleached than feldspars, no matter the extent of correction for fading. This highlights the danger of systematically selecting only one dosimeter in an archaeological or geological context. Finally, we wish to share some considerations and suggestions concerning the preparation of samples for measuring luminescence.

Investigating the effects of glacial shearing of sediment on luminescence signal

M.D. Bateman[1*], D.A. Swift[1] , J.A. Piotrowski[1,2], D. C.W. Sanderson[3]

[1]*Department of Geography, University of Sheffield, UK (email: m.d.bateman@Sheffield.ac.uk)*
[2]*Department of Earth Sciences, University of Aarhus, Denmark.*
[3]*Scottish Universities Environmental Research Centre, East Kilbride, UK.*

** Corresponding author: m.d.bateman@Sheffield.ac.uk*

Unexpectedly low luminescence of basal sediment sampled at Haut Glacier d'Arolla, Switzerland indicates that processes at the ice-bedrock interface may have the potential to reset (or 'bleach') natural luminescence signals (Swift *et al.*, 2011). Using a purpose-built ring-shear apparatus situated in a light-controlled environment we have experimentally investigated the potential for resetting of mineral grains under conditions similar to those found at the ice-bedrock interface. An initial experiment used medium quartz sand from relict dune system with a naturally acquired palaeodose of ~5 Gy, basal shearing conditions similar to that found at the base of a glacier (v = 1 mm/min, σ = 100 kPa), and shearing displacement of up to 12.8 m. Shear stresses and volume changes of the sand during shearing were monitored. Incremental sampling during the shearing experiment was undertaken to track changes in the physical and luminescence properties of the sand as strain/shearing increased. The results demonstrated very clearly that increased strain/shearing resulted in an increase in the number of zero-dose grains. It also showed that whilst the mean palaeodose remained consistent there were changes in the size and number of palaeodose components as strain/shearing increased. A second experiment was undertaken using a shearing displacement of up to 19.2 m, annealed medium quartz sand gamma dosed to ~50 Gy and greater normal stresses (up to σ = 150 kPa) and shearing velocity (v = 2 mm/min). Results from these experiments will be presented with a view to elucidating whether changes in luminescence can be associated with changes in the physical characteristics of sediment under these monitored shear stresses/pressures.

References

Swift, D.A., Sanderson, D.C.W., Nienow, P.W., Bingham, R.B., Cochrane, I.C. (2010): Anomalous luminescence of subglacial sediment at Haut Glacier d'Arolla, Switzerland – a consequence of resetting at the glacier bed, *Boreas*, DOI: 10.1111/j.1502-3885.2010.00196.x

Methodological studies on luminescence dating of Volcanic Ash beds

R. H. Biswas[1*], M.A.J. Williams[2], R. Raj[3], S. Mishra[4], N. Juyal[1], A. K. Singhvi[1]

[1]*Geoscience Division, Physical Research Laboratory, Ahmedabad 380009, India (* biswasrabiul@gmail.com)*
[2]*Geographical & Environmental Studies, University of Adelaide, Adelaide 5005, Australia*
[3]*Department of Geology, Faculty of Science, M. S. University of Baroda, Vadodara 390 002, India*
[4]*Department of Archaeology, Deccan College, Pune 411006, India*

** Corresponding author: biswasrabiul@gmail.com*

Dating of volcanic ashes has been problematic on account of anomalous fading of the luminescence signal. Earlier attempts to date volcanic ashes using volcanic glass, quartz and feldspar met with limited success (e.g. Berger, 1992; review by Fattahi and Stokes, 2003). Fattahi and Stokes (2000) dated volcanic quartz in the red emission to 1.2 Ma, but questions like, the exact nature of the emissions used, their universal applicability, have remained largely unexplored. This study systematically examined the protocols used in the dating volcanic ashes in India from varied contexts. The age controls were based on, i) stratigraphy, and, ii) luminescence dating of the horizons above and below the ash deposits. Geochemically, all these ashes have been designated as the youngest Toba ash (securely dated to 74 ka) but an exception has been the Bori sample for which, despite the chemical similarity, Ar-Ar ages of ~600 ka had been reported. The age of ash at Bori is still being passionately debated. Samples from Tejpur (N 21°46′N, E 73°18′), Rehi (N 24°32′N, E 82°16′) and Kuntheli (N 24°30′N, E 82°00′), Bori (N 19°07′N, E 74°06′) and Morgaon (N 15°17′N, E 74°18′) were studied. Polyminerallic fine (4-11 μm) grains were used and the equivalent doses (D_e) were estimated using four different protocols, viz., i) TL MAAD in blue emission, ii) isothermal (ITL) MAAD in red emission, iii) IRSL SAR with stimulation at 50°C, and 4) post infrared (PIR) IRSL SAR with stimulation at 300°C in blue emission and a preheat of 320°C gave maximum D_e. TL MAAD (blue), ITL MAAD (red) and IRSL SAR gave low D_e's and PIR-IRSL SAR D_e's were about 1.6-2.0 times higher than IRSL SAR. The g-value of IRSL signal ranged from 3-6 %/decade and for PIR-IRSL was 0-1.3 %/decade (Auclair et al., 2003). Alpha efficiencies of PIR-IRSL at 320°C were 0.036-0.055 and were consistently higher than that for IRSL at 50°C, buttressing the suggestion that IRSL and PIR-IRSL originated from different charge trapping states. The D_e's of Tejpur, Rehi and Kuntheli ashes ranged from 325-360 Gy using PIR-IRSL SAR and translated to D_e of 325-535 Gy with fading correction using Kars et al. (2008). An unresolved issue is the variation in the dose-rates for ash samples, both intra-region and intra-layer reflecting the mobility of K due to leaching. Assuming ash to be well mixed during transport, a local mean of radioactivity was used which gave ages in the range 59-78 ka, largely consistent with the expected age of 74 ka and with quartz SAR ages of bounding sediment layers. Samples from Bori and Morgaon, gave PIR-IRSL D_e's of 142 and 203 Gy translating to ages of 25-35 ka. Given the earlier Ar-Ar ages of 600 ka and geochemical suggestion of its being due to youngest Toba ash event, dated 74 ka, this present OSL age can only be reconciled to by suggesting it to be reworked ash, and that the luminescence dates the reworking event. Methodological aspects of luminescence dating of volcanic ash, dose rate estimation including the alpha efficiency and microdosmietry and dating range obtainanble using PIR IRSL will be presented.

References

Auclair, M., Lamothe, M., Huot, S. 2003. Radiation Measurements 37, 487-492.
Berger, G.W. 1992. Geolgoy 20, 11-14.
Fattahi, M., Stokes, S., 2000. Radiation Measurements 32, 479-485.
Fattahi, M., Stokes, S., 2003. Earth Science Reviews 62, 229-264.
Kars, R.H., Wallinga, J., Cohen, K.M., 2008. Radiation Measurements 43, 786-790.

TL Emission and X-rays Diffraction from Al_2O_3 Thin-Films Deposited on Monocrystalline Silicon wafer by Magnetron Sputtering

J. F.S. Bitencourt[1*], K. A. Gonçalves[1], A. Ventieri[1], J. C. Mittani[2], S. H. Tatumi[1,2]

[1] *Escola Politécnica da Universidade de São Paulo, 380 Luciano Gualberto avenue, São Paulo, Brazil, 05508-010 (jfsousab@yahoo.com.br)*
[2] *Faculdade de Tecnologia de São Paulo, 30 Cel. Fernando Prestes square, São Paulo, Brazil, 01124-060.*

** Corresponding author: jfsousab@yahoo.com.br*

Samples of aluminum oxide thin-films were produced using magnetron sputtering technique from a α-Al_2O_3 target. Aluminum oxide powder obtained from polymeric calcination was mechanically compressed and sintered at high temperature to form a solid bulk to be used as a sputtering target. Deposition process was carried out using an RF magnetron sputtering reactor with low argon atmosphere (~5.3 mTorr, Ar flow at 18 sccm); the substrate was positioned 100 mm from the target and power supply was kept at 200 W for the duration of the deposition (481 minutes). The thin-film was deposited in three separated substrates at the same time and each one of them received a different heat-treatment. Sample A was not treated; sample B was treated at 500°C for 60 minutes and sample C was treated at 1100°C for 60 minutes. X-rays diffraction peaks from aluminum oxide (alpha or gamma structures) could not be observed in the diffractograms obtained from the three samples (A, B and C) due to the 30 nm thickness of the films (probe perfilometry). Nonetheless, intensity and roughness among the diffractograms could be easily distinguished, what can be due to the crystallinity of the thin-film interfering with the diffracted X-rays. For the TL measurements, the samples were previously irradiated with a ^{60}Co gamma-rays source with dose of 1 Gy. A TL/OSL reader from Daybreak Medical and Nuclear Systems Inc. model 1100-series equipment, with a BG-39 optical filter coupled to the PMT, produced four emission curves: one for each sample (A, B and C) plus one from a irradiated standard Si sample with no deposited film, for means of comparison. Both A and Si standard samples did not exhibited significant TL emission, whilst B sample exhibited two TL peaks at 170 and 400°C, and sample C exhibited three TL peaks at 170, 285 and 400°C. The heating rate was kept at $3°C.s^{-1}$ up to 500°C. These emissions can be related to the presence of F and F^+ centers (oxygen vacancies) inside aluminum oxide crystalline lattice, as seen in other works from the group (Bitencourt and Tatumi, 2009) and dosimetry research groups (Akselrod et al., 1990; Akselrod et al., 1993 and Akselrod et al., 1998).

Keywords: thin-films, thermoluminescence, X-ray diffraction, magnetron sputtering

References

[1] Bitencourt, J. F. S. and Tatumi, S. H., 2009. Synthesis and thermoluminescence properties of Mg^{2+} doped nanostructured aluminium oxide. Physics Procedia **2**, 501-514. doi:10.1016/j.phpro.2009.07.036.

[2] Akselrod, M.S., Gorelova, E.A., 1993. Deep traps in highly sensitive α-Al_2O_3:C TLD crystals. Nucl. Tracks Radiat. Meas. 21 (1), 143–146.

[3] Akselrod, M.S., Kortov, V.S., Kravetsky, D.J., Gotlib, V.I., 1990. Highly sensitive thermoluminescent anion-defective α-Al_2O_3 single crystal detectors. Radiat. Prot. Dosim. 32 (1), 15–20.

[4] Akselrod, M.S., Agersnap Larsen, N., Whitley, V., McKeever, S.W.S., 1998. Thermal quenching of F-center luminescence in Al_2O_3:C. J. Appl. Phys. 84 (6), 3364–3373.

ESR Dating Teeth and Molluscs from Dakhleh Oasis, Egypt: Constraining Pluvial Events and Hominin Activity in the Western Desert

B.A.B. Blackwell[1,2*], A.R. Skinner[1,2], A.E. Deely[2], R.A. Long[2], T.M. Truongchou[2], M.R. Kleindienst[3], C.S. Churcher[4], J.R. Smith[5], J.M. Kieniewicz[5], K.A. Adelsberger[5,6], J.I.B. Blickstein[2]

[1] *Dept. of Chemistry, Williams College, Williamstown MA, 01267, USA; bonnie.a.b.blackwell@williams.edu*
[2] *RFK Science Research Institute, Glenwood Landing, NY, 11547-0866, USA*
[3] *Dept. of Anthropology, University of Toronto at Mississauga, Mississauga, ON, L5L 1C6, Canada.*
[4] *Dept. of Zoology, University of Toronto, Toronto, ON, M5S 3B2, Canada.*
[5] *Dept. of Earth & Planetary Sciences, Washington University in St. Louis, St. Louis, MO, 63130-4862, USA.*
[6] *Dept. of Environmental Studies, Knox College, Galesburg, IL, 61401-4999, USA.*

** Corresponding author: bonnie.a.b.blackwell@williams.edu*

Receiving only 0.7 mm/y of precipitation, Dakhleh Oasis, which sits in Egypt's hyperarid Western Desert, today lacks naturally occurring surface water. Paleolithic artefacts, fossil ungulate teeth and snails occurring within the Pleistocene deposits and dotting the surface record times when higher rainfall and/or groundwater tables during pluvial events allowed surface water to exist in wetlands, small ponds, and large lakes, enabling hominin habitation. Pleistocene artesian spring deposits, buried soils, and lake sediment all attest that the Oasis had surface water during pluvial periods. The lakes captured and deposited the calcareous silty sediment (CSS) and other sediment. Differential GPS measurements show that a paleolake with an area of $\geq$ 60 km^2 existed during the late Middle Pleistocene. In places, the lake deposits also house the Dakhleh Glass, formed during a meteoritic impact. Archaeological finds ranging from Upper Acheulean to Middle Stone Age (MSA) occur in the lags and sedimentary deposits, and on the older geomorphic surfaces. Roman and Historic finds occur throughout the central oasis. From Dakhleh's Localities D006 and D348, 27 herbivore tooth fragments were independently dated with ESR using modelled time-averaged dose rates. At D348, in the Teneida Basin, the CSS marls contained Pleistocene bone fragments, MSA artefacts, *Alcelaphus*, *Damaliscus*, *Equus*, suid, *Lymnaea stagnalis* (freshwater snail), marsh grass and reed macrofossils and root casts. A tooth recovered from below the CSS dated at 195 ± 11 ka (assuming LU), which correlates with Oxygen Isotope Stage (OIS) 7a. At D006, in the Kellis Basin, sand dunes, deflation, and blowouts complicate the stratigraphy. The mid-Holocene to Recent deposits form most of the surface, but blowouts have exposed the underlying red Pleistocene muds from Lake Kellis, the Mut Formation. In some blowouts, several different beds have been deflated to form the surface lag. Blowouts have yielded artefacts ranging from MSA to modern, and Middle Pleistocene skeletal remains, including *Gazella*, *Phacochoerus*, *Loxodonta africana*, *Hippopotamus*, *Pelorovis antiquus*, *Syncerus*, and *Felis lybica*. Minimum and maximum potential cover thicknesses and water depths were used to constrain the cosmic dose rates. At D006, snails dating between 7 ± 1 and 14 ± 1 ka in surface samples hint that several ponds existed in the earliest Oxygen Isotope Stage (OIS) 1 or latest OIS 2. Herbivore teeth dated at 49 ± 5 ka, correlating with early Oxygen Isotope Stage (OIS) 3, 106-115 ± 5-11 ka (OIS 5c), 123-130 ± 7-12 ka (OIS 5e), 151-165 ± 11-16 ka (OIS 6c), 185 ± 15 ka (OIS 6e/7a boundary), and 216 ± 14 ka (OIS 7c). The herbivore frequency data, therefore, indicate that at least seven periods with higher rainfall and/or groundwater tables made the Western Desert more habitable during the later Quaternary than today.

Keywords: ESR dating; Dakhleh Oasis, Egypt; paleoclimate analysis; Paleolithic artefacts; cosmic dose rate modelling

Timing of the deglaciation in Southern Patagonia: Investigating the applicability of K-feldspar IRSL

R. L. Blomdin[1,2*], A.S. Murray[2], R. Sohbati[2], J.-P. Buylaert[2,3], K.J. Thomsen[3], K. N. Jansson[1], H. Alexanderson[4]

[1] Department of Physical Geography and Quaternary Geology, Stockholm University, SE-106 91 Stockholm, Sweden
[2] Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, University of Aarhus, Risø DTU, 4000-Roskilde, Denmark
[3] Radiation Research Division Risø, National Laboratory for Sustainable Energy, Risø DTU, 4000-Roskilde, Denmark
[4] Divison of Geology, Department of Earth and Ecosystem Sciences, Lund University, S-223 62 Lund, Sweden

The dynamics of the Late Glacial Magellan ice lobe, in southern Patagonia, and the timing of the retreating ice margin has been the object of discussion for many years. Two main factors contribute to the difficulties in determining the detailed retreat pattern: (1) terrestrial evidence suggests a dynamic ice sheet sensitive to climate fluctuations and (2) C^{14} ages of terrestrial remains are inconsistent with deglaciation models. The aim of this project is to investigate the applicability of OSL dating to sediments from southern Patagonia. Unfortunately the quartz OSL signal is weak, does not show a significant fast component, and is considered unsuitable for dating. Here we examine the potential of K-feldspar IRSL signals. Samples were collected from landforms interpreted as being deposited during deglaciation, with an expected age of between 16 and 22 ka, and from recently deposited sediments. A post-IR IR SAR dating protocol was tested on 180-250 μm K-rich feldspar extracts, using large aliquots. Average doses were much larger than expected, and even the IR_{50} equivalent doses indicated ages of ~50 ka (without correction for fading). This apparent incomplete bleaching is also present in modern analogue samples, which suggest residual ages of >15 ka. These residual doses are not significantly dependent on preheat temperature, suggesting they do not arise from thermal transfer, but probably come from incomplete bleaching of the IRSL trap. We report these findings in detail and use small aliquot dose distributions to examine whether there are well-bleached grains contained within the modern analogues. This information is then used to guide the interpretation of small-aliquot dose distributions of the older samples. The reliability of the minimum ages derived from these distributions is tested by applying the same methods to samples from the northern sector of the Patagonian Ice Sheet, for which some quartz data are available.

On the visualization of the components in a quartz OSL signal

A.J.J. Bos[1*], J. Wallinga[2]

[1] *Delft University of Technology, Mekelweg 15, 2629JB, The Netherlands (E-mail: a.j.j.bos@tudelft.nl)*
[2] *Netherlands Centre for Luminescence dating, Mekelweg 15, 2629JB, The Netherlands.*

* *Corresponding author: a.j.j.bos@tudelft.nl*

Under constant stimulation power the optically stimulated luminescence (CW-OSL) signal of quartz can be represented by the sum of a finite number of exponential functions. Based on the relatively rapidity of resetting upon light exposure, these are referred to as (ultra-)fast, medium and slow components. For quartz OSL dating, the fast component is most suitable as it is rapidly reset by natural light exposure and because it is stable on geological timescales. For dating of samples where the fast OSL component is at or near saturation, one of the slow components may potentially be used for dating. Isolation of the desired OSL component is important as contamination with other (unsuitable) components may result in inaccurate dating results.

Quartz CW-OSL signals usually show rather featureless decay curves. By modulating (ramping) the stimulation power, a peak-shaped OSL curve can be obtained, where the peaks correspond with the OSL components. Contrary to earlier suggestions[1,2], it is now both theoretically[3,4] and experimentally[5] proven that stimulation power modulation does not result in better separation of the OSL components.

In this contribution we discuss two issues with regard to the choice of stimulation mode:
1) Measurements should be made using constant stimulation, as this gives the highest signal-to-noise ratio and produces a constant background of leakage stimulation light. Moreover it is the quickest stimulation mode for readout. CW-OSL is preferred both for routine dating, and for detailed component analysis.
2) For visualization purposes, modulated signals are advantageous. There is no need no measure them. They can be obtained by a simple mathematical transformation of the CW-OSL signal, resulting in a pseudo OSL signal. Transformation of a CW-OSL signal into a pseudo OSL signal can reveal the presence of different components in a more pronounced way, just like a small peak in a spectrum can be highlighted by plotting a spectrum on a logarithmic scale in stead of a linear one. We show that pseudo hyperbolically-modulated (HM) OSL, rather than the widely used linearly-modulated (LM) OSL, is most suitable to highlight the fast component. Pseudo exponentially-modulated (EM) OSL is the transformation of choice for showing the slow component(s). The pseudo OSL curves can be used for rapid visual inspection of the relative contribution of the OSL components prior to further analysis.

References

1. Li, S.H., Li, B. Radiat. Meas. 41 (2006) 534-541.
2. Mishra, D.R., Kulkarni, M.S., Rawat, N.S., Muthe, K.P., Gupta, S.K., Bhatt, B.C., Sharma, D.N. Radiat. Meas. 43 (2008) 1177–1186.
3. Jain, M., Lindvold L.R. Ancient TL 25 (2007) 69-80.
4. Bos A.J.J., Wallinga, J. Phys. Rev. B79 (2009) 195118.
5. Wallinga, J., Bos, A.J.J., Duller, G.A.T. Radiat. Meas. 43 (2008) 742–747.

Luminescence dating applied to early medieval buildings : the study of the crypt of Chartres' cathedral (Eure-et-Loir, France)

A. Bouvier[1*], P. Guibert[1], C. Sapin[2], S. Blain[1]

[1] *CNRS - University de Bordeaux 3, Institut de recherche sur les Archéomatériaux, (IRAMAT-CRP2A), UMR 5060, Maison de l'Archéologie, F-33607 Pessac Cedex (bouvier_armel@yahoo.fr, guibert@u-bordeaux3.fr, blain.sophie@gmail.com)*
[2] *CNRS - Université de Bourgogne, Archéologie, Terre, Histoire ,Sociétés (ARTeHIS)– UMR 5594 , Dijon, France, (sapin.christian@orange.fr)*

** Corresponding author: bouvier_armel@yahoo.fr*

The cathedral of Chartres (France, department of Eure et Loir) lies on ancient remains preserved into a crypt but their chronology has not been clarified until now. Furthermore, the location of the early cathedral has never been recognized too, even if some archaeologists estimate that the well preserved masonry structure in the crypt might be the remains of the chancel of the primitive cathedral.
In order to clarify this question, twelve bricks were sampled from these structures to carry out luminescence dating. This study was performed using OSL measurements of quartz grains for paleodose determination, high resolution low background gamma spectrometry for determination of K, U and Th in bricks, and TL dosimetry ($CaSO_4$:Tm) for the environmental dose rate at the precise location of samples.
Accurate results of the paleodose were obtained, but, with this classical first approach, a highly scattered distribution of ages was obtained (from the early iron ages to the roman period) giving evidence for overestimation of quartz OSL ages in many samples.
Complementary experiments were then carried out until we noticed unexpected properties of the luminescent material. Indeed, the OSL measurements were performed on what was supposed to be quartz inclusions (80-160 μm in diameter) with transparent and homogeneous patterns by optical observation of thin sections. They showed an unexpected but significant internal radioactivity due to the presence of important amounts of U and Th (from 0.2 to 6 ppm U, and from 1 to 14 ppm Th according to sample). The internal content of radioelement in the quartz grains used for OSL experiments was measured using ICP-MS that required less than 0.4 g of material.
After accounting for the internal dose-rate of quartz grains in the age calculation (this is mainly due to alpha particles), the dating results are grouped together in the early middle ages (7th-8th century AD).

OSL-dating of Holocene tsunami deposits and its potential for improving the event chronology of Phra Thong Island, Thailand.

D. Brill[1,*], N. Klasen[2], K. Jankaew[3], H. Brückner[2]

[1] *Department of Geography, University of Marburg, Deutschhausstraße 10, 35032 Marburg, Germany (brilld@staff.uni-marburg.de)*
[2] *Institute of Geography, University of Cologne, Albertus-Magnus Platz, 50923 Köln, Germany*
[3] *Department of Geology, Chulalongkorn University Bangkok, Thailand*

** Corresponding author: brilld@staff.uni-marburg.de*

To evaluate the potential of optical dating (OSL) in establishing a proper tsunami chronology for Phra Thong Island, Western Thailand, the method was applied to a suit of tsunamigenic and littoral sand-sized deposits for which radiocarbon data of Jankaew et al. (2008) provided independent age control. Measurements were carried out on small aliquots of quartz grains following the SAR-protocol of Murray and Wintle (2003). The calculation of burial doses was based on the comparison of four different age models to account for partial bleaching and post-depositional disturbance of the luminescence signal: central age model (CAM), finite mixture model (FMM), minimum age model (MAM) (Galbraith & Green 1990, Galbraith et al. 1999) and lowest-5 % (L5%, Olley et al. 1998). For each sample we selected the best fitting approach based on its equivalent dose (De) distribution and compared the results with the independent age control. Littoral sand from beach ridges and the foreshore zone revealed well bleached signals which agreed with independent radiocarbon ages of Jankaew et al. (2008). OSL dating of the poorly bleached tsunami layers revealed ages of less than 50 years for the 2004 Indian Ocean Tsunami (IOT); significantly underestimated ages compared to independent radiocarbon data were obtained for a palaeotsunami layer. This discrepancy allowed for two possible explanations: (1) The true age of the layer is much younger than the independent reference ages suggest or (2) post-depositional remobilization, indicated by the bimodal De distribution, affected the OSL signal of the layer so that only FMM allowed the calculation of realistic OSL ages. Since only the latter provided ages that were in agreement with historical and stratigraphical data it was favored to represent the true burial age. Afterwards, luminescence dating was extended to tsunami layers and beach ridges of unknown age, to contribute to a better understanding of the Phra Thong tsunami chronology.

References

Galbraith, R.F. and Green, P.F. (1990) Estimating the component ages in a finite mixture. *Nuclear Tracks Radiation Measurements* 17 (3), 197-206.

Galbraith, R.F., Roberts, R.G., Laslett, G.M., Yoshida, H. and Olley, J.M. (1999) Optical dating of single grains of quartz from Jinmium rock shelter, northern Australia. Part I: experimental design and statistical models. *Archaeometry* 41, 339-364.

Jankaew, K., Atwater, B.F., Sawai, Y., Choowong, M., Charoentitirat, T., Martin, M.E. and Prendergast, A. (2008) Medieval forewarning of the 2004 Indian Ocean tsunami in Thailand. *Nature* 455, 1228-1231.

Murray A.S., Wintle A.G. (2003) The single aliquot regenerative dose protocol: potential for improvements in reliability. *Radiation Measurements* 37, 377-381.

Olley, J., Caitcheon, G. and Murray, A.S. (1998) The distribution of apparent dose as determined by optically stimulated luminescence in small aliquots of fluvial quartz: implications for dating young sediments. *Quaternary Geochronology* 17, 1033-1040.

Thermal Characterization of ancient Hearths from the Cave of Les Fraux (Dordogne, France) by thermoluminescence and magnetic susceptibility measurements.

A. Brodard[1*] , P. Guibert[1], F. Leveque[2], V. Mathe[2], L. Carozza[3], A. Burens[3].

[1] *University of Bordeaux 3 - CNRS, IRAMAT-CRP2A, UMR 5060 Maison de l'Archéologie, F-33607 Pessac Cedex*
[2] *University of La Rochelle -CNRS, LIENSs, UMR 6250 2 rue Olympe de Gouges, F-17042 La Rochelle Cedex*
[3] *University of Toulouse le Mirail - CNRS, GEODE, UMR 5602 Maison de la Recherche, 5 Allées A. Machado, F-31058 Toulouse Cedex 1*

** Corresponding author: aurelie.brodard@gmail.com*

The cave of Les Fraux (Dordogne, France) is an exceptionally preserved Bronze Age site with both archaeological vestiges and rock art. Numerous traces of fires were observed and we were particularly interested in studying their effects on sediment to better understand their use centuries ago. Our present objective is the evaluation of the intensity of the fires by determining past temperature (palaeotemperature) attained by the sediment. The principle of palaeotemperature determination is based on thermoluminescence (TL) properties of quartz and magnetic susceptibility of the sediment. First, a cartography of magnetic susceptibility was made *in situ*. On the basis of both susceptibility cartography and visual patterns of sediment, small samples (1 - 2 grams) were taken out. Quartz grains were extracted from these sediment samples. Besides, fourteen thermal references were processed by heating fractions of the pristine sediment of the cave (unfired) that was also sampled. They were heated in air in an electric oven according to an accurately designed thermal protocol. Each fraction was heated at a maximum temperature varying from 200°C to 650°C, keeping an unheated sample as a witness. The TL signal shows significant variation allowing the palaeotemperature determination. By comparison of TL signal of anciently heated quartz to the reference ones, we were able to obtain the maximum equivalent temperature attained for each samples extracted from ancient fires. Thanks to that we could estimate magnetic susceptibility as a function of temperature and draw palaeotemperature cartography of the studied areas. The next step will be archaeological experimentations of fires that will allow us to validate our methodology and model fires by their intensity, issued energy (light and heat), quantity of wood consumed in a given duration. That project will contribute to a better identification of the function of the site.

Keywords: Thermoluminescence, Quartz, Palaeotemperature, Magnetic Susceptibility

Constraint of time averaged water content using drained measurements

C. I. Burbidge[1], G. J.O. Cardoso[1], D.C.W. Sanderson[2], M. I. Dias[1]

[1] *GeoLuC, Instituto Tecnológico e Nuclear, Sacavém, Portugal, christoph@itn.pt*
[2] *Scottish Universities Environmental Research Centre, East Kilbride, UK.*

* *Corresponding author: christoph@itn.pt*

The aim of the present study is to demonstrate the utility of drained water content measurements in constraining estimates of the time averaged water content of sediments and artefacts. Accurate evaluations of the time averaged water contents of a sample and its environment are important for trapped charge dating methods. Conversion from dry to wet infinite matrix dose rates in a "typical sample" (of pottery, in soil) using ratios of mass stopping powers [1] produces a difference in overall dose rate and hence age of c. 1% per 1% water content [2]. The possible range of water contents in a sample are delimited by the dry and saturated states. Most samples for trapped charge dating are taken from above the water table at the time of sampling. Most sampling locations have been subject to wetting but also suffered dry periods. While above the water table samples are subject to drainage, so except for precipitation or ground-water through-flow events, their maximum water content is that which they retain when drained. Conversely, for samples that are regularly but not permanently saturated, drained water content may represent a reasonable minimum estimate. The drained upper limit or field capacity of a sample and/or its surroundings is therefore a relevant parameter for the evaluation of time averaged water content during the period to be dated. Standard methods for laboratory evaluation of the drained upper limit include pressure plate extraction of pore water from prepared material, but an estimate can be obtained simply by draining until "drip dry" [3]. In the present study water contents were measured following drainage for between 0 and 8 days, for 239 dating samples of a wide range of soil, sediment and other types, taken from 30 sites with a variety of climatic and hydrological conditions. These are compared with saturated and in situ water content values in terms of the samples' contexts and textural classification. Plots of drained versus in situ water contents, as proportions of saturation, contained groups that exhibited trends following approximate power law relationships ($y = a.x^b$). Samples of different textures tended to separate along a given trend line, but overlaps indicated that the textural classifications assigned to each sample were not always good predictors of water retention. In addition to a "main sequence", less populous groupings appeared to relate to the as-sampled condition of certain material types; in some cases indicative of the development of water repellency. However, sandy sediments in temperate/maritime climates exhibited sufficiently consistent relationships between texture and water retention that one could be used accurately as a predictor of the other. Drainage for one or more days has been found to yield useful values for the constraint of the average water content of a sample and/or its surroundings in environment dose rate calculations for trapped charge dating. This approach is most useful for samples taken in dry conditions, where the drained values provide a realistic upper limit for the time averaged water content, and the in situ water content can be reasonably assumed to represent the lower bound. However, the drainage method is designed to provide additional relevant data to help evaluate the effects of past variations: it will always be up to the individual researcher to decide (i.e. assume) what those variations were and hence how the measured values should be used.

References

[1] Zimmerman, D.W. 1971. Archaeometry, 13, 29-52.
[2] Aitken, M.J. 1985. Thermoluminescence Dating. Academic Press.
[3] Ratliff, L.F., et al. 1983. Soil Science Society of America Journal, 47, 770-775.

A comparative study of post-IR IRSL and IR-RF dating of sand-sized K-feldspar extracts

J.P. Buylaert[1,2,*], M. Jain[2], A.S. Murray[1], K. Thomsen[2], T. Lapp[2]

[1] *Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, University of Aarhus, Risø DTU, 4000-Roskilde, Denmark*
[2] *Radiation Research Division, Risø National Laboratory for Sustainable Energy, Risø DTU, 4000-Roskilde, Denmark*

* *Corresponding author: jabu@risoe.dtu.dk*

Luminescence dating using K-feldspar rich extracts has undergone major developments in the last few years. Two new but quite different techniques have emerged: an infrared-radiofluorescence method (Erfurt and Krbetscheck, 2003) and a post-IR elevated temperature IRSL (Thomsen et al., 2008 ; Thiel et al., 2011) method. The main driving force behind these developments is the desire to find a signal that is not affected by anomalous fading. There is some evidence that both techniques produce accurate results but a systematic comparison of one against the other, and against independent age control, is not yet available. We have recently developed an IR-RF system on the standard Risø TL/OSL reader. Luminescence detection is carried out using a chroma D 900/100 interference filter (bandpass: 850-945 FWHM) and a liquid crystal light-guide that collects light from the sample during irradiation (Lapp et al., these proceedings). The system allows fully-automated IR-RF measurements at practical irradiation time scales comparable to those of standard luminescence measurements, and it is possible to do in-situ bleaching using 395 nm LED for regenerated RL measurements. Both the preheat temperature and the RF measurement temperature may be regulated using a heater plate mounted underneath the beta source.
For our age comparison we have selected a range of aeolian and shallow marine sediments ranging from a few ka to 130 ka; these were chosen because they are likely to have received the most light exposure in nature. Independent age control for the younger samples is based on quartz OSL and ^{14}C dating whereas for the older samples our two Eemian testing sites (130-125 ka, Gammelmark in Denmark, Sula in Russia) are used. We first present results of investigations into the dependence of the IR-RF signal on preheat and stimulation temperature. We use these data to select the optimum conditions for measuring IR-RF, and compare the resulting ages with those based on IRSL measured while the sample is held at 290^{o}C, after a prior IR stimulation at 50^{o}C ($pIRIR_{290}$); both sets of measurements use the same K-feldspar fractions. We also report on the apparent stability of these signals in nature (using samples which should be in dose response curve saturation) and on the bleachability of these signals using bleaching experiments (daylight, solar simulator) and modern analogues; the origins of the difficult-to-bleach residual doses are also discussed. Finally, we discuss both the advantages and the disadvantages of the IR-RF and high temperature pIR-IRSL methods for dating Late Pleistocene sediments.

Keywords : post-IR IRSL, infrared - radiofluorescence, K-feldspar, accuracy

References

Erfurt G. and Krbetscheck M.R. (2003) IRSAR – A single-aliquot regenerative-dose dating protocol applied to the infrared radiofluorescence (IR-RF) of coarse-grain K-feldspar. Ancient TL 21, 35-42.
Thiel C., Buylaert J.P., Murray A., Terhorst B., Hofer I., Tsukamoto S. and Frechen M. (2011) Luminescence dating of the Stratzing loess profile (Austria) – Testing the potential of an elevated temperature post-IR IRSL protocol. Quaternary International 234, 23-31.
Thomsen K.J., Murray A.S., Jain M. and Bøtter-Jensen L. (2008) Laboratory fading rates of various luminescence signals from feldspar-rich sediment extracts. Radiation Measurements 43, 1474-1486.

Quartz OSL dating using different grain-size fractions for sanddune accumulation from Qinwangchuan Basin, west Chinese Loess Plateau

G.C. Cao[1,2], H. Long[2,3], J.R. Zhang[2,3], Z.P. Lai[1,2*]

[1] *Key Laboratory of Environment and Resources on Tibetan Plateau, Qinghai Normal University, Ministry of Education*
[2] *Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China (*Email: zplai@isl.ac.cn)*
[3] *Graduate School of Chinese Academy of Sciences, Beijing 100049, China*

** Corresponding author: zplai@isl.ac.cn*

Dune systems represent important palaeoenvironmental archives and therefore provide valuable information on past climate conditions of dryland regions. A precise age determination of the aeolian activity itself is a crucial step towards a better understanding of past environmental conditions. The optical stimulated luminescence (OSL) dating technique is a reliable way to determine the ages of these sanddune sediments. Recently, based on quartz OSL dating of middle-grain (38-63 μm) fraction, we have reported the formation ages of the palaeodunes (thickness ca. 10-20 m) intercalated in thick loess accumulations, located in southern Qinwangchuan Basin of the western Chinese Loess Plateau. The advantage of using the middle-grain fraction is the convenience to extract pure quartz from the sediments without the use of dangerous HF. But the main grain-size component of the sanddune sediments is the fraction of 100-300 μm instead of 38-63μm. In this study, in order to check if the OSL ages of middle-grain quartz can represent the periods of these sanddune accumulation, we selected five samples from sanddune sediments, from which different grain-size quartz fractions (38-63 μm, 90-150 μm, 150-200 μm, 200-250 μm and 250-300 μm) were extracted. Their equivalent doses were obtained using the standard single aliquot regenerative (SAR) protocol. The results suggested that different grain-size fraction for each sample are consistent within error, and that the ages of these samples fall in 25-15 ka which possibly imply a period of increased aridity.

Keywords: Quartz OSL dating; D_e determination using different grain size; Sanddune sediments; Chinese Loess Plateau

Development of EMCCD based spatially resolved luminescence dating System

N. Chauhan*, P. Adhyaru, M. Shah, H. Vaghela, A. K. Singhvi

Physical Research Laboratory, Ahmedabad-380 009, India

* *Corresponding author:* chauhan@prl.res.in

Development of an Electron Multiplier Charge Coupled Device (EMCCD) based luminescence dating system is reported here. This development follows the work of Greilich et. al. 2002, and aims to apply luminescence dating to; 1) samples, where grain separation is routinely not possible (such as rock surfaces (glacial derived boulders and lithic implements), mineral grains in a carbonate matrix (aeolianites and terrestrial carbonates) or fusion crust of the meteorite (for the estimation of terrestrial ages), and 2) interior of large grains where significant beta dose gradients exist and which can be exploited to extend the dating range of luminescence methods (Chauhan et al., 2009). The system enables position sensitive measurements of luminescence from samples and provides for estimation of spatially resolved equivalent dose. The user can select the region(s) of interest on the images for dose evaluation. The system comprises, 1) sample stimulation unit (comprising linear heating and a set of blue and IR LEDs), 2) optics unit (comprising imaging optics), and 3) a data acquisition and processing unit. Custom made stimulation electronics provides the flexibility to stimulate the sample by heat and/or by light (IR/Blue) at variable feedback controlled rates using a Lab View based interfacing software. A microprocessor programmed in BASCOM is used to synchronize the actions of stimulation unit. The optical arrangement images the luminescence emitted on to the chip of EMCCD (512×512 pixels, each of 16μm×16μm size) and an imaging ratio of ~ 1:1 is maintained. The optics has a flexible focusing and a filter housing that enables change of filters combinations without disturbing the optical setup. The EMCCD captures the luminescence in form of images as a function of time and these images are processed using a MATLAB based program with a flexible spatial integration. This program, additionally enables, alignment of the acquired images using a set of control points which could either be identifier slots on sample holder or even a configuration of bright grains. The dose evaluation is based on integrated intensity from selected pixels and the construction of a growth curve as a function of doses. Initial experiments provided satisfactory dose recovery results. Programs for the analysis of the depth of beta dose and the optical depth are also made to ensure that the dose reconstruction is based on replication of irradiation in nature. Current efforts include experimental measurements of natural samples and the results will also be reported.

References

Chauhan et. al. 2009, Radiation Measurements 44, 629-633.
Greilich et. al. 2002, Naturwissenschaften 89, 371-375

Optical dating of the 12 May 2008, Ms 8.0 Wenchuan earthquake related sediments: tests of zeroing assumptions

J. Chen*, H. Yang, J. Liu

State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China

** Corresponding author: chenjie@ies.ac.cn*

Encouraging optical dating results (e.g., Liu et al., 2010; Lu et al., 2002; Malik et al., 2010; Palyvos et al., 2010; Thomas et al., 2007;) have suggested that the method is capable of producing robust chronological schemes for paleoearthquake events. However, a potential problem in such settings is that light exposure of earthquake related sediments may not have been sufficient to completely reset the OSL signal prior to deposition. Incomplete resetting of the OSL signal will lead to an overestimation of the age. Although modern age samples from various depositional environments were examined for signal resetting (e.g. Bailey, 2003; Singarayer et al., 2005; Stokes et al., 2001), little such effort has been made on modern earthquake related sediments to provide a sound justification for the use of luminescence dating in such settings. The objective of this study was, therefore, to examine signal resetting of the 12 May 2008, Ms 8.0 Wenchuan earthquake related sediments, and to explore the suitability of optically stimulated luminescence (OSL) to date sediments directly associated with seismic events.

We have tested the extent of bleaching of three typical sediments from: (1) a ~50 cm thick Wenchuan earthquake-dammed lake flood discharge sediments section deposited on top of lower terrace of the Jian Jiang at Dengjia; (2) a ~50 cm thick earthquake-dammed lake deposits at Sandongshui; and (3) sand blows formed during earthquake and same source silty sands. A preliminary results from optical dating of fine-grained quartz extracted from 11 samples suggest that: (1) All De values obtained from both Dengjia and Sandongshui section were between 3-10Gy, indicate that it should take caution for optical dating of such paleoearthquake related sediments. However, residual De values of less than 0.2Gy were observed in two samples collected from pre-earthquake surface. (2) De values obtained from two sand blow samples were 1.8 and 3.2 Gy respectively, De values from their same source sands were between 4-7Gy, indicate partial bleaching. Optical dating of both feldspar and different coarse-grain fractions of Qz are still being processed.

Two-stage thermal stimulation of thermoluminescence

R. Chen[1*], J. L. Lawless[2],V. Pagonis[3]

[1]Raymond and Beverly Sackler School of Physics and Astronomy, Tel Aviv University, Tel Aviv 69978, Israel (e-mail: chenr@tau.ac.il)
[2]Redwood Scientific Incorporated, Pacifica, CA94044-4300, USA
[3]Physics Department, McDaniel College, Westminster, MD21157, USA

** Corresponding author:* chenr@tau.ac.il

A thermoluminescence (TL) model of two-stage stimulation of electrons into the conduction band, prior to recombination is discussed. This release of the carriers is assumed to take place via an intermediate localized excited state. Electrons are thermally stimulated from the trap into an excited state and then thermally released into the conduction band from which they may either be retrapped or recombine with holes in centers. The model resembles the previous "semilocalized" model (Mandowski, 2005; Pagonis, 2005), except that we concentrate only on recombinations of electrons that go through the conduction band. It also bears similarity to the effect of thermally-assisted optically stimulated luminescence (OSL) previously discussed in the literature (see e.g. McKeever et al., 1997).

The model is studied by writing and solving the set of the relevant four simultaneous differential equations which govern the process during heating or isothermal phosphorescence decay. Using different sets of parameters, we can get pseudo-first-order, pseudo-second-order as well as intermediate cases, which are identified by their symmetry coefficient. Once the effective order is established, different analytical methods are used to determine the effective activation energy and frequency factor. The methods used are the peak-shape methods, the various-heating-rate (VHR) method and the method based on the change of phosphorescence decay with temperature. The results are compared to the parameters used in the simulation. In many cases, the effective activation energy is equal to E_1+E_2 where E_1 and E_2 are, respectively, the activation energies for the first and second stage of thermal stimulation. The effective frequency factors found are usually between s_1 and s_2, the frequency factors of the first and second stages, respectively. The numerical-simulation results are accompanied by an analytical treatment using the usual quasi-steady assumption. Unusual cases in which the effective frequency factor and the effective retrapping probability coefficient are temperature dependent, are identified. Some cases in which the effective activation energy is close to E_1 rather than E_1+E_2 are identified and discussed. The relevance of this possible situation to the evaluation of the stability of TL signals is also considered.

Keywords: Two-stage TL, effective activation energy, stability, simulation.

References

Mandowski, A., 2005. Semi-localized transitions model for thermoluminescence. Journal of Physics D: Applied Physics 38, 17-21.

Pagonis, V., 2005. Evaluation of activation energies in the semi-localized transition model of thermoluminescence. Journal of Physics D: Applied Physics 38, 2179-2186.

McKeever, S.W.S., Bøtter-Jensen, L., Agersap Larsen, N. And Duller, G.A.T., 1997. Temperature dependence of OSL decay curves: Experimental and theoretical aspects. Radiation Measurements 27, 161-170.

Studying the slip rate of central Altyn Tagh Fault: terraces, fault and OSL dating

Y. Chen, S.-H. Li* , B. Li

Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China

*Corresponding author: shli@hku.hk

The strike slip Altyn Tagh Fault (ATF) acts as major boundary fault separating Tibet plateau and Tarim basin, forming a remarkable linear structure with a total length of 1600 km. Its geodynamic features such as the average slip rate is the key to understand the intracontinental deformation since the convergence of Eurasia and India plate. In previous studies, the ATF slip rate was estimated using cosmogenic radioisotope ages of samples from river terrace surfaces associated with the fault offset from riser displacements. The selection of which terrace ages to be used for calculating the slip rate has been one of the most contested questions. This can lead to the slip rate vary by a factor of 1.2 to 5 for the same site.

Optically stimulated luminescence (OSL) dating gives the ages of sediments since their last exposed to sunlight. The slip rate of central Altyn Tagh Fault using OSL dating was studied near the Aksay segment, NW China. Three river terraces were identified in the site where a river is cut through by the ATF. The terrace risers were offset by the slipping fault. Loess overlain these terrace surfaces constrains the terrace ages. The average slip rate of ATF was determined using fault displacement divided by the OSL ages from loess immediately above the gravels on river terraces.

The results demonstrate that: (1) the average Holocene slip rate of central ATF is around 12 mm/yr. The result is well concordant with our previous study using the ages of loess deposited on banks of deflected stream channels. (2) the upper terrace ages should be used in slip rate calculation as they represent the initiation time of riser offset. (3) loess deposited soon after the terrace formation. Their OSL ages well constrain the age of terrace, indicating that OSL chronology of loess is reliable and can be used to date the active faulting event.

Keywords: Altyn Tagh Fault; slip rate; terrace; OSL dating

Quartz OSL Dating of Sorted Circles in Ny-Ålesund, Svalbard

J.-H. Choi[1,2*], G. Y. Jeong[3], H. S. Lim[4], J. I. Lee[4], H. I. Yoon[4], S.-C. Hong[1,5]

[1] *Division of Earth and Environmental Science, Korea Basic Science Institute, Ochang Centre, Chungbuk 363-883, South Korea (jhchoi@kbsi.re.kr)*
[2] *Department of Isotope Geochemistry, University of Science and Technology, Daejeon 305-350, South Korea*
[3] *Department of Earth and Environmental Sciences, Andong National University, Andong 760-749, Republic of Korea*
[4] *Division of Polar Environmental Research, Korea Polar Research Institute, Incheon 406-840, South Korea*
[5] *Department of Geography Education, Seoul National University, Seoul 151-742, South Korea*

** Corresponding author: jhchoi@kbsi.re.kr*

Establishing chronologies of glacier-related sediments is of importance in many studies on climate changes of polar regions because it provides direct or indirect clues for understanding the timing of local glacier retreat. In periglacial regions, glacier-related sediments, including moraine deposits, sometimes form a distinctive geomorphic structure, called *sorted circles*, through repeated freeze-thaw cycles on flat areas. This structure has a sorted appearance commonly due to a border of stones surrounding finer materials in the inner part of the circles. In terms of OSL dating, the sorted circles are considered to have two main advantages over other glacigenic sediments; (1) The sediments that comprise the sorted circles have naturally been well-sorted, thus it is easy to collect samples, (2) According to the numerical model on the formation of sorted circles, it is implicitly presumed that some portions of the finer grains above the permafrost layer have been exposed to sunlight for prolonged period of time and their OSL signals are well bleached during formation of sorted circles. If this is the case, the OSL ages of the well bleached finer grains in the inner part of the circles are expected to indicate the minimum age of the last local glacier retreat. In this paper, we investigated the possibility of OSL dating of sorted circles using samples recovered from 6 sorted circles in Ny-Ålesund, Svalbard. In routine performance tests based on single-aliquot regenerative-dose protocol, the quartz OSL property of all the samples appears to be suitable for OSL dating; Fast OSL component is dominant in OSL signals, and in dose recovery test, the laboratory doses, administered to each aliquot using ^{90}Sr beta source, were accurately recovered. However, the dose administered with gamma source was not recovered in single grain scale. In this study, we investigate further this difference between β- and γ-dose recovery test in single-and multiple grain scale. Our results appear to indicate that all the sorted circles have formed during Holocene (up to very recent, ~ 1 ka).

Keywords: Glacier retreat, Sorted Circles, Ny-Ålesund, Svalbard, Quartz OSL

A luminescence dating study of loess deposits in Yili river basin, in Xingjiang of western China

E Chongyi[1,2,3], Z. Lai[1,2,3]*

[1] *Key Laboratory of Qinghai-Tibetan Plateau Environment and Resource, MOE, Qinghai Normal University, 810000 Xining, P.R.China*
[2] *Luminescence Dating Laboratory, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, P.R. China*
[3] *School of Biology and Geography, Qinghai Normal University 810000, Xining, P.R.China*

** Corresponding author: zplai@isl.ac.cn*

The study area lies in the central Asia arid zone, a transitional zone between two major climate systems: the westerlies dominated "European" system to the west and the monsoon dominated "East Asian" system to the east. More and more evidence show that palaeosol in loess-palaeosol sequences in the Central Asian also developed under warm and wet interglacial climates, in-phase with those in the East Asian domain on orbital timescales. But it is a question that on the sub-orbital timescales, were the climatic changes also in-phase between the Central Asian and the East Asian? Thus, a high resolution dating study in this area is essential. Zeketai (ZKT) loess section is in the Yili river basin in Xiniang Province in China, situated at the foothills of the Tianshan Mountains. It is a representative section in this area and has been intensively studied. However, significantly different views exist on the chronology of the section, leading to different models of climatic change patterns. The current study aims to establish a luminescence chronology for ZKT section, and then discuss the palaeoenvironmental changes. The comparison of luminescence results with radiocarbon dating results on snails will also be discussed.

Keywords: Yili river basin; ZKT section; luminescence dating

Applying Al_2O_3:C chips for annual dose determination in luminescence dating of archaeological samples

A. Chruścińska[1*], P. Bilski[2], U. Lombardo[3], H. L. Oczkowski[1], K. R. Przegiętka[1], K. Sulkowska-Tuszyńska[4], B. Winiarska[2]

[1]*Institute of Physics, Nicolaus Copernicus University, Toruń, Poland*
[2]*Institute of Nuclear Physics, Krakow, Poland*
[3]*Institute of Geography, University Bern, Bern, Switzerland*
[4]*Institute of Archaeology, Nicolaus Copernicus University, Toruń, Poland*

** Corresponding author: alicja@fizyka.umk.pl*

The exact determination of the annual dose in luminescence dating is as important as the accurate determination of the paleodose. Dating of archaeological objects is usually complicated by the heterogeneity of the sample environment. Then, installing the luminescence dosimeters in the place where the sample was taken from is often the best solution for the external gamma dose assessment. Time during which the dosimeters can remain at the archaeological site is important. Two different cases of the application of Al_2O_3:C OSL dosimeters (Landauer chips, 5 mm diameter, 0.4 mm thick) are presented in details. In the first case, the dosimeters were kept in walls of medieval building (Teutonic Castle in Malbork, Poland) for 16 months. The second case is forty-day long installation of the dosimeters in a shell midden (the Llanos de Moxos, Bolivian Amazonia). For the first case the gamma doses red from dosimeters installed *in situ* were compared with the results obtained from the brick samples taken to the laboratory and analysed by the gamma spectrometry.

Chips of Al_2O_3:C were applied not only *in situ* but also in the laboratory for measurements of annual beta dose of bricks and fired clay. For the specific geometry applied for the dosimeter irradiation, the ratio between the dose experienced by chips and the internal sample dose obtained with the help of gamma spectrometry was estimated.

The OSL signal of Al_2O_3:C chips was stimulated by light of the tungsten–halogen lamp equipped with a GG-420 excitation filter (450–550 nm; ~30 mW cm^{-2}) and detected by the EMI 9235QA photomultiplier using the conventional Hoya U-340 filter. Each chip was individually calibrated by sensitivity and the dose of about 0.2mGy could be measured with the average precision of 4%.

Using the dosimeters for the annual dose determination sets some special requirements for the equipment of a dating laboratory. Dosimeters are usually few orders more sensitive to ionizing radiation then minerals whose luminescence is normally measured for paleodose determination. Additionally, standard OSL/TL readers that are used for paleodose determination are equipped with radiation sources that are intended to deliver dose equivalent to the paleodose and it is hundreds or thousands times greater than normal annual dose. This means that the radiation sources installed in these readers are far too much active preventing their usage for constructing the growth curve of dosimeters. It is necessary to use another less active source or to find a way of attenuating the dose rate from the standard source. Presumably, each laboratory solves this problem in its own way but then it is good to have the opportunity to compare its own solutions with others. Here, the results of applying a polypropylene stopper under the $^{90}Sr/^{90}Y$ source in the Risø TL/OSL System TL-DA-12 are given. The spatial distribution of background dose derived from the scattered primary radiation in the reader chamber is presented as well.

A computer program for the deconvolution of the thermoluminescence glow curves employing an interactive model

K. S. Chung[1*], J. Lee[2], J.-L. Kim[2]

[1]*Institute of National Science and Department of Physics, Gyeongsang National University, Jinju 660-701, South Korea, chungks@gnu.ac.kr*
[2]*Health Physics Department, Korea Atomic Energy Research Institute, P.O. Box 105, Yuseong, Daejeon 305-600, South Korea*

** Corresponding author: chungks@gnu.ac.kr*

A widely accepted model to resolve thermoluminescence (TL) glow curves is based on the one trap one recombination center (OTOR) model. In the OTOR model, the total glow curve is produced merely by the summation of the glow peaks, each of which is the result of the charge flow among one kind of trap and corresponding recombination center through its own conduction band. For a model consisting of more than one trap, an electron released from a trap could be captured by another trap via nonlocal conduction band and eventually traps interact with each other (interactive model, Marcazzo, 2007). In spite of a big difference between the OTOR model and real physical process of TL mechanism exist (Sakurai, 2001), it is so difficult to employ more general model such as interactive model because of the difficulty to get the efficient numerical solutions of coupled differential equations.

Recently, an algorithm which can be used to numerically analyze the TL curves with interactive model is proposed (Chung et al, 2010). In the model, not only many kinds of trap but also many kinds of recombination centers (RCs) with different physical characteristics including radiative properties are considered. The kinetics of trapping and recombination, for q traps and p RCs is governed by $(q+p+1)$ set of differential equations and the luminescence intensity is evaluated by time variation of only the radiative RCs among all RCs. In the work, to avoid a blow up of solutions caused by the small relative errors, some parameters of each equation treat as fixed value at an initial time t_0 and then time evolutions of the concentration of electron in the q traps and the concentration of hole in the p RCs obey analytically solvable decay type equations. This kind of method called the quasi-static approximation (QSA) never blows up compared to other traditional methods in deriving the solutions.

In the present work, an efficient computer program was developed in order to deconvolute the TL glow curve with the QSA scheme. The program was designed to be easily used on MS Windows-based computer with a graphical user interface. In this program, a new method based on the interactive model was adopted to analyze the TL glow curve with the traditional first-order, second-order, general-order and mixed order kinetics model and general approximation method (Chung et al, 2005). The program was tested with simulated and experimental TL glow data and the results were found to be adequate and reliable. The program can be simultaneously applied to various sets of TL and optically stimulated luminescence (OSL) glow data of a TL/OSL material exposed to different types of radiation sources and/or recorded with different types of heating and stimulation profiles. A full functional version of this program can be freely downloaded from the website http://physica.gnu.ac.kr/TLanal.

References:
Chung, K.S. et al., 2010, 16th International Conference on Solid State Dosimetry.
Chung, K.S. et al., 2005, Radiat. Prot. Dosim. 115, 345-349.
Marcazzo, J. et al., 2007, J. of Lumin. 126, 245-250.
Sakuri, T., 2001. J. Phys. D Appl. Phys, 34, L105-L107.

First steps towards spatially-resolved OSL dating with Electron Multiplying Charge-Coupled Devices: System design and image analysis

L. Clark-Balzan[1*],J.-L. Schwenninger[1]

[1] *Research Laboratory for Archaeology and the History of Art, University of Oxford, Dyson Perrins Building, South Parks Road, Oxford, OX1 3QY, United Kingdom*

**Corresponding autho:* laine.clark-balzan@keble.ox.ac.uk

Standard luminescence dating techniques, in which samples are reduced to homogeneous mineral extracts during laboratory preparation, discard vital information about the physical location of each grain within its original burial environment. The most significant loss is likely to be dosimetric data, but micromorphological evidence relating to bioturbation or other environmental factors that influence the dating outcome can also be destroyed. Spatially resolved OSL (SR-OSL), the use of a system to record luminescence from known sources within an intact sample, may help to retain such information when combined with appropriate sampling and preparation methods. Whether SR-OSL can be a viable future alternative for dating, however, depends on the speed, reproducibility, and general applicability of measurement techniques. Several SR-OSL detection techniques have been investigated through the years, but these have rarely been used for dating (Greilich, Glasmacher and Wagner, 2005). This work is a first step towards the development of a standardized SR-OSL methodology by investigating the detection of ultraviolet OSL emissions with EMCCD cameras and the analysis of the resultant data. Although EMCCDs have been used to detect infra-red radiofluorescence in feldspars (Pfeifer and Krbetschek, 2009) and thermoluminescence of siliceous rock slices (Schmidt et al., 2010), analysis of typical UV-band luminescence emissions from quartz has not been reported. Desired frame rates and signal to noise ratio requirements for imaging at low intensity make EMCCD sensors a suitable choice for the measurement of ultra low intensity UV OSL or TL. System sensitivity is also controlled by the design of the attached optics and sample holder/stimulation geometry. We present OSL and TL images of a variety of materials, including dosed aluminium-oxide, feldspars and quartz grains with various optical systems. Images of natural UV OSL signals from feldspar and quartz confirm the order of magnitude difference between their emission intensities. With a judicious choice of frame rates and gain settings, however, a significant proportion of quartz grains emit luminescence at intensities above the detection background. Software for image registration and analysis of the data is also discussed. Our results indicate that accurate photometric calibration is vital for this type of quantitative analysis, and the stabilization of the latest generation of EMCCD cameras allows greater precision and accuracy in such measurements.

Keywords: OSL, Luminescence, EMCCD, Spatially Resolved, Dating

References

Greilich, S., Glasmacher, U.A. and Wagner, G.A. (2005) Optical dating of granitic stone surfaces. *Archaeometry* 47, 645-665.

Pfeifer, S.S. and Krbetschek, M.R. (2009) Radioluminescence Investigations on Alumosilicates for Age Determination. *Verhandlungen der Deutschen Physikalischen Gesellschaft.* Dresden, Germany. March 22-27. Dielectric Solids Division Overview of Invited Talks and Sessions, 18.

Schmidt, C., Rufer, D., Pettke, T., Preusser, F., Krbetschek, M., Dornich, K., Mittelstrass, D. and Hilgers, A. (2010) Determining dose rate distribution patterns in siliceous rocks using LA-ICP-MS and spatially resolved luminescence measurements. *UK TL/OSL/ESR Meeting.* Oxford, United Kingdom. Sept. 8-10.

SAR-OSL dating of quartz of different grain sizes extracted from a loess section in southern Romania embedding the Campanian Ignimbrite/Y5 tephra layer

D. Constantin[1], A. Timar-Gabor[1*], D. Veres[2], R. Begy [1], C. Cosma[1]

[1] Faculty of Environmental Science, Babeş-Bolyai University, Fântânele 30, 400294 Cluj-Napoca, Romania
[2] Department of Geology, Babeş-Bolyai University and Institute of Speleology of the Romanian Academy, Cluj-Napoca, Romania

* *Corresponding author:* alida.timar@ubbcluj.ro

Loess deposits are widespread in Romania and many open profiles are found along the river valleys crossing the southern plains of the country. Whilst the importance of these sections in understanding paleoclimate dynamics and the Paleolithic cultural dispersal at continental scale is crucial, little chronological information is generally available for most of these sites.
In recent years, quartz has become the dosimeter of choice and modern optical dating technology is increasingly applied to various grain-size fractions of quartz that have been extracted from loess. However, our previous investigations on SAR-OSL dating of quartz extracted from the well-represented loess paleosol sequences from southeastern Romania indicated that luminescence dating of loess is not a straightforward issue. Here we report new results from the on-going investigations on the potential of quartz optical dating for establishing a reliable chronology for Romanian loess-palaeosol sequences. We applied the single aliquot regeneration protocol on a suite of different grain-sized quartz (4-11 μm, 63-90 μm, 90-125 μm and respectively 125-180 μm) extracted from two samples of loess collected from the Jiu Valley upper terrace cover. The two analised samples closely bracket a 50 cm thick volcanic ash layer that has securely been identified as the Campanian Ignimbrite/Y5 tephra (ca. 40 cal ka BP) through detailed geochemical analysis of glass shards. For all quartz grain sizes the SAR protocol with a preheat of 10 s at 220°C, a cutheat to 180°C and a hot bleach at the end of each cycle for 40 s at 280°C was applied. The suitability of SAR protocol for dating these samples was confirmed through recycling, recuperation and dose recovery tests. The age results from all grain sizes are consistent within error limits (ranging from 39.5 ± 3.7 to 44.2 ± 4.1 ka) and indicate that the tephra layer is indeed the Campanian Ignimbrite/Y5 tephra. This tephra originated from the largest eruption of the Campi Flegrei caldera and is one of the most important Marine Isotope Stage 3 temporal/stratigraphic markers, with crucial importance in linking marine, lacustrine, loess, cave and archeological records, stretching from the Mediterranean Sea to the Volga Plain.
The importance of this study are twofold. Firstly, the occurrence of the Campanian Ignimbrite/Y5 tephra in this region provides another important tie-point for developing a regional tephrostratigraphic framework. Secondly, our luminescence investigations indicate that previous conclusions regarding OSL dating of loess from Eastern Romania may be valid only for loess deposits from that particular region, and might not apply to quartz extacted from loesses deposited in other parts of the country. These observations highlight the need for more extensive investigations into the luminescence properties of loess quartz and its chronological applicability, as well as into the origin of loess and quartz contributions from different primary sources.

Keywords: quartz, OSL, SAR protocol, grain size, loess, Campanian Ignimbrite/Y5 tephra

Comparison of OSL ages from young dune sediments with a high-resolution independent age model

I. Costas[1*], T. Reimann[2], J. Ludwig[1], S. Lindhorst[1], S. Tsukamoto[2], H. C. Hass[3] , C. Betzler[1]

[1]*Institute for Geology and Palaeontology, University of Hamburg, Bundesstr. 55, 20146 Hamburg (iria.costas@uni-hamburg.de), Germany*
[2]*Leibniz Institute for Applied Geophysics (LIAG), Section S3: Geochronology and Isotope Hydrology, Stilleweg 2, 30655 Hannover, Germany*
[3] *Alfred Wegener Institute for Polar- and Marine Research (AWI), 25992-List, Germany*

** Corresponding author: (iria.costas@uni-hamburg.de*

Optically stimulated luminescence (OSL) dating of very young sediments (<150 yr) is a challenging issue due to low signal-to-noise ratio of the natural signal. Young samples are also very sensitive to thermal transfer or insufficient resetting of the luminescence signal during sediment transport. Thus it is important to have a good independent age control to check the reliability of the OSL ages. In this study, a time control based on a series of aerial images of a shifting sand dune was used to improve the temporal resolution of an OSL age model. The study area is located on the island of Sylt (southern North Sea); the investigated dune shifts with a mean migration rate of 4.7 m/a. Six aerial images and two historical maps available back to the year 1925 allowed the reconstruction of dune movement through time. Based on this, an age model has been developed to attribute sedimentary-architectural elements of the dune to time. Along a 245 m transect oriented parallel to the direction of dune movement (W-E), 14 samples for OSL dating were collected at equidistant locations at a depth of 0.7 m below the surface. This transect covers the time span probably since the year 1920 and thus provides a high-resolution sedimentary record. Sand-sized quartz (150-250 μm) was used for determining the equivalent dose (D_e) applying the SAR protocol. In order to minimize thermal transfer, low temperature preheat and cutheat (180°C and 160°C) were applied. Results of the OSL dating showed that the oldest age appeared to be 175±15 years whereas the modern analogue was dated to 32±5 years. In comparison with the aerial images, the OSL ages show a systematic overestimation of 20-40 years and not all of them are in chronostratigraphic order.

Keywords: OSL dating, young dune sediments, age control by aerial images, age overestimation.

Experimental simulation of beta-dose heterogeneity in sediment, using artificial radionuclides

A. C. Cunningham*, D. J. DeVries, D. R. Schaart

Delft University of Technology, Faculty of Applied Sciences, Mekelweg 15, 2629 JB Delft, The Netherlands

* *Corresponding author:* a.c.cunningham@tudelft.nl

Understanding the spread in equivalent-dose (D_e) measurements is an important aspect of OSL dating. Ideally, prior to age estimation, an assessment should be made of the likely spread in D_e that is caused by dose-rate heterogeneity in the sediment. Such a procedure would greatly increase the validity of OSL ages, particularly for sediments susceptible to partial bleaching, and for sediments with coarse or poorly sorted grain size distributions. In this paper we take a step towards a general model of dose-rate heterogeneity, by simulating the ^{40}K-derived beta dose to quartz.

It was suggested by Mayya et al. (2006) that the ^{40}K beta dose could be the major source of dose-rate heterogeneity in sandy sediments. This is because its location is concentrated in grains of K-feldspar; and because the mean range of its beta emission in sediment is less than 1 mm. If the effect of beta-dose heterogeneity is to be modelled, it is necessary to determine the effects of grain size and K-feldspar content on the D_e distribution. Here we present a new experimental design, in which we construct a 'sand-box' containing grains of quartz mixed with large grains of NaOH. The NaOH is bombarded beforehand with neutrons in a nuclear reactor to produce ^{24}Na. The artificially produced ^{24}Na is a beta emitter, with a beta spectrum almost identical to ^{40}K. However, because the half-life of ^{24}Na is only 15 hours, a considerable dose can be delivered to the quartz grains within a short space of time.

We made single-grain OSL measurements of the dose delivered to quartz, after two weeks of exposure in the mixed sediment. To complement the measurements, we conducted a computer simulation of the same set-up, using a Monte Carlo transport code. The Monte Carlo simulations were able to accurately reproduce the spread in the measured single-grain D_e distribution. However, the computations show that the spread in D_e is sensitive to the initial conditions, particularly the grain-size distribution of the source particles.

In this paper we will present the experimental and computational simulations of beta-dose heterogeneity, analyse the shape of the D_e distributions, and explore the consequences for OSL dating.

Reference:

Mayya, Y.S., Morthekai, P. Murari, M., Singhvi, A.K. 2006. Towards quantifying beta microdosimetric effects in single-grain quartz dose distribution. Radiation Measurements 41, 1032-1039.

Initial OSL dating results for sedimentary silt sized quartz grains from Galería archaeological site, Atapuerca, Spain: observations on multi- and single-grain datasets

M. Demuro[1*], L.J. Arnold[1], J.M. P. Casanova[1], A. Pérez-González[2].

[1] *Programa de Geocronología, Centro Nacional de Investigación sobre la Evolución Humana, CENIEH, Paseo Sierra de Atapuerca s/n, 09002 Burgos, Spain. (martina.demuro@gmail.com).*
[2] *Programa de Geoarqueología, Centro Nacional de Investigación sobre la Evolución Humana, CENIEH, Paseo Sierra de Atapuerca s/n, 09002 Burgos, Spain.*

** Corresponding author: martina.demuro@gmail.com*

The endokarstic system of the Sierra de Atapuerca, north-central Spain, contains an extraordinary archive of Lower to Middle Pleistocene human remains and Lower Palaeolithic stone artefacts. Previous age constraint has been provided on this depositional sequence by TL and IRSL dating of polymineral fine-grained material (Berger et al 2008) and combined ESR/U-series ages, which indicate several infilling episodes in the Middle to Late Pleistocene. Here we provide initial results of a new luminescence dating study of this sequence employing some of the latest techniques in OSL dating of coarse-grained quartz. This study forms part of a broader ongoing project concerned with establishing firm chronologies for early human occupation in Spain and Europe. OSL samples were collected from sedimentary units associated with occupation layers, TG4 and TG3. Silt sized quartz grains were isolated following standard procedures and all multi-grain and single-grain OSL measurements were carried out on TL/OSL Risø readers. Dosimetry was determined using a combination of in-situ gamma spectrometry and low-level beta counting. This study will present results obtained after a systematic characterisation of quartz OSL properties performed at the single-grain and multi-grain level. Linearly modulated (LM)-OSL and continuous-wave (CW)-OSL analyses were undertaken to determine the signal composition of these quartz samples and the contribution of each component to the main quartz OSL signal, as well as their thermal stabilities and dose saturation properties. Insights will also be provided on: (i) the level of aliquot-to-aliquot and grain-to-grain OSL signal variability, (ii) the types of grains present in the sample and their suitability for OSL dating, (iii) the existence of individual components suitable for dating beyond the conventional OSL age range (preferably at the single-grain level), and (iv) the presence of 'supergrains' that have higher-than-usual saturation doses. We also provide details of thermal transfer (TT)-OSL signal characteristics and initial observations on its suitability for dating these samples. The outcome of these investigations will underpin further application of OSL dating to unknown age deposits in Atapuerca and will significantly increase the reliability of the ages obtained for these important archaeological sites.

Reconstructing Sea Levels in Antarctica Using Optically Stimulated Luminescence from Cobble Surfaces

R. DeWitt[1*], A.R. Simms[2], L. Miller[2], P. Kouremenos[3]

[1]*Department of Physics, Oklahoma State University, Stillwater, OK 74078, USA (rkalchg@okstate.edu).*
[2]*Department of Earth Science, University of California, Santa Barbara, CA 93106, USA.*
[3] *Boone Pickens School of Geology, Oklahoma State University, Stillwater, OK 74078, USA.*

** Corresponding author: rkalchg@okstate.edu*

Most current methods of reconstructing past sea levels within Antarctica rely on radiocarbon dating. However, radiocarbon dating is limited by the availability of material for dating and problems inherent with radiocarbon reservoirs in Antarctic marine systems. Here we report on the success of a new approach to dating raised beach deposits in Antarctica for the purpose of reconstructing past sea levels. This new approach is the use of optically stimulated luminescence (OSL) on quartz-grains obtained from the underside of cobbles within raised beaches and boulder pavements.

Samples were collected from 3 sites around Maxwell Bay in the South Shetland Islands. For each OSL-sample we collected representative surrounding rocks and the underlying material for low-level Ge gamma spectroscopy in the laboratory. We isolated mineral grains from the outer 1 mm of the underside of the cobbles with a diamond saw in a dark room. The slices were carefully crushed with pestle and mortar as is conventionally done in pottery dating and quartz separates were prepared. We used a SAR procedure with high-temperature OSL bleaching to measure the equivalent dose. The dose rate was determined with low-level gamma spectrometry of the surrounding material and the crushed rocks themselves. All quartz samples have been found to be contaminated with feldspar and fading corrections were applied.

The results are internally consistent and fit well with previously published radiocarbon ages obtained from the same formations. In addition, when the technique was applied to a modern beach, it resulted in an age of zero. The ages indicate that a period of increased uplift has occurred over the last 500 years. We find that the average uplift rates from approximately 5,500 years BP to around 500 years BP were on the order of 2 mm/yr. Between 500 and 250 years ago, the rate changed to an average of 10 mm/yr with a total amount of uplift of around 6 m over the last 250 years. Our results suggest that this method will provide a valuable tool in the reconstruction of past sea levels in Antarctica and other coarse-grained beach deposits across the globe.

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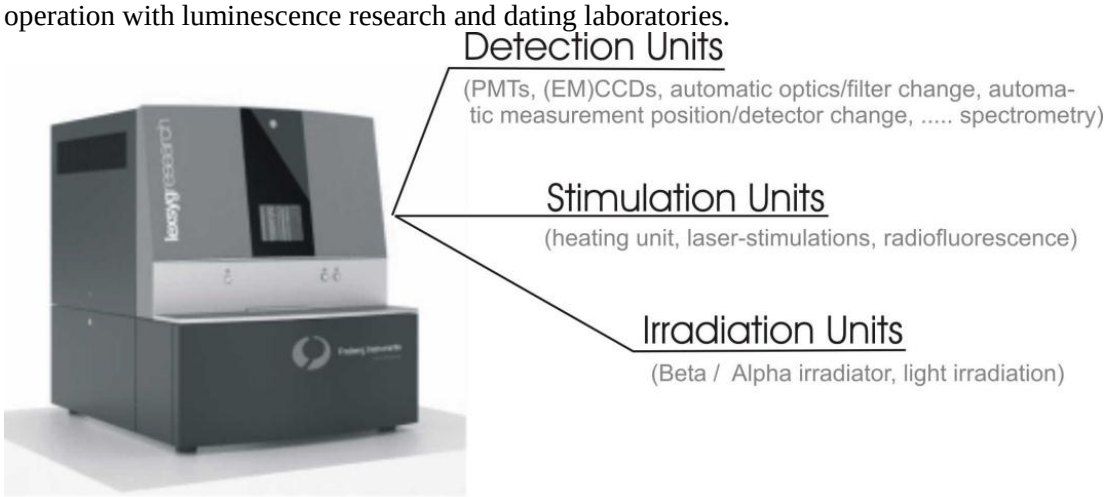
LEXSYG – a new measurement system for luminescence research and dating

K. Dornich[1*], M. Krbetschek[1,2], A. Hilgers[3], D. Mittelstrass[1]

[1] *Freiberg Instruments, Am St. Niclas Schacht 13, D-09599 Freiberg*
[2] *TU Freiberg, Institut für Angewandte Physik, Leipziger-Str. 23, D-09596 Freiberg*
[3] *Universität zu Köln, Geographisches Institut, Albertus-Magnus-Platz, D-50923 Köln*

** Corresponding author: Dornich@freiberginstruments.com*

LEXSYG is a luminescence reader recently designed and constructed by Freiberg Instruments in co-operation with luminescence research and dating laboratories.



It is a highly flexible modular measurement system for TL, OSL/IRSL and RL measurements. A basic measurement chamber (Fig.) can be equipped with a variety of modules for irradiation, luminescence stimulation and detection. This paper presents a LEXSYG-research configuration of this instrument. However, each modular unit incl. its unique features can be used in a more conventional arrangement, e.g. a basic TL or TL/OSL reader.

The measurement chamber has an 80 cups/discs capacity and is designed for vacuum/inert gas use. Samples are stored independent from the measurement section and hence sample change is possible at (nearly) any time and radiation cross-talk is avoided. The Beta (Sr-90) irradiation unit provides a homogeneous irradiation field with deviation across the sample area (10 mm diameter) of $< \pm 3$ (about ±2% at 8mm) and allows RF imaging (8mm). Sample heating (TL/preheat) can be performed up to 700°C. There are possibilities of OSL excitation by up to 3 light-fiber coupled lasers (850nm / IRSL; 532nm & 475nm / green & blue OSL) which homogeneously illuminate the sample area. The lasers can be used independently/simultaneously in CW or modulated mode. The instrument configuration presented has 2 PMT (one standard bialkaline and an IR-sensitive cooled tube) and a cooled EMCCD based detection units. While the PMTs are used for conventional small aliquot measurements, the latter can carry out spatially resolved (resolution c. 16 µm/Pixel) / single-grain measurements of hundreds of grains at once. Each detection unit is equipped with an optical shutter. Two automatically changing optical filter units – one for TL/OSL and one for RF measurements – adapt relevant PMT or imaging optics (EMCCD) at the same time. Luminescence detection windows can be set from UV to NIR and new optical filter-combinations have been tested for particular emission wave-bands and luminescence types of feldspars and quartz to perform high efficiency luminescence measurements for experimental work and routine dating applications. Furthermore all detectors can be changed automatically between the TL/OSL and RF position also within a measurement sequence. A solar light simulation unit allows optical bleaching of samples under different conditions within the chamber. Technical information on the luminescence measurement system is supplemented by examples of measurement results.

Accuracy and precision of equivalent dose determination using single grains of quartz at high doses

G.A.T. Duller*

Institute of Geography and Earth Sciences, Aberystwyth University, Aberystwyth, SY23 3DB, UK

** Corresponding author: ggd@aber.ac.uk*

Saturation of the optically stimulated luminescence (OSL) signal from quartz is commonly observed, but poorly understood. For some samples the signal appears to grow to an upper limit with no signs of further growth, for others the signal exhibits continued growth at high laboratory radiation doses (e.g. Lowick et al. 2010). This variability is observed both for aliquots containing multiple grains, and for single grain measurements. As the age of samples being dated increases, the importance of saturation increases. Understanding the behaviour of the OSL signal from single grains of quartz at high doses is essential since the method is being increasingly used to date samples close to saturation in the pursuit of the origins of modern humans (Jacobs et al. 2006, Armitage et al. 2011). A commonly reported phenomenon is that some aliquots measured using the single aliquot regenerative dose (SAR) protocol yield a sensitivity corrected value for the natural (L_n/T_n) that is greater than the saturation value measured in the dose response curve using laboratory irradiation, and hence it is not possible to calculate an equivalent dose (D_e) value for them. Standard practice has been to exclude such results from analysis, but intuitively this may lead to systematic errors in the calculated D_e for a sample.

In this study quartz grains from Kalambo Falls, Zambia, are used to undertake a series of dose recovery experiments, using increasingly large recovery doses. Data are analysed to assess the proportion of grains for which L_n/T_n exceeds the saturation level during the SAR procedure, and to assess the accuracy and precision of single grain quartz OSL measurements for recovering the dose administered to samples as they approach saturation. Different approaches to improving the accuracy with which doses can be recovered are explored, and practical limits for the maximum doses that can be reliably dated are proposed.

References

Armitage, S. J., Jasim, S. A., Marks, A. E., Parker, A. G., Usik, V. I. and Uerpmann, H. P. (2011). The Southern Route "Out of Africa": Evidence for an Early Expansion of Modern Humans into Arabia. Science 331: 453-456.

Jacobs, Z., Duller, G. A. T., Wintle, A. G. and Henshilwood, C. S. (2006). Extending the chronology of deposits at Blombos Cave, South Africa, back to 140 ka using optical dating of single and multiple grains of quartz. Journal of Human Evolution 51: 255-273.

Lowick, S. E., Preusser, F. and Wintle, A. G. (2010). Investigating quartz optically stimulated luminescence dose - response curves at high doses. Radiation Measurements 45: 975-984.

Assessing the use of the range-finder OSL dating protocol on fluvial sediments from the Punjab, Pakistan

J. A. Durcan*, H.M. Roberts, G.A.T. Duller

Institute of Geography and Earth Sciences, Aberystwyth University, Aberystwyth, SY23 3DB, UK

* *Corresponding author:* jjd08@aber.ac.uk

The range-finder (RF) OSL dating protocol provides a means of rapid age estimation using the optical signal from quartz mineral grains treated with a pared-down laboratory protocol. The RF protocol has been proposed and tested by Roberts et al. (2009) using a range of aeolian sediments from a variety of geographic locations. Durcan et al. (2010) applied this protocol to a small number of more complex fluvial samples from Pakistan, however there was only limited corroborating age control, in the form of two radiocarbon (^{14}C) ages.

This study aims to test the RF OSL dating protocol more intensively than previous studies, using sediments from a 200 km transect of a palaeo-tributary of the Indus River in the Punjab, Pakistan. These fluvial samples have more complex depositional histories than those used by Roberts et al. (2009). The applicability of the RF dating protocol to samples with both narrow and broad dose distributions is explored, and the number of aliquots required to calculate an equivalent dose (D_e) is studied. Consideration is also given to the most appropriate form of statistical treatment for use when calculating RF D_e values. The application of 'standard' rejection criteria usually applied to FP OSL signals (e.g. the recycling and OSL IR depletion ratio) is also explored. Additionally a re-assessment of the 30% uncertainty previously recommended for RF OSL age estimates (Roberts et al., 2009) is made. Comparisons are made between the fully prepared (FP) and RF OSL dating of a number of samples, as well as evaluating the RF OSL age estimates against independent age control (^{14}C dating) where available.

References

Durcan, J.A., Roberts, H.M. and Duller, G.A.T., 2010. Testing the use of range-finder OSL dating to inform field sampling and laboratory processing strategies. Quaternary Geochronology, 5, 86-90.

Roberts, H.M., Durcan, J.A. and Duller, G.A.T., 2009. Exploring procedures for the rapid assessment of optically stimulated luminescence range-finder ages. Radiation Measurements, 44, 582-587.

Chronology of the oldest hominid settlements in Western Europe: contribution of the combined US-ESR dating method applied to fossil teeth

M. Duval[1*], C. Falguères[2],J.-J. Bahain[2]

[1]Centro nacional de investigación sobre la evolución humana (CENIEH). Paseo de Atapuerca, s/n, 09002 Burgos, Spain. mathieu.duval@cenieh.es
[2]Muséum National d'Histoire Naturelle, Département de Préhistoire, Muséum national d'histoire naturelle, UMR7194, 1 rue R. Panhard 75013 Paris, France

* *Corresponding author:* mathieu.duval@cenieh.es

The chronology of the Genus *Homo* dispersal into Europe is a key topic in prehistory. Nowadays, the number of ancient archaeological sites attesting the presence of hominids during Early Pleistocene is becoming quite significant. Nevertheless, dating these old sites with absolute methods is still a real challenge, mainly because only a few of them may be used for this age range. In this sense, the Electron Spin Resonance (ESR) dating method has a great potential and shows the major advantage to be possibly applied to a large variety of materials (fossil teeth, quartz grains, carbonates, among others), which allows working in any geological context.
Within the European continent, Iberian Peninsula probably delivered the highest number of evidences of ancient hominid occupations. For about 20 years, our team has focused part of its research in attempting to date fossil teeth from these sites. We present here a synthesis of the combined US-ESR ages obtained at Atapuerca Gran Dolina TD-6, Atapuerca Sima del Elefante TE-9, Fuente Nueva-3, Barranco León, Venta Micena and Vallparadís sites.
From a methodological point of view, the quite large dataset (20 teeth) covers various sedimentary contexts and may be considered as a reliable starting point to assess the real potential of the combined US-ESR dating. Our work show that dating such old fossil teeth is quite complex, mainly because these samples have some features that are not encountered when working with younger ones. However, despite some limits identified, these results also indicate that the combined US-ESR dating method may work, under certain conditions, for Early Pleistocene fossil teeth. Our results associated to palaeomagnetic and biochronological studies provide a major contribution to the chronological framework of the first hominid settlements in Western Europe.

Sea-water input to Lake Iznik (Turkey) during Late Pleistocene

A. E. Erginal[1], N. G. Kiyak[2]

[1]Canakkale Onsekiz Mart University, Department of Geography, Canakkale, TR-17O20, Turkey
(E-mail: aerginal@comu.edu.tr)
[2]ISIK University, Department of Physics, Archeometry Laboratory, Istanbul, TR-34980, Turkey

* *Corresponding author:* aerginal@comu.edu.tr

In beachrock investigations, examining micro-fabric characteristics and stable isotope composition of interstitial carbonates together with absolute ages is of prime importance for deciphering the origin and paleoenvironmental inference of such cemented hardgrounds. When viewed from this aspect, the physico-chemical properties of cement composed mostly of low-mg calcite, high Mg-calcite, aragonite or their combination record paleo-hydrologic and climatic conditions when connective carbonate polymorphs were precipitated from water mass. As is known, such cemented beaches pertain mostly to intertidal zone of tropical and subtropical coasts, suggesting cementation of grains and gravels by intertidal precipitates. The marine-like cement types in a fresh-water Lake Iznik beachrock that also contains abundant amount of lagoon cookle *Cerastoderma glaucum* is, however, unusual and is therefore of special geologic interest.

In this study, beachrocks collected from southeast and northeast shores of the Lake Iznik were studied on the basis of micro-fabric analyses, optical age (OSL) estimations and stable isotope ($\delta^{13}C$, $\delta^{18}O$) measurements. Scanning electron microscopy analyses demonstrated the presence of marine-like cements growth in both sites, such as micrite envelopes, bladed isopachous aragonite rims, void fills, radial aggregates and exceptionally meniscus bridges. The age of beachrocks go back to 20.285 ± 2.06 ka to the southeast and 15.180 ± 1.13 ka to the northeast. The fossil shells *Cerastoderma glaucum*, a lagoon cookle living in euryhaline conditions, were found to the northeast seem to have cemented within beachrock beds. $\delta^{13}C$ and $\delta^{18}O$ determinations of beachrocks (eight samples) revealed the mean values of +1.45‰ PDB and -2.45‰ PDB, respectively. Seven samples of fossil shells, however, yielded $\delta^{13}C$ and $\delta^{18}O$ values of +1.41‰ PDB and -2.43‰ PDB, respectively. These values represent insignificant heterogeneity and reveal that $\delta^{13}C$ values are relatively of heavier isotopic composition in proportion to that of $\delta^{18}O$ marked by relatively lighter values.

Based on the above data, beach grains and gravels on the shore of Lake Iznik cemented at late Pleistocene. Stable isotope values explain that amalgamating cements typical of marine-phreatic environment might have precipitated from marine or marine-like waters. A sound evidence for such different pale-hydrological conditions comes from the existence of lagoon mollusc *Cerastoderma glaucum*. Thus, a possible incursion to the fresh-water Lake Iznik took place between 15.180 ± 1.13ka and 12.235 ± 1.145 ka.

Keywords: Beachrock, carbonate cementation, lake-level variation, cement micromorphology, Late Glacial Era, Lake Iznik, NW Turkey.

OSL dating from pieces of ceramics using coarse grained (200-400 μm) quartz added to the clay

K. Eskola*, M. Oinonen

Finnish Museum of Natural History, Dating Laboratory, University of Helsinki, Finland, kari.o.eskola@helsinki.fi, markku.j.oinonen@helsinki.fi,

** Corresponding author:* kari.o.eskola@helsinki.fi,

There are some categories of ceramics where has been added coarser grained sand or crushed stone material to the clay before it has been fired. This coarser material is added in purpose to make the ceramics harder than it would be if only clay were used. Typically this coarser material contains lot of quartz that is suitable for luminescence dating. This kind of ceramics can be found as pieces of pottery during archaeological excavations. In this work we have made luminescence dating for pieces of pottery representing this kind of ceramics. The age of dated samples varies from few hundred to few thousand years. The dating method is based on OSL-method and SAR-protocol. The material used in measurements is quartz that is separated from the dated samples. The grain size of the used quartz is 200-400 μm after the quartz is separated and from clay with mechanical and chemical treatments and sieved. The advantage of making luminescence dating from this kind of ceramics is that the quartz separated from the fired ceramics is well bleached and also giving usually very bright luminescence signal. This makes possible to make luminescence dating from relatively small pieces of ceramics which also means that there are more potential sample material to be dated. The project will proceed towards broader comparison of radiocarbon dated and OSL dated pottery and will be integrated with the larger effort to date ceramics sequences in Finland through Bayesian modelling. Furthermore, as insensitive to reservoir effect hampering the radiocarbon dating of coastal samples, OSL dating of pottery is foreseen to contribute significantly in improving the knowledge on Baltic-sea reservoir effect.

Keywords: ceramics, OSL, SAR

Combined ESR/U-Series chronology of Hominid-bearing layers at Galeria site, Atapuerca, Spain

C. Falguères[1*], J-J Bahain[1], A. Perez-Gonzalez[2], J. L.Bischoff[3], A. Olle[4], D. Moreno[1-4], J.-M. Dolo[5], A. I. Ortega[2], J. Vallverdu[4], E. Carbonell[4], J. M. Bermudez de Castro[2], J. L. Arsuaga[6]

[1] Département de Préhistoire, Muséum national d'histoire naturelle, UMR7194 du CNRS,
1, rue rené Panahrd, 75013, Paris, France, (falguere@mnhn.fr; bahain@mnhn.fr, moreno@mnhn.fr)
[2] Centro Nacional de Investigación sobre la Evolución Humana (CENIEH) Avenida de la Paz 28, 09004-Burgos, Spain (alfredo.perez@cenieh.es; anaisabel.ortega@cenieh.es; mcnbc54@mncn.csic.es)
[3] US Geological Survey, ms/470, 345 Middlefield Rd, Menlo Park CA 94025, United States of America (jbischoff@usgs.gov)
[4]IPHES (Institut Català de Paleoecologia Humana i Evolució Social). Area de Prehistòria URV, Plaça Imperial Tarraco, 1, 43005 Tarragona, Spain (robert.sala@urv.cat, andreu.olle@prehistoria.urv.net; josep@prehistoria.urv.cat; eudald.carbonell@urv.net)
[5] CEA/I²BM, F-91401 Orsay Cedex, France. (jean-michel.dolo@cea.fr)
[6] Centro Mixto UCM-ISCIII de Evolución y Comportamiento Humanos Instituto de Salud Carlos III, c/ Sinesio Delgado 4, Pabellón 14, 28029 Madrid, Spain (jlarsuaga@isciii.es)

* *Corresponding author:* j falguere@mnhn.fr;

The Sierra de Atapuerca, Northern Spain, has yielded a conspicuous number of prehistoric and palaeontologic data documenting the Human history in Eurasia during the last million years. Three major sites, Gran Dolina, Galeria and la Sima del Elefante, found in the Trinchera area close to each other, document almost all of the entire period of the Pleistocene from the oldest Hominin of Western Europe dated to 1.1 to 1.3 Ma at Elefante (Carbonell et al., 2008) to 0.2 Ma on the top of the Galeria archaeological sequence. Recently, a chronology for Dolina and Galeria sites, based on luminescence data (TL and IRSL) applied on cave sediments, was published (Berger et al., 2008). The authors proposed for Galeria an age of 450 ka for the units lower GIII and GII suggesting that the human occupation is younger than the hominid remains of la Sima de los Huesos (>530 ka) close to 1km distance (Bischoff et al., 2007).

In this paper, we present new results obtained by combined ESR/U-series method on herbivorous teeth sampled in different levels of Galeria site. They are in agreement with TL ones for the upper part of Galeria (GIV and GIIIb) around 200-250 ka. From GIIIa to GIIa levels, the TL ages change abruptly getting older of 200 ka while ESR ages stay relatively constant when depth increases. Our results suggest a different interpretation in terms of chronology between GII, GIII and GIV units of Galeria and the upper part of Dolina (TD10 and TD11).

Late Quaternary evolution of Lake Manas with constraints of OSL ages

A. Fan[1,2], S.-H. Li[2,*], Y.-G. Chen[1]

[1] Department of Geosciences, National Taiwan University, Taiwan
[2] Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong(shli@hku.hk)

* *Corresponding author:* shli@hku.hk

Located in the western Junggar Basin, the lake Manas has been formed in a structure depression since early Quaternary. It is separated with other smaller lakes by the tectonic activities of reverse faults in the lake margin, which gave rise to the uplift forming a NE-SW ridge. The optically stimulated luminescence (OSL) dating is applied on the lacustrine sediments and shoreline deposits collected from the lake to construct a chronological frame for the purpose of understanding climatic and tectonic evolution since the last inter-glacial period. Our results yielded three stages of high lake levels occurred in 120-100 ka, 85-75 ka, and 45-25 ka ago, which correspond to the marine isotope stage (MIS) 5 and 3. No evidence for Holocene high lake level was found in the studied area. The uplift of the ridge separating the modern lakes can be constrained between 75 and 30 ka by the OSL ages of lacustrine sediments on the ridge as well as of the lower lake section. It is concluded that the evolution of Lake Manas is controlled by both climatic and tectonic forcings.

OSL as a bridge between Paleoseismology; Paleoclimatology and Archeology in Iran

M. Fattahi[1,2,*]

[1] Oxford University Centre for the Environment, South Parks Road, Oxford, OX1 3QY
[2] Institute of Geophysics, University of Tehran, Kargar Shomali, Tehran, Iran

* *Corresponding author:* Morteza.Fattahi@ouce.ox.ac.uk

Iran is one of the most tectonically active regions on the Alpian-Himalian earthquake belt. The reason that Iran is seismically active is the N-S convergence between Arabian and Eurasia. Active faulting has produced mountains and has changed the topography and drainage patterns on the surface, and the geomorphology is able to retain information about fault evolution over relatively long timescales. The earthquake faults are mostly located at the boundary of plains and mountains where streams or qanats provide water and fertile soil for settlement and agriculture. The arid semi-arid environment of Iran is the reason that Iranian has mostly concentrated along the edge of mountain ranges, where the risk from earthquake is the highest. OSL has been employed to date past earthquake and to provide the ages of the abandoned fan surface, dry bed lakes and dry bed sediments that have been displaced by active faults. These provided fault slip-rate which is a valuable constraint both in understanding the local earthquake hazard and the regional tectonics. OSL dating of loess; alluvial fan deposition; river traces; dry lakes and dry bed sediments also provided valuable information to constrain the timing and controls on late Quaternary landscape development in the deserts of eastern Iran. Bam earthquake in 2003, destroyed the old city of Bam and seriously damaged the monument of Arge Bam. This scenario has happened frequently in the past. There are many ancient buildings in Iran which are made by unheated breaks. OSL is the ideal method to determine the age of their reconstruction. Therefore, Iranian have lived in locations vulnerable to earthquakes, and climate change. OSL has helped us to study past environmental change; to assess the hazard posed by earthquakes, and to increase our understanding of the development of ancient societies. After several years of intensive work, paleoseismologists, paleoclimatologist and archeologist who works on Iran, has accepted OSL as a novel dating technique for this arid reigon.

Keywords: OSL, Paleoseismology, Paleoclimatology, Archeology, Iran

Luminescence Dating of Prehistoric Rock Alignments

J. K. Feathers*

University of Washington, Box 353100, Seattle, WA 98195-3100 USA

* *Corresponding author:* jimf@u.washington.edu

Prehistoric rock alignments are ubiquitous throughout the northern Rockies and adjacent high plains and occur as far north as Alaska and as far south as Texas. The alignments are usually either linear, interpreted as hunting drive lines, or circular, interpreted as surviving remains of mostly perishable houses ("tipis"). While providing a remarkable record of prehistoric settlement and subsistence, the alignments are poorly dated. Luminescence dating of sediments underneath the rocks is explored here. The focus is on two locations in northern Montana: a complex of both circular and linear alignments, called the Kutoyis site, just east of the Rocky Mountain front, and a series of circular alignments further east on the Plains, called the Whitewater sites. The rationale for using luminescence is that sediments within the top few centimeters of a stable surface will cycle to the surface through turbation providing opportunity for some grains to be fully bleached, a process curtailed by placement of a rock on the surface. Application of a minimum age model should yield the age of rock placement. Samples were collected in vertical tubes under dark conditions, with the expectations that the top few centimeters will provide the age of interest and, if the model is correct, that the average age should increase with depth. Because single-grain analysis to isolate fully bleached grains is needed and because the samples are small, a sensitive dosimeter is required. Quartz in the region is far too insensitive to be useful, so feldspar is employed. Stimulation is by an IR laser, and equivalent dose is determined by SAR (Auclair et al. 2003) with a fading correction applied to the age following Huntley and Lamothe (2002). Dose rates were determined both by laboratory measurements of sediments and overlying rock and by *in situ* measurements using $CaSO_4$:Dy dosimeters. A 2.58 specific gravity density solution was employed to isolate K-feldspars. At single-grain scale, it is desirable to assess K content of each grain to correct for potential differential dose rates. Grains were transferred from single-grain disks to SEM stubs and analyzed with energy-dispersive x-rays. The results of this showed that many of the grains measured were not K-feldspars. The K-content at Kutoyis averaged only 2-3%, while it was much higher at Whitewater. The latter grains were also more sensitive to luminescence. The SEM analysis also showed that original use of the laser at 90% power created sufficient heat to shatter the grains. Subsequent analysis at 70% power did not shatter the grains, but nevertheless stimulation temperatures are probably higher than what was programmed. Age assessments from different segments of the vertical sampling tubes confirmed that average age increased with depth in agreement with the model. A near zero age was also determined for a sample collected from the modern surface (not under a rock), although procedures may be over-estimating ages slightly. An agreement of ages from two samples under the same rock, one near the center and one near the edge, discounted any horizontal turbation at least for that sample, a more general conclusion also suggested by the much greater ages at Whitewater where rocks are smaller. Ages at Kutoyis ranged from 0.3-1.1 ka (consistent with some radiocarbon dates of 0.4 and 0.8 ka), while those at Whitewater were much older, around 3 ka.

Luminescence dating of glaciofluvial deposits from middle-low latitude mountain areas in southwestern China

J. Feng[1*], L. Zhou[1], W. Zhang[2]

[1]Laboratory for Earth Surface Processes, Department of Geography, Peking University, Beijing 100871, China (*junf@pku.edu.cn*)
[2]College of Urban and Environmental Sciences, Liaoning Normal University, Dalian 116029, China

** Corresponding author: junf@pku.edu.cn*

Middle-low latitude mountain areas in East Asia contain rich information about climate change during the late Quaternary. Many studies in these areas focus on glaciations and landscape evolution history. In this study, we report preliminary results of a geochronological investigation in the Qianhu Mountain of Yunnan Province which is located to the east of the Tibetan Plateau. This is one of the key areas at middle-low latitudes where extensive glacial deposits have been found. No systematic research on the chronology of the glacial deposits has been done, posing major limitation to the understanding of the Quaternary glaciations history, regional uplift and climate change in middle-low latitudes mountain areas. We collected samples from glaciofluvial deposits at four sites at the altitude of 3980m, 3920m, 3830m, and 3600m respectively. Fine grained quartz fraction (4-11 μm) was extracted from eight samples. The equivalent dose was determined using the single-aliquot regenerative-dose protocol. Unlike the dimmed quartz widely reported for other glacial sediments, the blue light stimulated OSL signal was bright and dominated by the fast component, making these samples suitable for the SAR protocol. The TL glow curves of these samples were featured by a main peak at 350℃ and a secondary peak at 220℃, which requires a more stringent thermal treatment. In order to avoid the use of different traps incorporated in the signals of regenerative dose and test dose, equal thermal treatment was chosen for the preheat and cut heat. Linearity check and dose recovery tests were carried out with preheat and cut heat temperatures ranging from 250℃ to 280℃ in 10℃ interval. The results show that the 260℃/260℃ combination behaved best. Therefore, we measured the samples with a preheat of 260℃ (holding for 10s) before the blue light stimulated OSL at 125℃. A cut heat of 260℃ was applied before the OSL response to a test dose of ~8.76Gy was measured. The equivalent doses obtained by using the SAR range from 13.1±0.4 Gy to 91±5 Gy, and show surprisingly small scatter for each individual sample; the relative errors are mostly no more than 8%. Therefore, optically stimulated luminescence holds great promise in providing a reliable dating method for glaciofluvial deposits of the Qianhu Mountain. Nevertheless, two samples collected from the same site at the elevation of 3830m are found to vary widely (13Gy to 44Gy). The causes for the disparity are not clear, which requires further investigation.

Keywords: OSL, glaciofluvial deposits, SAR, middle-low latitude mountains

OSL Chronology of Holocene Sand Mobility at Nam Co in Tibet

M. Frechen[1*], S. Tsukamoto[1], J. Berking[2], A. Weil[2], B. Schütt[2]

[1] Leibniz Institute for Applied Geophysics, Section 3: Geochronology and Isotope Hydorology, Stilleweg 2, D-30655 Hannover, Germany, e-mail: Manfred.Frechen@liag-hannover.de; Sumiko.Tsukamoto@liag-hannover.de
[2] Freie Universität Berlin, Department of Earth Sciences, Institute of Geographical Sciences, Physical Geography, Malteserstr. 74-100, D-12249 Berlin, Germany

* *Corresponding author:* Manfred.Frechen@liag-hannover.de

The aim of our study is to reconstruct past environmental and climate conditions including periods of Holocene sand mobility along the shoreline of one of the largest lakes on the south-eastern Tibetan Plateau, the Nam Co. The Quaternary sediments are of glacial, fluvial, aeolian and lacustrine origin and cover the lake basin catchment. OSL dating was carried out on 19 samples from dune sands taken in the SE part of Lake Nam Co. Independent age control is available from radiocarbon dating applied on intercalated organic matter. For coarse-grain quartz measurements, the post-IR OSL SAR protocol was used, because some of the samples showed IRSL signals due to feldspar contamination. Standard performance tests were applied including preheat plateau test, dose recovery and IR depletion ratio. Our standard medium sized aliquots (6 mm) yielded rather dim OSL signals so that large aliquots (9 mm) were used for measurements. The preliminary results indicate mainly Late Holocene deposition ages ranging from a few thousand years to modern.

Keywords: quartz, OSL, dune sands, Tibet, Holocene

Testing a multi-step post-IR IRSL dating method on polymineral fine grains from Chinese loess

X. Fu, B. Li, S.-H. Li*

Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China

**Corresponding author: shli@hku.hk*

Luminescence dating using feldspar has been limited by anomalous fading. Recently, a multi-elevated-temperature post-IR IRSL protocol (MET-pIRIR) for optical dating of K-feldspar has been proposed by Li and Li (in review) to overcome the fading problem. In this protocol, multi-step IRSL measurements with increasing stimulation temperature from 50 to 250°C were conducted to obtain a series of MET-pIRIR signals and corresponding De values and ages. Similar MET-pIRIR De values were obtained at high stimulation temperatures (200 and 250°C), indicating a negligible anomalous fading for these signals. Hence, no fading correction is needed for this protocol. It is suggested that the MET-pIRIR method can be applied to coarse grain (125-150 or 150-212 μm) K-feldspar samples with various geological settings in China (Li and Li, in review).

In this study, the potential of MET-pIRIR dating using polymineral fine gains (4-11 μm) is tested using the loess samples from Chinese Loess Plateau. The advantage of using fine grains is that the internal dose is negligible, thus there is no necessity to assume the concentrations of internal radioactive elements (^{40}K and ^{87}Rb). Behaviors of the MET-pIRIR signals from the fine grain polymineral are studied. Pulse annealing experiments indicate that IRSL signal of the polymineral extracts originate from both K-feldspar and Na-feldspar. Fine grain polyminerals from the loess samples within the last glacial period are dated using the MET-pIRIR protocol. The polymineral fine grain MET-pIRIR dating results obtained are compared with the coarse grain (63-90 μm) K-feldspar MET-pIRIR dating results and the previously published quartz OSL SAR dating results (Lu et al., 2007; Lai, 2010). The stratigraphy of the profile also provides an age control. Our results indicate that the MET-pIRIR protocol can be successfully applied to the polymineral fine grains from loess. The advantage and disadvantage of polymineral fine grain MET- pIRIR dating over coarse grain K-feldspar MET- pIRIR dating are discussed.

Reference:

Li, B. and Li, S.H, 2011. Luminescence dating of K-feldspar from sediments: A protocol without anomalous fading correction. Quaternary Geochronology, in review.

Lu, Y.C., Wang, X.L and Wintle, A.G., 2007. A new OSL chronology for dust accumulation in the last 130,000 yr for the Chinese Loess Plateau. Quaternary Research 67, 152-160.

Lai, Z.P., 2010. Chronology and the upper dating limit for loess samples from Luochuan section in the Chinese Loess Plateau using quartz OSL SAR protocol. Journal of Asian Earth Sciences 37, 176-185.

OSL dating of raised beach sand deposits along the southern coast of Norway

M. Fuchs[1,*], D. Sauer[2]

[1]Geographical Institue, University of Bayreuth, 95440 Bayreuth, Germany
[2]Institute of Soil Science and Land Evaluation, Hohenheim University, 70599 Stuttgart, Germany

* Corresponding author: markus.fuchs@uni-bayreuth.de

Raised beach deposits are typical features in southern Norway, explained by the continuous Holocene glacio-isostatic uplift. Therefore, the ages of the beach deposits increase with elevation and distance from the present coastline, representing an excellent natural laboratory to test hypotheses on landscape evolution and soil formation. To evaluate these hypotheses, a reliable chronostratigraphy is of crucial importance. For the southern coast of Norway, raised beaches and their associated deposits were mainly dated by radiocarbon dating. Because of the sandy nature of the beach deposits, optical stimulated luminescence (OSL) represents an alternative dating technique with the advantage of (1) direct sediment dating and (2) the possibility of dating sediments, which do not contain any organic material for radiocarbon dating. However, OSL dating of Scandinavian sediments is challenging, because they often show poor luminescence characteristics, which is generally explained by their glacial origin. In this study we demonstrate the OSL dating suitability of sandy beach deposits from the coast of southern Norway, using sand-size quartz grains. For De determination, a standard single aliquots regenerative (SAR) dose protocol is applied to small aliquots and single grains. The luminescence characteristics are described by signal components (fast, medium, slow) based on linear modulation techniques. The resulting OSL ages are discussed and checked against independent age control of the ^{14}C-based sea level curves.

OSL dating for incision rate estimation in Pamir

M. C. Fuchs[1*], R. Gloaguen[1], M. Krbetschek[2], A. Szulc[1]

[1] Department of Geology, TU Bergakademie Freiberg, Bernhard-von-Cotta-Strasse 2, 09596 Freiberg, Germany
[2] Department of Applied Physics, TU Bergakademie Freiberg, Leipziger Strasse 23, 09596 Freiberg, Germany

* *Corresponding author: fuchsm@stundent.tu-freiberg.de*

The Pamir and Tien Shan are among Earth's largest intra-continental orogen and host to some of the highest uplift rates and most powerful river systems on the planet. As a proxy for characterizing the rates and distribution of neotectonic deformation in the Pamir-Tien Shan of Tajikistan, we use the evolution of the drainage network. The continuing post-collision deformation with northward subduction of the Indian plate involves topographic growth of the Pamir establishing east-west-trending belts of shortening along which catchment discharge and corresponding sediment transport was aligned. The influence of the Westerlies results in focused precipitation. Such complex tectonic-geomorphologic-climatic feedbacks are especially well exhibited in river-capture, river-reversal and regional erosion history. The Panj, for example, is unusual in that it flows northwards and then doubles back to the southwest, cutting the Darvaz range and other major Cenozoic deformation zones. We suggest that the complex structure of the Panj is a composite feature, developed by river capture from the pre-existing east-flowing drainage pattern and likely controlled by an active continental subduction zone beneath. Focusing on the Panj trunk river and its major tributaries, we have conducted detailed sampling of river terraces and lake sediments. These have been subjected to a combination of optically stimulated luminescence (OSL) and cosmogenic nuclide (^{10}Be) dating to provide the time scale of terrace or lake sedimentation and abandonment. Incision rates are used to quantify the response rates of the landscape to tectonic-climatic forcing. Preliminary results from single-aliquot measurements of quartz from 20 OSL samples provide Panj terrace ages between 1 and 30 ka. Appropriate measurement procedures are assured by preheat and dose recovery tests. Accurate measurements of the relative heights of these terrace–sediment bodies above the modern river level are achieved by differential GPS. Terrace heights from 5 to 85 m a.s.l. correlate with increasing OSL ages. Estimated OSL ages and corresponding terrace altitudes enable quantification of incision rates to be between 2 and 6 mm/a. Pronounced erosion is indicated by narrow valley morphology and agrees with estimates derived by OSL. The relation to fault structures is analysed based on longitudinal river profiles. Additional information on tectonic forcing is deduced from tectonic geomorphology via remote sensing technologies.

Keywords: optically stimulated luminescence, fluvial terraces, incision rates, tectonic geomorphology

Luminescence Dating of Mammoth Remains from Northern Switzerland

D. Gaar[1*] ,F. Preusser[2] ,L. Galioto[3]

[1] Institute of Geological Sciences, University of Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland (gaar@geo.unibe.ch)
[2] Institute of Physical Geography and Quaternary Geology, Stockholm University, 106 91 Stockholm, Sweden
[3] Kantonsarchäologie Aargau, Industriestrasse 3, 5200 Brugg, Switzerland

* *Corresponding author:* gaar@geo.unibe.ch

Remains of at least two mammoths (*Mammuthus primigenius*) have been found after blastings in a quarry in the northern lowlands of Switzerland in July 2010. During the subsequent salvage excavation two blocks of the embedding sediment have been taken for luminescence dating just besides the remains. From the blocks fine grain samples (4-11 μm) as well as different coarse grain fractions (ranging from 63 – 250 μm) have been extracted and prepared for luminescence measurements. Luminescence dates on the polymineral and pure quartz fine grain fraction are compared to those obtained from small aliquots and single grain analyses of the coarse grain fraction. First results from polymineral fine grains give an age which lies at the transition from MIS 4 to MIS 3 and beyond the range of ^{14}C dating technique. These are some of the oldest numerically dated mammoth remains of Europe.

Understanding the role of opacifiers in the luminescence of mosaic glass: characterization of the optical properties of cassiterite (SnO_2)

A. Galli[1,2]*, M. Martini[2,3], E. Sibilia[2,3], I. Villa[2]

[1]CNR-IFN, Istituto di Fotonica e Nanotecnologie (anna.galli@mater.unimib.it)
[2]Dipartimento di Scienza dei Materiali, Università degli Studi di Milano Bicocca, via R. Cozzi 53, I-20125 Milano
[3] INFN, Sezione di Milano Bicocca, Piazza della Scienza 1, I-20126 Milano

** Corresponding author: anna.galli@mater.unimib.it*

Thermoluminescence (TL), radioluminescence (RL) and Optically Stimulated Luminescence (OSL) have been exploited to study the optical properties of glass tesserae of the baroque mosaics of the vault of San Pietro cathedral in Rome. Recent results gave evidence that the dosimetric properties of mosaic glasses depend on the presence of microcrystals in the silica network. The role of quartz and calcium antimoniate crystals in the luminescence emission for dating and authentication of glass have already been shown. For the samples object of the present study, taking into account their chemical composition and presence and type of crystalline inclusions, it was observed that those opacified with tin-based additives (namely lead stannate and tin oxide) showed higher luminescence sensitivity, being therefore more suitable for dating applications. A positive correlation between the presence of cassiterite and the possibility of measuring a natural TL and/or OSL signal, and consequently to evaluate the equivalent dose, was confirmed. A study of the pure mineral was therefore planned. The present work discusses the luminescent properties of natural cassiterite, the crystalline form of tin oxide having the tetragonal rutile structure. The TL glow curves present four peaks at 120 °C, 180°C, 300°C and 365°C respectively; the first two are thermally instable at room temperature, while the others ones are stable and exhibit a linear growth with dose up to about one hundred Gy. The recombination centers responsible for such emissions have been identified by means of wavelength-resolved TL measurements and are detected also in the RL spectrum which shows four emission bands, in the UV (325-350 nm), blue (460 nm), orange (550-590 nm) and red-IR (775 nm) wavelength regions respectively. The TL and OSL signals stability have been checked by investigating the fading characteristics of the signals, after storage at room temperature and at 50°C. Limits and potentialities of cassiterite in glass dating application are discussed.

Investigating the reliability of K-feldspars as chronometers using the post-IR IRSL signal

L. Gliganic*, Z. Jacobs, R. G. Roberts

Centre for Archaeological Science, School of Earth and Environmental Sciences, University of Wollongong, Wollongong, NSW 2522, Australia

**Corresponding author: LG527@uowmail.edu.au*

The infrared stimulated luminescence (IRSL) signal of potassium (K)-feldspars can be used to estimate the depositional age of Late Pleistocene sediments. This signal has several advantages over the OSL signal from quartz grains, being generally brighter and saturating at higher doses, but it suffers from anomalous (athermal) fading, which has compromised its accuracy for dating of many Pleistocene deposits. Recent research (Thomsen et al., 2008; Buylaert et al., 2009), however, has demonstrated that the extent of fading can be reduced by measuring the IRSL signal at an elevated temperature (e.g., at 225°C) after stimulating the sample with IR at a much lower temperature (e.g., 50°C). This 'post-IR IRSL' dating procedure first removes the population of electrons most likely to fade before accessing traps that suffer less from fading. In this presentation, we will report the results of investigations using the post-IR IRSL signal from multigrain aliquots of K-feldspars to date sediment samples collected from a Middle and Later Stone Age archaeological site (Mumba rockshelter) in the Lake Eyasi Basin of northern Tanzania. K-feldspar grains of 180–212 μm in diameter were isolated for measurement, and the blue emissions were detected after passing through a combination of BG39 and Kopp 7-59 filters. Our results indicate that, when IR stimulation of the natural and laboratory doses is preceded by a preheat of 260°C for 60 s, a maximum stimulation temperature of ~225°C can be used before a substantial isothermal TL signal is induced. Dose recovery experiments using the IRSL signals measured at 50°C, at 225°C, and at 225°C after an initial 50°C bleach, indicate that a given laboratory dose can be recovered, and a duplicate regenerative dose successfully recycled, using the single-aliquot regenerative-dose (SAR) procedure. Of the signals tested, the post-IR IRSL signal suffered least from fading. At Mumba rockshelter, the fading-corrected ages obtained using the post-IR IRSL signal are stratigraphically consistent and in statistical agreement with the ages obtained using the OSL signal from single grains of quartz. As the latter mineral has proven problematic for luminescence dating across large parts of East Africa, the post-IR IRSL emissions from multigrain aliquots of K-feldspar offer a potential means to obtain reliable, fading-corrected ages for archaeological and other deposits that have been sufficiently bleached by sunlight before deposition and not disturbed afterwards by mixing processes.

*Keywords***:** Feldspars, post-IR IRSL, Tanzania, archaeological dating

References:

Thomsen, K.J., Murray, A.S., Jain, M., Bøtter-Jensen, L., 2008. Laboratory fading rates of various luminescence signals from feldspar-rich sediment extracts. *Radiation Measurements* 43, 1474-1486.

Buylaert, J.P., Murray, A.S., Thomsen, K.J., Jain, M., 2009. Testing the potential of an elevated temperature IRSL signal from K-feldspar. *Radiation Measurements* 44, 560-565.

A study of the relationship between IRSL and BLSL for K-feldspar from sediments

Z. Gong, B. Li, S-H Li*

Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China

*Corresponding author: shli@hku.hk

In luminescence measurement of K-feldspar, both infrared (IR) and blue light could be used as stimulation sources. The relationship between the IR stimulated luminescence (IRSL) and blue light stimulated luminescence (BLSL) was investigated using a range of stimulation temperatures from 60 °C to 200 °C, in order to explore the sources of luminescence signals from K-feldspar. Component analysis suggests that the BLSL measured at 60 °C from K-feldspar can be fitted using three components, namely fast, medium and slow components. The relationship between IRSL and the different components of BLSL were investigated using following sets of experiments.

1) Post-IR BLSL experiments:

It was observed that 96% of the fast component and 91% of medium components of BLSL could be bleached by IR stimulation for 5000 s at 60°C, but there was only a reduction of 12% in the slow component. These results suggest that sources for IRSL at 60°C are mainly associated with fast and medium components of BLSL at 60°C.

2) Post-blue IRSL experiments:

It was observed that the IRSL at 60 °C can be bleached to a negligible level (~1%) by blue light stimulation at 60 °C for 80 s. It is indicated that the source traps of IRSL measured at low temperature (60 °C) is a subset of the source traps of BLSL measured at 60 °C.

3) Post-blue IRSL at elevate temperatures

For the post-blue IRSL at 200°C, 10% of its initial signal was remaining after the blue light bleaching at 60 °C for 80 seconds. Such post-blue IRSL signal is more thermally stable than both the 60°C and 200°C IRSL signals, as shown by pulse annealing studies. These results indicate that at least two groups of trap populations are involved in the IRSL signals at elevated temperature (200°C). One group of traps is relatively easier to be bleached by blue light and has less thermal stability. The others are hard-to-bleach by blue light but have higher thermal stability.

Ionization efficiencies alanine dosimeters and tooth enamel exposed to gamma and X-ray irradiators

R. Grün[1*], R. Mahat[1,2]

[1]Research School of Earth Sciences, The Australian National University, Canberra ACT 0200, Australia
[2]Department of Physics, University of Malaya, 50603 Kuala Lumpur, Malaysia

* *Corresponding author:* Rainer.Grun@anu.edu.au

With increasing occupational health and safety concerns about of radioactive materials, more and more Cs and Co gamma irradiators are replaced by X-ray sources, as these do not contain any radioactive substances. This happened at ANU where first a cobalt source was decommissioned, followed by the cesium source. A new X-ray irradiator was cross-calibrated to the previously used Cs source using alanine dosimeters. These were also originally used to calibrate the Co and Cs sources. The alanine results for the X-ray source were comparable to independently carried out Fricke dosimetry. However, when using the X-ray source for D_e estimations on fossil teeth, the estimated doses resulted in ridiculously young ages. It turned out that the X-ray ionisation efficiency of tooth enamel is about five times higher than expected from the alanine response. Furthermore, the X-ray responses of enamel samples of very similar age and Cs D_e values are quite different. These complications not only have implications for the use of X-ray sources for ESR dating of tooth enamel, but also for dose rate calculations which are based on the assumption that the ionisation response is strictly dose dependent. One would expect that similar considerations apply to beta rays.

Ages of Bronze age Xindian Culture in Erfang section in Lajia of the northeastern edge of Tibetan Plateau and their palaeoenvironmental implications

H. Guangliang [1], Z.P. Lai[1,2,*], Y.J. Sun[2, 3]

[1] Key Laboratory of Qinghai-Tibetan Plateau Environment and Resource, MOE, School of Life and Geographic Science, Qinghai Normal University, Wusi Road, XiNing 810008, China
[2] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, 18 XinNing Road, XiNing 810008, China (*Email: zplai@isl.ac.cn)
[3] Graduate School of Chinese Academy of Sciences, Beijing 100049, China

* *Corresponding author:* zplai@isl.ac.cn

The well-known Lajia archaeological site was situated in the Guanting Basin in the northeastern edge of the Tibetan Plateau, and located in the second terrace of the Yellow River. The excavation of the Lajia site started in 1999. More than twenty human skeletons were found within an area of about 100 square meters. In a house of about 15 square meters there were fourteen skeletons with two adults trying to protect twelve children. They were all buried in a sudden in-situ. The Lajia site recorded a prehistoric natural disaster, whose reason was thought to be a combination of earthquake and flooding due to the collapse of a slide-dammed lake in the Yellow River. The world oldest millet noodle was found in this site and were dated by AMS 14C to be at ca. 4000 yr BP (Lu, H.Y., Yang, X.Y., Ye, M.L., Liu, K.B., Xia, Z.K., X.Y., Cai, L.H., Wu, N.Q., Liu, D.S., 2005. Millet noodles in Late Neolithic China. Nature 437: 967-968.). The noodle was covered by a bowl when the disaster occurred and its age represented the time of the disaster. The Lajia site was abandoned by the prehistoric people after the disaster, and was then re-inhabited at about 1400 BC by the people of Xindian Culture (1400-700 BC). Erfang site is a representative of Xindian Culture and is located in the east edge of the Guanting basin. The excavation of the Xindian Culture is intensive, however, the chronological data is still very limited and no luminescence dating data has been reported by far. In the current study, both OSL and AMS 14C dating (using charcoals) are applied to samples from Erfang archaeological site. The chronology will be presented and the inference for archaeology will be discussed.

Keywords: Luminescence and radiocarbon dating; Archaeological Erfang site; Xindian Culture; Guangting Basin;.Tibetan Plateau

OSL sensitivity of quartz: definition and geological significance based on Brazilian sediments

C.C F. Guedes[1*], A.O. Sawakuchi[1], R. DeWitt[2], P.C.F. Giannini[1], V.R. Mendes[1], A Zular[1]

[1]Departamento de Geologia Sedimentar e Ambiental, Instituto de Geociências, Universidade de São Paulo, Rua do Lago, 562, São Paulo-SP, Brazil - 05508-080 (ccfguedes@yahoo.com.br).
[2]Radiation Dosimetry Laboratory, Department of Physics, Oklahoma State University, 1110 South Innovation Way Drive, Stillwater, OK 74074, USA.

* *Corresponding author:* ccfguedes@yahoo.com.br

The OSL sensitivity of quartz is influenced by the parent rock and is known to change during sedimentary reworking. Therefore quartz OSL sensitivity can be used for geologic studies of quartz provenance and sediment transport. However, in recent publications there is no uniform definition of the term "sensitivity." Differences in measurement techniques (e.g. stimulation power) and signal determination (e.g. integration intervals, normalization dose) make the comparison between studies very difficult. In this work we propose a standardization of the OSL sensitivity determination. We also explore the geological meaning of the OSL sensitivity variation of quartz sand aliquots using 35 samples from two different areas in Brazil (Santa Catarina State and Maranhão State) of mainly fine and very fine quartz rich sand from Pleistocene and Holocene stabilized costal dunes and marine deposits. Measurements obtained as part of the SAR dating procedure were applied to determine the sensitivity with the purpose to minimize measurement time and use more aliquots per sample. The natural dose signal was not utilized in order to avoid the exponential part of the dose-response curve and the underestimation of the OSL sensitivity for samples with higher natural doses. To minimize sensitivity changes due to laboratory procedures, we evaluated the calculation of the natural sensitivity using the signal of the first test dose, after the natural signal, and the first dose applied to obtain the dose-response curve. Four different signals were calculated and compared for each aliquot. The signals were estimated using the first 2s (fast component dominated) and the total signal from the first regeneration dose (maximum of 10Gy) of the dose-response and the signal from the first test dose (maximum 20Gy). The calculated signal was normalized to 1Gy by linear interpolation. For samples with high natural doses the test dose used during the SAR-procedure (up to 20Gy) might already exceed the linear range of the dose response. Consequently the interpolation to 1Gy shows a tendency to underestimate the OSL sensitivity. The maximum values of the first regeneration dose did not exceed 10Gy, at which point the dose-response curve is still expected to be linear. The OSL signal also depends on the volume of quartz (number and size of grains), power of laser stimulation and efficiency of the photomultiplier. In order to eliminate the influence of the equipment on the OSL signal we propose normalization by measuring a standard (Al_2O_3) with the same volume and grain-size as the sediment aliquots (in our case 120-150 μm, ~400 grains). Sample sensitivity was calculated using the equation $\delta S=((Ss/Sa)-1)*100$, where Ss is the signal of the sample normalized to 1Gy and Sa is the signal of the Al_2O_3 standard normalized to 10 mGy. With the purpose to standardize the OSL sensitivity measurement, the following examples used the integral signal of the first regeneration dose and the values were normalized by the Al_2O_3 standard, which has the advantage of eliminating the influence of the stimulation power of the laser or LED. We notice a great difference in the measured OSL sensitivities from the two locations. Samples from the Santa Catarina area are one order of magnitude more sensitive than the samples from Maranhão despite a similar depositional context (mainly eolian dunes). The regional context (e.g. source area, climate, depositional history) apparently has a larger influence on OSL sensitivity than the last depositional context.

Beyond the superposition theorem: the effects of local environment on grain size beta dose correction factors.

G. Guérin*,[1], N. Mercier[1], R. Nathan[2]

[1] IRAMAT-CRPAA, UMR 5060 University of Bordeaux-CNRS, Esplanade des Antilles, Maison de l'Archéologie, F-33607 Pessac cedex, France (* *Corresponding author ; Email :guillaume.guerin@u-bordeaux3.fr)*
[2] CRUK/MRC Gray Institute for Radiation Oncology and Biology, University of Oxford, Old Road Campus Research Building, Oxford, OX3 7DG, United Kingdom.

** Corresponding author: guillaume.guerin@u-bordeaux3.fr*

Grain size is an important factor in assessing dose-rate in the framework of luminescence dating studies. External beta dose-rates are progressively reduced as the grain size is increased and tabulated correction values have been proposed by Mejdahl (1979), Fain *et al.* (1999) and Brennan (2003). All these studies are based on the superposition theorem (Aitken, 1985), which stipulates that the absorbed external dose-rate fraction can be inferred from the self dose fraction absorbed by a grain due its own radioactivity due to radiation equilibrium. However, the underlying assumption that the superposition theorem is valid in real-world sediments has not been investigated.
Heterogeneous sediments, in terms of source and material non-uniformity, were explored at high spatial resolution using Monte Carlo simulations (Geant4). The effect of the environment of the grains is taken into account: it is shown that grain shape, dimensions and composition are not sufficient to derive accurate beta dose attenuation factors. It was found such misevaluations result in errors to the determined ages of up to 10%.We suggest a range of case studies where it becomes necessary to characterize samples at a micromorphological scale to assess external beta dose-rates to sedimentary grains.

References

Aitken, M. J. (1985). *Thermoluminescence dating.* Academic Press, London.
Brennan, B. J. 2003. Beta doses to spherical grains. *Radiation Measurements,* 37, 299-303.
Fain, J., Soumana, S., Montret, M., Miallier, D., Pilleyre, T. & Sanzelle, S. 1999. Luminescence and ESR dating: Beta-dose attenuation for various grain shapes calculated by a Monte-Carlo method. *Quaternary Geochronology,* 18, 231-234.
Mejdahl, V. 1979. Thermoluminesce dating: beta-dose attenuation in quartz grains. *Archaeometry,* 21, 61-72.

Current challenges in Luminescence dating applied to building archaeology

P. Guibert[1*], I .K.Bailiff[2], S. Blain[1], A. Bouvier[1], A. Gueli[3], M. Martini[4], E. Sibilia[4], G. Stella[3], S. O. Troja[3]

[1]CNRS-Universite de Bordeaux 3, UMR 5060, Institut de Recherche sur les Archéomatériaux (IRAMAT-CRP2A), Maison de l'Archéologie, F-33607 Pessac, France
[2]University of Durham, Department of Archaeology, Luminescence Laboratory, South Road, Durham, DH1 3LE, UK
[3] PH3DRA laboratory, Department of Physics and Astronomy, Centro Siciliano di Fisica Nucleare e di Struttura della Materia, Università di Catania & INFN Sezione di Catania, via Santa Sofia 64, I-95123 Catania, Italy
[4] INFN and CUDaM, Università di Milano Bicocca, via R. Cozzi 53, I-20125 Milano, Italy

** Corresponding author: guibert@u-bordeaux3.fr*

Within the framework of the GdRE (European Research Group supported by the CNRS) entitled "*Ceramic Building Materials and new dating methods*", luminescence dating has been carried out in conjunction with archaeological and historical analyses and other dating methods (archaeomagnetism on bricks and radiocarbon on charcoals found in mortar) on a corpus of 25 key sites of the early medieval period (C5th to the C11th A.D.) in France and South-East England. The main archaeological objective of the group (Bordeaux, Durham, Milan, Catania) is to improve our understanding of the evolution of architecture and the use of building materials from late Antiquity to the Romanesque period. Among the topics relevant to chronology that are being addressed by this multidisciplinary study include: i) the production of bricks *ad novo*, or reuse from Gallo-Roman or Romano-British production (*spolia*), ii) re-examining the chronology of building or architectural structures established by art historians on the basis of stylistic criteria.

Although Roman bricks were frequently reused in early medieval buildings in England and Normandy until the 11th century, no general rule appears to apply and the medieval production of bricks has been confirmed in many places (e.g., Mont Saint Michel, St Philbert de Grandlieu, St Martin d'Angers, St Martin of Tours at Chipping Ongar). For those sites, luminescence dating has produced direct chronological information that in some cases confirms and clarifies the expected chronology based on stylistic dating, and in some other cases indicates that a revision is necessary (e.g., luminescence dates indicate that St Martin of Angers is ca. 150 years older than presumed).

From a methodological perspective, the GdRE has studied general problems of luminescence dating by means of intercomparison experiments. In particular, discrepancies have been observed between the results of polymineral fine grain and quartz inclusion paleodose estimates irrespective of the method used (TL or OSL). In some cases, quartz ages were significantly older than the fine grain dates, even after correction for fading. However in other cases there was also evidence for age overestimation using quartz, and we have linked this to the presence of significant concentrations of U and Th in quartz grains requiring an increase in the dose rate due to an internal grain contribution. In addition to these technical issues, the reuse of Roman building materials in medieval construction presents a potential problem regarding the dating of construction. This issue is being examined by experiments with mortar dating and brick surface dating, the preliminary results from which we report in this paper. Despite some notable successes our multi-laboratory comparisons continue to reveal the need for significant improvements in methodology if higher precision is to be consistently and reliably obtained when applying luminescence to the dating of ceramic elements of medieval buildings.

Luminescence dating of the Yellow River terraces in the Hukou area, China

Y.-J. Guo[1], W.-L. Qiu[2], G. Hu[1], L.-P. Zhou[1], J.-F. Zhang[1]*

[1]MOE Laboratory for Earth Surface Processes, College of Urban and Environmental Sciences, Peking University, Beijing 100871, China
[2]School of Geography, Beijing Normal University, Beijing 100875, China.

. *Corresponding author: jfzhang@pku.edu.cn

Previous studies on the evolutionary history of the Yellow River, the second largest river in the world in terms of sediment discharge, have mainly focused on the evidences of the geology and geomorphology for lacking of a reliable chronological framework for the fluvial sequences. In this study deposits from the strath terraces of the Yellow River in the Hukou area in the middle reaches of the Yellow River were dated using luminescence techniques. In the field four terraces (T1 to the highest terrace T4) and a newly formed terrace (T0) due to knickpoint retreat were recognized. The terrace deposits for T3 and T4 consist of gravel, floodplain silt and loess. Floodplain and loess samples were taken for optical dating. The optical ages of the loess samples were used for evaluate the reliability of the dating results of the floodplain samples. The optical ages of the floodplain sediments are considered as the formation age of strath terrace. In the laboratory, Coarse (90-125 μm for floodplain samples) and middle (45-63 μm for loess samples) quartz grains were extracted from all the samples and used for equivalent dose (De) measurements using the single-aliquot regenerative-dose (SAR) protocol. Preheat plateau tests and dose recovery tests were performed to observe their luminescence behaviors. The results showed that these quartz extracts are suitable for measurement using the SAR protocol; the De values are independent of temperature over the range of (200-280°C), and the given doses were well recovered. A preheat of 200°C for 10 s was then used for De measurements on all samples. The dating results show that the T0 terrace is 7.7±0.5 ka old. The T1 and T2 terraces, on which the Longwanchan paleolithic site were found, on the west bank of the river were dated to ~30 and ~50 ka, respectively. For the T3 terrace, samples from two sections located on the west and east banks of the river were dated. The two floodplain samples from T3 on the east bank were dated to 114.2±10.6 and 99.8±8.4 ka, respectively, and the overlying loess sample to 90.6±6.7 ka. They are in stratigraphical order. The optical ages of the two floodplain samples from T3 on the west bank are 83.5±5.4 and 90.9±7.7 ka, respectively, and the ages of the two overlying loess samples are 20.3±2.0 and 74.4±4.4 ka. The loess sample with the age of 20.3±2.0 ka was collected from a hill-slope, and therefore we infer that this sample may be slope-wash deposits. For the highest terrace (T4), the two floodplain samples were dated to ~119 and ~125 ka, respectively, and the two overlying loess samples to ~128 and ~66 ka. The ages of these four samples are in stratigraphical order, and their OSL dose-response curves appear not be in saturation, but the evolution of the Yellow River terraces indicates that these ages may be underestimated. Based on the heights of strath surface and the OSL ages, the average incision rates of the river were calculated to be ~0.40 m/ka

Keywords: Luminescence dating, river terraces, the Yellow River, incision rate

On the infrared-stimulated luminescence in quartz

B. Guralnik[1,*], C. Ankjærgaard[2,3], M. Jain[2], A. Murray[2], F. Herman[1]

[1] Department of Earth Sciences, ETH, 8092 Zurich, Switzerland
[2] Radiation Research Division, Risø National Laboratory for Sustainable Energy, DTU, Denmark
[3] Netherlands Centre for Luminescence Dating, Technical University of Delft, The Netherlands

** Corresponding author:* benny.guralnik@gmail.com

It is not uncommon to find quartz with a fast-decaying IRSL signal which cannot be removed by standard laboratory chemical treatments. Even the reference quartz sample WIDG8 (Wintle and Murray, 1997), used in the development of the Single-Aliquot Regenerative-Dose (SAR) protocol, shows a significant IRSL decay at room temperature, although this is small compared to the blue light stimulated luminescence. Generally, such IRSL from quartz is ascribed to discrete mineral inclusions of feldspar; however, this assumption has not been tested thoroughly. Understanding the origins and the dosimetric potential of the IRSL signal in quartz grains is especially important for dating young sedimentary provinces (around rapidly uplifting mountain belts), for OSL thermochronometry and surface exposure dating; such quartz often shows a significant IRSL signal but the fast (blue-stimulated) OSL component tends to be either absent or poorly sensitized.

Due to the exceptionally strong Si–O bonds, quartz is one of the purest natural mineral phases, incorporating only small amounts of 'foreign' elements into its crystal lattice. The ions Al^{3+}, Na^{+} and K^{+}, which are also the main constituents of feldspar, can exist as true structural impurities in the quartz lattice (Flem et al., 2002). The question is whether IR-sensitive quartz has discrete feldspar inclusions, or whether nanoscale structures (clusters) of feldspar-like constituents are sufficient to produce a detectable IRSL signal. Even if randomly distributed, these impurities could also act as donors in the quartz lattice with a high cross-section for IR.

Here we present the various OSL characteristics in single and multiple grain aliquots of WIDG8, and combine these luminescence observations with geochemical analyses using laser ablation ICP-MS. We use time-resolved (TR) measurements to distinguish between the IRSL signal from the quartz fast component, and the 'contaminating' IRSL. The TR-IRSL has a slow decay typical of quartz (30–45 μs lifetime) and a fast decay (< 2 μs) typical of feldspar and other minerals (Jain et al. 2006; Ankjærgaard et al., 2010). However, we present data that show that other potential inclusions (zircon [$ZrSiO_4$], kyanite [Al_2SiO_5]) have very similar IRSL characteristics, and must be considered as equally likely candidates; clusters of Al within the quartz lattice may exhibit kyanite-like behaviour. We examine these different possibilities by comparing geochemical analysis with luminescence behaviour.

Keywords: Quartz, IR stimulateon, TR-OSL, Kyanite, micro-inclusions, feldspar

References

Ankjærgaard, C., Jain, M., Thomsen, K.J., Murray, A.S., 2010. Radiat. Meas. 45, 778-785
Flem, B., Larsen, R.B., Grimstvedt, A., Mansfeld, J., 2002. Chemical Geology 182, 237–247
Jain, M., Andersen, C.E., Bøtter-Jensen, L., Murray, A.S., Haack, H., Bridges, J.C., 2006. Radiat. Meas. 41, 755–761
Lapp, T., Jain, M., Ankjærgaard, C., Pirzel, L., 2009. Radiat. Meas. 44, 571–5
Wintle A.G., Murray A.S., 1997. Radiat. Meas. 27, 611–24

Preliminary dating results of Longgupo site in China by the combined ESR-U series methods

F. Han [1,2*], J.-J. Bahain[2], C. Falguères[2], É. Boëda[3,4,5], H. Yamei[4,5], H. Wanbo[4,6], T. Garcia[7], Y. Gongming[1], L. Chunru[1]

[1] State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China (hanfei64@hotmail.com)
[2] Departement de Prehistoire Muséum National d'Histoire Naturelle, UMR7194 du CNRS, 1, rue René Panhard 75013, Paris, France (bahain@mnhn.fr)
[3] UMR 7041 CNRS ArSCAN, équipe AnTET, université Paris Ouest–Nanterre La Défense, 21, allée de l'Université, 92023 Nanterre cedex, France (eric.boeda@gmail.com)
[4] Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, No. 142, Xizhimenwai Street, Beijing 100044, PR China (houyamei@ivpp.ac.cn)
[5] Joint Laboratory of Human Evolution and Archaeometry, Chinese Academy of Sciences, Beijing 100044
[6] Chongqing Three Gorges Institute of Paleoanthropology, China Three Gorges Museum, Chongqing 400015, PR China (huangwanbo@sina.com)
[7] CEA, LIST, Laboratoire National Henri Becquerel, Gif-sur-Yvette, F-91191, France (garcia@cea.fr)

* *Corresponding author:* hanfei64@hotmail.com

Longgupo Cave site, located in Wushan County, Chongqing, China has attracted recent attention because of the discovery of a upper incisor and a mandible fragment that were attributed to *Homo* in association with late Pliocene-Early Pleistocene fauna and numerous lithic artefacts. In 2006, Chinese-French joint excavation was carried out on this site, and detailed stratigraphy of the highly complex cave infillings was described (Boëda *et al.*, 2011). Here we report our preliminary dating results of seven herbivorous fossil teeth from different archaeological layers of the lowest unit C III of the sequence by combined ESR-U series methods. Uranium-series analysis shows that no obvious uranium leaching has occurred, and all the teeth underwent a very recent uranium uptake history except one. Three teeth collected from layer C III'5 to the base of C III'6 of the north wall, ranging between 1.5 to 2.6 Ma according with the sequence basically. However, the results of four teeth from the south wall of the site present an inverse correlation with the stratigraphical sequence, which is dated from 2.3 to 1.1 Ma. This is probably caused by measured *in situ* dose rate, which may not represent the mean past value and increased during the history. This also raises the possibility that it was an undetected intrusion from a higher part of the deposit.

Keywords : Longgupo site, China, ESR-U series methods, fossil tooth, Pleistocene

Thermoluminescence color image analysis of sediments from Lake Hovsgol, Mongolia, and its potential to investigate paleoenvironmental change

A. Inagaki[1], N. Hasebe[2*], N. Endo[3], K.Ito[2], K. Kashiwaya[2]

[1] Graduate School of Natural Science and Technology, Kanazawa University
[2] Institute of Nature and Environmental Technology, Kanazawa University
[3] Collage of Science and Engineering, Kanazawa University

* *Corresponding author:* hasebe@kenroku.kanazawa-u.ac.jp

The seasonal climate differences in continental interior are very intense due to the heat balance. Lake Hovsgol in Baikal Rift Zone is located on high plateau of Mongolia and has a small water catchment, which make the lake sensitive to insolation. The sediments of Lake Hovsgol record paleoclimate change in good condition because it has only one outlet at its south end, Egiin river, without influence of human activity.

A lot of proxies in core samples (e.g. diatoms, mineral particle size, biogenic SiO2, pollens, trace elements) have been considered for reconstructing paleoclimate. In this study, thermoluminescence color image (TLCI) analysis is applied to continuous lake sediments core (HDP-04) to see what kinds of information can be extracted from TLCIs.

TLCIs were recorded by digital camera and the RGB information of each color pixel was converted into numerical information to plot on CIE (Commission Internationale de l'Eclairoge) chromaticity diagram. Number of pixels within a color zone (five color zones were defined in this study) was counted for statistical color analyses. Twelve images were investigated for each aliquot.

TLCI analytical results for Lake Hovsgol sediments are;

1) TLCIs showed poor reproducibility (large standard deviations in emission intensities) among twelve aliquots on the same samples, therefore, the average was calculated by removing the highest and the lowest aliquots in the emission intensity.

2) The emission intensity of TLCI varies along the core depth. The amount of HCl-soluble-material showed similar fluctuation and the color pixel points on CIE chromaticity diagram fell in the same region with those for calcium carbonate from catchment area, indicating that major source of luminescence is from calcium carbonate.

3) When TLCIs were investigated after grain size separation, the emission intensities of coarse samples were higher than that of fine samples.

4) A small number of color pixels were found on blue-purple region apart from main cluster of pixels in the CIE diagrams for fine (aeolian) particles.

5) The emission intensity is not a direct indicator of glaciation or insolation cycles except for several events, in which both of the emission intensity and the rate of red emission were decreased.

Based on above observations, we can conclude that TLCI fluctuates as a function of the amount of HCl-soluble-material, grain size, and unknown factors. TLCI has a possibility to extract information for aeolian component in lake sediments. To characterise sample TLCI, more suitable color threshold on CIE chromaticity diagram can be proposed.

New findings concerning quartz properties important for luminescence dating of sediments in the Swiss NW Alpine foreland.

A. Heer[1*], H. Veit[1], M. D. Bateman[2], G. Adamiec[3], I. Hajdas[4], J.-H. May[5]

[1]Geographisches Institut, Universität Bern, Hallerstrasse 12, 3012 Bern, Switzerland, heer@giub.unibe.ch*
[2]Department of Geography, University of Sheffield, Sheffield S10 2TN, United Kingdom
[3]Institute of Physics, Silesian University of Technology, ul. Krzywoustego 4, 44-100 Gliwice, Poland
[4]IBP, SFIT (ETH Zürich), Schafmattstrasse 20, 8093 Zürich, Switzerland
[5]SEES, University of Wollongong, Wollongong, NSW 2522, Australia

* *Corresponding author:* heer@giub.unibe.ch

Application of the Optically Stimulated Luminescence (OSL) and radiocarbon dating, with the aim of establishing the chronology of postglacial lake shore deposits from Grosses Moos (Swiss NW Alpine foreland), showed that the dimness of the sedimentary quartz and resultant poor counting statistics, required the use of large multi-grain aliquots for determining the equivalent doses. This is contrary to the common practice of using small aliquots or single grain luminescence measurements for sediments with complex depositional histories. L_x/T_x tests conducted at the single quartz grain (SG) level revealed that an extremely low proportion (0.5%) of bright grains were dominating the luminescence signal with the remainder being very dim and contributing little to the total signal. Thus large aliquots are equivalent to small aliquots of samples containing a larger proportion of bright grains.
The presence of lots of dim quartz also has implications for the statistical analysis applied to equivalent doses (D_e) replicates when trying to determine an age. Low overdispersion (OD) calculated for D_e replicates and a large number of SAR OSL measurements were required in order to also gain a representative number of bright grains and so reproducible results. The number of aliquots measured, but not their size was decisive for the resulting OD. The OD values obtained from the dose recovery experiments (formerly used as the arbitral σ_b when modelling age estimates) in fact reflected the OD of the photomultiplier tube (PMT) related to the average luminescence intensity (σ_{PMT}). Thus these OD values should not be further used for modelling purposes. For dim quartz data the additional OD (σ_b) value loses its physical importance of being an expression of microdosimetry, beta source inhomogeneity, crystallographic variability or complexity of environmental processes, because large standard errors obscure this information.
In the littoral sediments of Grosses Moos major D_e distributions dominated by a well bleached component with minor contributions from bioturbated and incompletely bleached sediment were anticipated. Because weighted models (e.g. Central Age Model: CAM, Minimum Age Model: MAM and Finite Mixture Model: FMM) favour D_e values resulting from sensitive grains, the final results are at least based on a small number of bright grains, thereby approaching results of modelling SG measurements. Model comparison showed that the FMM results surpass these of the MAM3 and CAM by yielding most consistent D_e values supported by radiocarbon dates.

Keywords: NW Alpine foreland, overdispersion, dim quartz, OSL dating, age modelling, radiocarbon

OSL as a new tool in low-temperature thermochronometry

F. Herman[1,*], B. Guralnik[1], C. Ankjærgaard[2,3], A. Murray[2], M. Jain[2], F. Preusser[4], S. Lowick[5], E. Rhodes[6]

[1] Department of Earth Sciences, ETH, 8092 Zurich, Switzerland
[2] Radiation Research Division, Risø National Laboratory for Sustainable Energy, DTU, Denmark
[3] Netherlands Centre for Luminescence Dating, Technical University of Delft, The Netherlands
[4] Dept. of Physical Geography and Quaternary Geology, Stockholm University, 10691 Stockholm, Sweden
[5] Institute of Geological Sciences, University of Bern, Baltzerstrasse 1+3, 3012, Switzerland
[6] Department of Earth and Space Sciences, UCLA, Los Angeles, CA 90095-1567, USA

* *Corresponding author:* frederic@erdw.ethz.ch

Utilizing the fact that temperature exerts a strong control on the retention times of radiogenic products at their production sites, thermochronometry is an extension of geochronometry focused on dating the cooling events of rocks below certain temperatures of interest. The existing variety of thermochronometeric methods covers a range of "closure temperatures" (T_c, the approximated temperature of the rock at a time corresponding to the apparent age of the radiogenic system in question, assuming a constant cooling rate; Dodson, 1973) from above 750°C (U-Pb in Zircon) down to ~70°C (U-Th/He in Apatite), assuming cooling rates of 10°C/Ma. Attempts to reconstruct landscape change in rapidly exhuming terrains, or to quantify the imprint of glacial cycles on high mountainous relief, have clearly demonstrated an acute necessity in thermochronometric systems of even lower closure temperatures, to allow tracing rapid relief change histories on short (<Ma) timescales.

Trapped charge in a crystal's lattice due to the ambient ionizing radiations (alpha, beta, gamma, cosmic) provides a great potential for a thermochronometric system (e.g. Grün et al., 1999; Herman et al., 2010), whose closure temperature (apart from the inherent dependency on the cooling rate) would only be a function of the kinetic parameters (activation energy, *E*, and frequency factor, *s*) of the trap to be measured.

We analyzed the luminescence signals of different minerals (e.g. quartz, feldspar, zircon, kyanite) in eleven bedrock core samples (depth range of 0.5 – 2.4 km, representing infinite holding temperatures of 22°C – 71°C, respectively), retrieved from the KTB-VB deep scientific drilling (Southern Germany), where long-term stable temperature conditions provide a natural isothermal holding experiment at a Ma-timescale. Here we report results from an unbleached feldspar fraction of 180–250 µm whose natural and regenerated luminescence signals were measured with IR LED's (830 nm) at 50°C followed by 290°C (pIRIR290), using a single-aliquot regeneration (SAR) protocol. The natural signals vary from near dose-response saturation at shallow depths to almost totally reset signals below a depth of 1 km (i.e., ambient rock temperature higher than 40°C). Negligible anomalous fading rate is supported both by near saturation natural signals and by further laboratory experiments. Isothermal experiments confirm an estimated closure temperature below 30°C; this is consistent with the closure temperature estimated usning *E* and *s* values for IRSL 50°C of Murray et al. (2009). These results are important towards developing a low-temperature thermochronometric system for geomorphological research.

Keywords: Low-temperature thermochronometry, OSL, IRSL, isothermal holding, pIRIR290

References

Dodson M.H., 1973. Contrib. Mineral. Petrol. 40, 259–274.
Grün, R., Tani, A., Gurbanov, A., Koshchug, D., Williams, I., Braun, J., 1999. J. Geophys. Res. 104, 17531–17549.
Herman, F., Rhodes, E.J., Braun, J. Heiniger, L., 2010. Earth Planet. Sci. Lett. 297, 183–189.
Murray, A.S., Buylaert, J.P., Thomsen, K.J., Jain, M., 2009. Radiat. Meas. 44, 554–559.

TT-OSL dating: an attempt to overcome SAR problems

M. Hernandez*, N. Mercier

IRAMAT-CRP2A (UMR5060) - University of Bordeaux - Maison de l'Archéologie, Esplanade des Antilles, 33607 Pessac cedex

* *Corresponding author:* hernandez-marion@hotmail.fr

One of the major challenges in OSL dating is to go beyond the age range currently limited by the saturation dose level of the quartz fast component signal widely used.
Recent methodological studies have demonstrated the ability of the TT-OSL signal to determine very high natural doses. In 2006, Wang *et al.* published the first results obtained on fine quartz grains from Chinese loess deposits for which the age was controlled by the Brunhes-Matuyama geomagnetic boundary at 0.78 Ma. In this study, a multiple aliquots protocol was performed to determine the equivalent dose.
Since then, several studies investigated the use of a Single Aliquot Regeneration protocol for TT-OSL alike those developed by Murray and Wintle (2000) for OSL signal. However, many problems were outlined such as poor recycling ratios and non zeroing intensity of the TT-OSL after a SAR cycle.
In this study, we present our investigations on the bleaching of the TT-OSL signal using different kinds of stimulation: UV, solar spectrum, heat. Regarding those results, different SAR protocols were tested and, for each of them, we discuss their limits. Finally, we propose a new broadly-applicable protocol based on a regenerative process allowing for build a growth curve in using multiple aliquots. This approach circumvents the problems induced by SAR, for which no reliable and widely applicable solution was found. Moreover, it is possible to plot in the growth curve numerous natural TT-OSL signals, and thus, get so much equivalent doses.
All those experiments were performed on samples from different South Western French sites.

Keywords : TT-OSL dating, quartz, bleach, SAR

OSL Dating of Gem-Bearing Alluvial Sections of Sri Lanka

T. Hewawasam[1*], P. Bishop[1], T. Kinnaird[2], D. Sanderson[2]

[1]School of Geographical and Earth Sciences, University of Glasgow, G12 8QQ, Glasgow, UK
[2]Scottish Universities Environmental Research Centre, Technology Park, East Kilbride, G75 0QF, UK.

* *Corresponding author:* tilak@sab.ac.lk

Sri Lanka has long been known for a rich diversity of gemstones in alluvial sections in broad river valleys at the bottom of the Central Highlands, but their absolute age of deposition is hitherto unknown. The gem-bearing gravel layers, enriched in heavy minerals and quartz pebbles/cobbles, are mostly found immediately above weathered rock. Overlying sedimentary materials have marked stratigraphy, consisting of several layers of varied composition and particle size. The alluvial sections show average thicknesses of about 7m over the region, extending in some sections to 20m or more. Previous palaeontological studies have suggested that these sections are of Quaternary age. The alluvial sections were derived from high-relief areas (composed of crystalline metamorphic rocks) in the Central Highlands containing residual and colluvium covers produced by slow hill-slope erosion processes (at rates of 20-40 mm/ky as derived by cosmogenic nuclides) and subsequent fluvial processes. Also, some of the alluvial fills consist of material derived from abrupt and episodic events such as landslides and flooding in periods of intensified monsoonal activity. Hence the erosion, transportation and deposition processes responsible for the sediments reflect the region's environmental history. Therefore, dating the alluvial layers, and relating their sedimentation rates and compositional variation across the stratigraphy, will enhance our knowledge and understanding of the environmental history of this tropical region as well as constraining the formation age of these important gem-bearing deposits.

In this study, OSL profiles were constructed for seven alluvial sections from two field campaigns in October 2010 and February 2011 in Sri Lanka, using the SUERC OSL portable reader. Twenty-one samples from two alluvial sections (Pelmadulla (7.5m thick) and Ganegama (4.7m thick)) were prepared for luminescence profiling in the laboratory, by separating the polymineral and quartz-rich fractions from small samples. Detailed dating analyses were also carried out on six tube samples, three from each section, collected from the top and middle of the alluvial fill and from the basal gem-bearing gravel layer. The SAR protocol was used to measure the luminescence in quartz grains and dose rates were calculated by beta and gamma spectrometry.

Laboratory profiling of the upper alluvial fills in the Pelmadulla and Ganegama sections yield apparent stored doses of between 2 and 20 Gy. In contrast, high stored doses were measured in the basal fill and gem-bearing gravel layer, ranging from 15 to 75 Gy. This remarkable difference in stored doses implies one or more depositional breaks in the sedimentary sequence. Detailed age determinations in the gem-bearing gravel layers give ages of 10ky and 9ky for the Pelmadulla and Ganegama sections, respectively. Overlying fills from both sections produced young depositional ages of 200-600y. Thus, the gem-bearing layers at the base of the sections are evidently older, with Late Pleistocene to Early Holocene ages. The overlying fills appear to have been rapidly deposited, more recently, probably by flushing of pre-existing material through the system during intensified climatic events. Our finding of recent rapid sedimentation in the inland river basins is supported by the minimum deposition along the Southern Coast of Sri Lanka over the last 4ky, as revealed by radiocarbon studies. The presentation describes these findings, which to our knowledge, provide the first absolute chronology for these Sri Lankan gem-bearing sediments.

Testing spatially resolved luminescence measurements for dose determination in individual quartz grains

A. Hilgers[1*], M. Krbetschek[2,3], D. Mittelstrass[2], C. Schmidt[1], C. Burow[1], K. Dornich[2]

[1]University of Cologne, Institute for Geography, Albertus-Magnus-Platz, D-50923 Cologne (a.hilgers@uni-koeln.de)
[2]Freiberg Instruments, Am St. Niclas Schacht 13, D-09599 Freiberg
[3]Institute of Applied Physics, TU Bergakademie Freiberg, Leipziger-Str. 23 , 09596 Freiberg, Germany

* *Corresponding author:* a.hilgers@uni-koeln.de

In luminescence dating the determination of burial doses on a grain-by-grain basis is preferable compared to multi-grain analysis. Measuring individual grains is vital to identify the 'true' dose in problematic samples such as heterogeneously dosed or bleached samples, or in sediments which where intermixed after deposition. Furthermore, sediments such as found in limestone caves often contain just very little amounts of sand-sized quartz grains. Here, a sound data base for equivalent dose determination is generated only by dose measurements of individual grains.
The most commonly used device for routine measurements of sand-sized single grains is the Risø single grain laser OSL system, i.e. a conventional TL/OSL luminescence reader with an additional single grain laser attachment. Luminescence stimulation is achieved by directing a green (532 nm) laser beam to any one of a hundred grains mounted on a special 9.7 mm diameter aluminium holder with 100 holes, each 300 µm in diameter and 300 µm deep. This limits the application of single grain laser luminescence (SGLL) measurements to grain sizes of preferably 180-250 µm. Although it must be noted here, that sample holders with smaller hole sizes are available upon request. However, the entire configuration limits the applicability of SGLL always to a certain grain size fraction. This study investigates the potential of spatially resolved luminescence measurements for determining doses in individual quartz grains. A newly developed luminescence reader (type LEXSYG-research, Freiberg Instruments) is used which is equipped with a cooled EM-CCD imaging system for luminescence detection with a resolution of c. 16 µm per pixel. This allows a higher flexibility with regard to the grain sizes usable for equivalent dose measurements. Furthermore, the reader is equipped with a Sr-90 beta source providing a homogeneous irradiation field with less than ±3 % deviation across a diameter of 10 mm and about ±2% at the area imaged (8 mm diameter). This homogeneity is crucial for determining doses accumulated in individual grains. Stimulation is acquired either by irradiation (RF), heating (TL, up to 700 °C) or illumination (OSL, a 532 nm laser). The grain-monolayer of the image area carries a high number of grains (in the range of 500 to 1000 for 200-300 µm diameter grains) which are measured at once. In combination with a variety of optical filters, built into automatically changing filter wheels, different stimulation-detection configurations are tested for quartz of different provenances. Spatially resolved single grain OSL and TL measurements (UV-violet emission) are compared to the common SGLL results in order to explore the potential of a new single grain approach for a broader range of grain sizes. Further valuable information is given by RF measurements, e.g. for a fast characterising of the main luminescence emissions of the grains. Spatially resolved TL measurements using the blue emission of quartz are carried out and discussed in the context of expanding the dating range of quartz from difficult environments.

Keywords: single grain OSL, single grain TL, single grain RF, quartz

Optical bleaching of TL glow peaks separated using computerized glow curve deconvolution of feldspar

D.-G. Hong[1*], K.-B. Kim[2]

[1]Department of Physics, Kangwon National University, Chuncheon, Kangwon-Do, 200-701, South Korea
[2]Cyclotron Research Institute, Kangwon National University, Chunchon, Kangwon-Do 200-701, Korea

* *Corresponding author: dghong@kangwon.ac.kr*

Controlled measurement of the intensity of the luminescence signal by optical stimulation from many crystals can provide a means of determining the time which has elapsed since the luminescence was last drained from the sample, the age of sample. If this technique is focused on the sediment dating, one of the necessary criteria is to investigate the bleachability of the sample. Although this research has been investigated for various types of feldspar, most works were performed on the basis of the TL intensity integrated for a particular temperature range in the glow curve, without any peak separation. However, it has been recognised that each glow peak of the feldspar sample is generally composed of the sum of overlapping peaks. The aim of this work is to investigate the bleachability by blue and infrared stimulation for thermoluminescence peaks separated using the computerized glow curve deconvolution (CGCD) method of feldspar.

Keywords : Feldspar; Bleaching; Computerized glow curve deconvolution

References

Zhang, J.F., Li, S.H. and Tso, M-Y.W., 2001. Assessment of bleaching of K-feldspar grains. Radiat. Meas., 103-108.

Sharma, B.A., Singh, A.N., Singh, S.N. and Singh, O.B., 2009. Application of computerized glow curve deconvolution to determine the sepectroscopy of traps in colorless microcline. Radiat. Meas., 32-37.

Investigations on Quartz and Feldspar Optical Dating of Quaternary Fluvial Terrace Sediments from Eastern Coast of Korea

S. Hong[1,3*], J.-H. Choi[1], R. Sohbati [2],A. Murray[2], J.-W. Kim[3]

[1] Division of Earth and Environmental Science, Korea Basic Science Institute, Ochang Centre, Chungbuk 363-883, South Korea (schong@kbsi.re.kr; jhchoi@kbsi.re.kr)

[2] Nordic Laboratory for Luminescence Dating, Department of Earth Science, Aarhus University, Risø DTU, Denmark

[3] Department of Geography Education, Seoul National University, Seoul 151-742, South Korea

** Corresponding author: schong@kbsi.re.kr*

Several flights of Quaternary fluvial terraces have been identified on the east coast of the Korean peninsula; these terraces are covered by well-sorted unconsolidated sediments and, in some places, the terrace sediments are cut by Quaternary faults of unknown age. Because the terraces are located near densely populated areas and, in at least one case, a nuclear power plant, it is important to reliably estimate the timing of the terrace formation and fault movement; this provides essential information on the assessment of local crustal stability (e.g. time-integrated uplift rate of terraces and the recurrence interval of Quaternary faults). In this paper, we set out to date Quaternary sediments on each terrace by quartz OSL and feldspar IRSL dating methods. Quartz and K- an Na-rich feldspar were extracted from ten samples, five samples of which were taken from a terrace sediment and the other five samples from fault outcrops; these are used for detailed investigation of luminescence properties and age estimation. Natural quartz OSL signals (stimulated by Blue-LED) from most of the samples examined are observed to be in saturation level; I/I_0 values are >0.85, with $2D_0$ (characteristic dose) values being ~ 200 Gy. Clearly quartz OSL is not a suitable signal for dating terrace sediments in this region. We also test the suitability of feldspar IRSL signals to dating, as it is well known that feldspar IRSL signals have much higher dose saturation level than quartz. The post IR-IRSL signals in K-rich feldspars (measured at 290^{o}C/200 s with a preheat of 320^{o}C/60 s) have been shown to fade at a negligibly lower rate (Thomsen et al., 2008; Buylaert et al., 2009); the K-rich feldspar signal is also found to be in saturation, with I/I_0 of 0.90-0.94. In contrast, we could obtain finite D_e values using Na-rich feldspar grains using Post IR-IRSL signal (measured at 290^{o}C/200 s with a preheat of 320^{o}C/60 s); D_e values of ~ 500 Gy were observed ($2D_0$ = ~900 Gy). Here we report our investigations into the IRSL and post IR-IRSL signal properties of both K- and Na- rich feldspars, including their fading characteristics and applicability to dating fluvial sediments from the east coast of Korea, and provide depositional ages to be used for understanding Quaternary tectonics in this region.

Keywords: fluvial terrace, Quaternary faults, quartz, K-rich feldspar, Na-rich feldspar, OSL/IRSL signal saturation

Applying the OSL method for dating the Little Ice Age: A case study in the West Kunlun, northwest Tibetan Plateau

G. Hu[1*], X.-K. Xu[1], J. Zhao[2], B. Pan[1], C. Yi[1], J. Zhang[3], T. Jiang[4]

[1]. Key Laboratory of Tibetan Environment Changes and Land Surface Processes, Institute of Tibetan Plateau Research, CAS, Shuangqing Rd 18 [#], Haidian District, 100085 Beijing, China
[2]. State Key Laboratory of Cryospheric Sciences, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou 730000, P.R. China
[3]. Key Laboratory for Earth Surface Processes, Department of Geography, Peking University, Beijing 100871, China
[4]. Key Laboratory of Tectonics and Petroleum Resources of Ministry of Education, China University of Geosciences, Wuhan, 430074, China

** Corresponding author: hugang@itpcas.ac.cn*

The Little Ice Age (LIA) is the latest global cooling event. On the Tibetan Plateau, there are widespread LIA glacial remains. However, the lack of independent age hampers further study because of the lack of suitable materials and dating methods. By using optically stimulated luminescence (OSL) method, we dated the LIA at Hongliutan Glacier, West Kunlun (N35°53', E79°23'), northwestern part of the Tibet Plateau. Field observation showed that three successions of LIA moraine exist in this area. The margin of the outside terminal moraine is 0.6 km away from modern glacier snout. The OSL samples were obtained near the outside terminal moraine includes three moraine deposits, three glacial-lacustrine fine sand and two glacial-fluvial sand sediments. For every sample, both coarse-grained (90-125 μm) and fine-grained (4-11 μm) fractions of quartz were used for equivalent dose measurements using the single-aliquot regenerative-dose (SAR) protocol. Because there were a lot of feldspar components exist in coarse sand, Samples were bleached for 100 s at 60 °C using IR before blue-light stimulation (Post-IR). The results show that the OSL ages of the fine-grained quartz from glacial-lacustrine deposit range from 0.25 to 0.59 ka. These ages are in strict stratigraphic order, and well consistent with the geomorphological features. The LIA glacial-lacustrine deposits have horizontal stratifications. This suggests the glacial-fluvial deposits were well sorted and had enough time to be bleached before deposited. The earliest LIA ended at 0.59 ka BP. However, two moraine samples are dated to 32.79 and 43.64 ka BP; the two modern glacial-fluvial samples have the ages of 1.46 and 7.55 ka. It is obvious that the OSL ages of the modern samples were much overestimated. The overestimation might be caused by the poor bleaching of these samples at deposition because the samples are from nearby weathering materials. More than 10 cm of the granite boulder over LIA terminal moraines have been weathered away. The moraine deposits are mixture features, quartz grains got no chance to have historical OSL signals be reseted. The glacial-fluvial sand is fast deposited; the partial bleaching contributes to age overestimation. For coarse sand, the apparent equivalent dose obtained using the Post-IR protocols show much greater scatter. The ages range from 0.01 to 0.87 ka for LIA glacial-fluvial sand, 43.64 ka and 50.31 ka for moraine deposits; 2.87 ka and 26.25 ka for modern glacial-lake sand. The error of most samples is larger than 2σ that means low precision. Most Post-IR OSL ages are larger than fine sand quartz except two LIA glacial-fluvial sand samples. This suggests that caution should be taken when Post-IR OSL is used to date the glacial sediments.

Keywords: Little Ice Age; Glacial Deposits; OSL; West Kunlun

Investigation of emission spectra, dose response and stability of Luminescence from NaCl

P. G. Hunter[1*], N. A. Spooner[1,2], I. McCulloch[3], D. Creighton[2], B.W. Smith[1]

[1] Defence Science and Technology Organisation, Edinburgh, SA 5111, Australia.
[2] Institute for Photonics and Advanced Sensing (IPAS), School of Chemistry and Physics, University of Adelaide, Adelaide, 5005, Australia
[3] Research School of Earth Sciences, Australian National University, ACT, 0200, Australia

** Corresponding author: peter.hunter@dsto.defence.gov.au*

Thermoluminescence (TL), Optically-Stimulated Luminescence (OSL) and Infrared-Stimulated Luminescence (IRSL) emitted from a set of 19 samples of common salt (NaCl) has been studied to identify any long-lived emissions suitable for application in retrospective dosimetry. Luminescence characterisation of these NaCl samples has been performed, including measurements of the TL emission spectra, measurement of the TL, OSL and IRSL dose response curves and assessment of the stability of the TL and OSL signals for suitability for use in the timeframe of interest.

The emission spectra for Natural TL and Artificial TL were analysed using a Fourier Transform spectrometer (3D-TL) to produce a comparison of the emission spectra immediately following $^{90}Sr/^{90}Y$ beta irradiation and after an 8 week storage delay. Selected emissions remaining after the 8 week storage time were analysed to determine their lifetime, and hence suitability to fulfil thermal stability requirements as a retrospective dosimeter. Changes in the candidate emission TL peaks due to variation in storage temperature were investigated over a range of temperatures, with spectra being measured at storage intervals ranging from minutes to months to characterise the change in characteristics.

TL, OSL and IRSL dose response curves were measured using a Risø TL/OSL DA-20 automated reader. Significant desensitisation of the TL glow peaks in the 200-260°C range (5K/second) during the course of TL readout has been reported previously; further investigations of this behaviour will be given here.

Quantitative TL, OSL and IRSL images have been collected using a Photon-Counting Imaging System (PCIS) for the purpose of assessing sample heterogeneity, and also to utilise the broad spectral response of the PCIS (50% points 300, 800 nm) to investigate luminescence in the far red and near-IR (> 695 nm) waveband.

Keywords: TL, OSL, IRSL, Emission Spectra, Retrospective Dosimetry, NaCl

On the multiple age determination from deep-sea core samples by quartz and feldspar: a case study from the Sea of Marmara (Turkey)

S. Huot*, M. Lamothe

Laboratoire de luminescence Lux, Département des sciences de la Terre et de l'atmosphère, Université du Québec à Montréal, Montréal (Canada)

** Corresponding author: huot.sebastien@courrier.uqam.ca*

Continental transform boundaries are regions affected by high seismic risk, causing large earthquakes and tsunamis. Preventive measures involve active monitoring of fault lines and advance warning systems to detect a tsunami in motion. However, theses offer no guaranties in unmonitored areas and are of limited value for prediction. We need new techniques to document pre-instrumental earthquake ruptures along fault segments of tectonics boundaries to better assess the seismic potential risk.
Here, we want to apply optically stimulated luminescence (OSL) in a deep-sea environment. Turbidites cannot be directly dated by OSL as these involve movement of sediment deep underwater. However, it can be applied to hemipelagic sediments, bounding each turbidite sequence, which could potentially have seen light before its sedimentation.
We sampled a sediment core (IZ-115) previously taken from the Sea of Marmara (Turkey). OSL will be applied on both the coarse-grain (> 40 μm) and fine-grain fraction. We will make use of froth flotation to separate quartz from feldspar minerals and heavy liquid to separate potassium-rich from sodium-rich feldspar. The environmental dose-rate will be measured by both high-resolution gamma spectrometry and alpha-particle spectrometry in order to assess the state of equilibrium in the uranium-238 decay series.
Here, we will report on our ongoing investigation.

Luminescence dating of fine grained sediments from Lake Hovsgol, Mongolia

K . Ito[1*], N. Hasebe[2], K. Kashiwaya[3], Y. Ganzawa[4]

[1] Institute of Nature and Environmental Technology, Kanazawa University, Japan
(Kakuma, Kanazawa, Ishikawa, Japan, 920-1192, kazumi-i@earth.s.kanazawa-u.ac.jp)
[2] Institute of Nature and Environmental Technology, Kanazawa University, Japan
[3] Institute of Nature and Environmental Technology, Kanazawa University, Japan
[4] Institute of Earth Science, Hokkaido University of Education, Hokkaido University of Education, Japan

** Corresponding author:* kazumi-i@earth

Sediment core samples are recovered from the lake bottom, and meaningful proxy records to represent surrounding environment are obtained along its depth. To convert the depth profiles to the age profiles, the age model determination plays an important role. This study aims to develop the new luminescence dating technique for small amount of samples of lake sediments and the technique must supply ages easily and quickly to provide many dated horizons in a core sample. For indirect annual dose calculation, new pellet making procedures is examined, and then laser ablation - inductively coupled plasma - mass spectrometry (LA-ICP-MS) is applied to measure the concentrations of radioactive isotopes (^{87}Rb, ^{232}Th, ^{234}U and ^{238}U). To investigate that the red thermoluminescence (RTL) from inorganic carbonate is capable of giving a reliable estimate of accumulated (or equivalent) dose since its deposition on the lake floor, the present work compare the result from RTL considering the residual dose of calcium carbonate from Lake Hovsgol to that estimated from conventional fine-grained quartz optical stimulated luminescence (OSL). Both equivalent doses are concordant considering the error range in most samples except for some samples which have particular reason, such as low equivalent doses and existence of authigenic carbonate. The depth profiles given based on luminescence ages are concordant with the age model of the other core sample from Lake Hovsgol and analyzed core has the environmental information from late MIS 5 or early MIS 4 to LGM.

Keywords: OSL, RTL, Carbonate, Lake sediments

Characterization of quartz luminescence signals from the Chinese Loess Plateau

M. Jackson[1*], H. Roberts[1], G. Duller[1], Z. Lai[2]

[1]*Institute of Geography and Earth Sciences, Aberystwyth University, Aberystwyth, SY23 3DB, U.K.*
[2]*Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, XiNing, China*

** Corresponding author: msj1@aber.ac.uk*

Chinese loess provides an excellent opportunity to test new methods of extending the maximum age range of luminescence dating and to investigate the luminescence behaviour of multi-grain aliquots. The mineral material is well bleached, homogeneous, and has been deposited semi-continuously over millions of years. Paleosols that formed in the deposit during interglacials provide a lithostratigraphy that is visible in the field and can provide independent age control through correlation with marine isotope stage (MIS) boundaries. A key section that has been intensively studied is Luochuan in the central Chinese Loess Plateau. Previous luminescence dating studies at this section have investigated thermoluminescence (TL), red TL (RTL), isothermal luminescence (ITL), sensitivity corrected multiple aliquot regenerative (SC-MAR) optically stimulated luminescence (OSL), pulsed irradiation (PI) SC-MAR OSL, thermally transferred OSL (TT-OSL), and single aliquot regenerative (SAR) OSL signals of quartz fractions as well as infrared stimulated luminescence (IRSL) and post IR OSL of polymineral and feldspar fractions (Lu et al. 2007, Lai et al. 2006, Buylaert et al. 2007, Wang et al. 2006, Lai 2009, Forman 1991). Some of the results agree with the independent age control whilst others do not. However, comparisons of the characteristics of these signals are complicated by differences in paleodose, dose rate, preparatory treatment, and measurement conditions.

This study comprises a comparison of different analyses of quartz luminescence, including component fitted LM-OSL, SAR CW-OSL, SC-MAR OSL, IRSL isolated fast component, and TT-OSL signal characteristics on the same suite of loess samples from Luochuan in order to investigate systematic differences between them as well as the effects of grain size and measurement conditions. Special attention is given to the relative shape of dose-response curves at high doses and the maximum reliable equivalent dose that each signal can obtain.

References

Buylaert, J. P., Vandenberghe, D., Murray, A. S., Huot, S., De Corte, F., and Van den Haute, P. 2007. Luminescence dating of old (>70 ka) Chinese loess: A comparison of single-aliquot OSL and IRSL techniques. *Quaternary Geochronology,* 2(1-4): 9-14.

Forman, S. L. 1991. Late Pleistocene chronology of loess deposition near Luochuan, China. *Quaternary Research,* 36(1): 19-28.

Lai, Z. 2009. Chronology and the upper dating limit for loess samples from Luochuan section in the Chinese Loess Plateau using quartz OSL SAR protocol. *Journal of Asian Earth Sciences,* 37(2): 176-85.

Lai, Z., Murray, A. S., Bailey, R. M., Huot, S., and Bøtter-Jensen, L. 2006. Quartz red TL SAR equivalent dose overestimation for Chinese loess. *Radiation Measurements,* 41(1): 114-19.

Lu, Y. C., Wang, X. L., and Wintle, A. G. 2007. A new OSL chronology for dust accumulation in the last 130,000 yr for the Chinese Loess Plateau. *Quaternary Research,* 67(1): 152-60.

Wang, X. L., Lu, Y. C., and Wintle, A. G. 2006. Recuperated OSL dating of fine-grained quartz in Chinese loess. *Quaternary Geochronology,* 1(2): 89-100.

Feldspar luminescence: An overview and look forward

M. Jain[1*], A.S. Murray[2], M.T. Andersen[1], J. P Buylaert[1, 2], K.J Thomsen[1], C. Ankjærgaard[3] V. Pagonis[4]

[1] Radiation Research Division, Risø National Laboratory for Sustainable Energy, DTU, Denmark
[2.] Nordic Laboratory for Luminescence Dating, Aarhus University, Risø DTU, DK-4000 Roskilde, Denmark.
[3] Netherlands Centre for Luminescence Dating, Technical University of Delft, The Netherlands
[4]McDaniel College, Physics Department, Westminster, MD 21157, USA

** Corresponding author: maja@risoe.dtu.dk*

Feldspar IRSL grows to much larger doses (> 1kGy) compared to quartz, thus providing a potential extension of the datable age range to cover the last 1Ma or so. However, the signal loss with time is faster than that expected simply from a consideration of trap depth and ambient temperature. This behaviour is commonly reffered to as anomalous fading, which is now widely accepted to be caused by direct tunnelling of electrons from the trap to nearby luminescence centres. Much of feldspar geochronometry has focused on determining fading rates and using these to correct apparent feldspar ages for anomalous fading. Such age corrections are typically 30-40% and the correction models are highly extrapolative, only apply to relatively young samples (< 50 ka) and are difficult to validate. Thus, to extend the accurately datable age range using feldspar as a natural dosimeter, we must identify an OSL signal much less prone to anomalous fading than the signal conventionally used.

Recent work at our laboratory has identified two important signals that show very low or almost no fading: a) an elevated temperature IRSL signal measured after a prior infrared bleach, and b) a Time-Resolved OSL signal obtained from a combination of detection between the pulses (after rejection of data in the first 5 μs) and selection of data only from the later part of the POSL measurement. We have also developed a comprehensive model using a single dosimetric trap to explain charge transport during feldspar luminescence. It is proposed that two dominant recombination routes in the band tails (0.05 eV phonon assisted diffusion and quantum mechanical tunnelling) together with energy-dependent, localised recombinations give rise to a range of observable luminescence phenomena in feldspars, e.g. the effects of preheat and prior optical bleach, elevated temperature optical stimulations, and shape of the IRSL and thermoluminescence peaks.

We present here new dosimetric results using the two non-fading signals. We also present investigations into the origin of the post IR-IRSL signal based on thermo-optical measurements and red-IR excitation spectrocopy. Finally, we present a detailed phenomenological model, based on a combination of localised and non-localised transitions, to establish linkages between thermoluminscence and thermally assisted optically stimulated luminescence in feldspars, and outline the way forward to date using feldspars.

Keywords: Anomalous fading, tunnelling, band tail states, IRSL, OSL

OSL under the microscope: insights into the origin of D_e overdispersion for single grains of quartz

N. Jankowski[1*], Z. Jacobs[1], R. G. Roberts[1], P. Goldberg[2]

[1]Centre for Archaeological Science, School of Earth & Environmental Sciences, University of Wollongong, Wollongong, New South Wales, 2522, Australia.
[2] Department of Archaeology, Boston University, Boston, Massachusetts. 00215, United States of America.

* *Corresponding author:* nrj934@uowmail.edu.au

The last decade has seen a revolution in optically stimulated luminescence (OSL) technologies and methodologies, enabling the determination of equivalent dose (D_e) estimates for individual, sand-sized grains of quartz. A common feature, however, of single-grain D_e distributions is the spread remaining after all measurement uncertainties have been taken into account; this spread is known as 'overdispersion'. Overdispersion in the D_e estimates obtained for individual quartz grains from archaeological sites has usually been attributed to one or more of the following factors: 1) post-depositional disturbance and/or mixing, 2) roofspall contamination and/or in situ weathering of bedrock, 3) spatial variations in the environmental beta dose rate. A lingering problem, however, is that conventional sample preparation methods destroy the sedimentary fabric that originally surrounded each of the datedquartz grains, thereby eliminating the chance to directly examine the possible role of the factors listed above. In this presentation, we will describe our ongoing investigations intothe integration of soil micromorphological techniques with the determination of D_e estimates for individual grains of quartz. Micromorphological features within the sample (e.g., clay cutans, calcite precipitates, insect burrows, etc.) can be identified from thin sections cut from a resin-impregnated sediment block sample, and distribution maps of U, Th, K can be quantified by fission track analysis, X-ray fluorescence, and scanning electron microscopy with wavelength-dispersive spectrometry. The use of Al_2O_3:C grains also allows the determination of the beta dose rate at specific points within the sediment block. The distribution of D_e estimates obtained from quartz grains extracted from portions of the block kept in darkness can then be compared with the beta-dose variations and physical evidence of sample heterogeneity, with the objective being to improve the accuracy of age determination from individual grains. Progress towards this objective will be reported for sediment samples collected from a geological site in Thirroul, New South Wales, Australia.

Keywords: soil micromorphology, D_e overdispersion, beta dose distribution

Variation of quartz OSL components with lithology, weathering and transportation

G. Y. Jeong[1*], J.-H. Choi[2]

[1]Department of Earth and Environmental Sciences, Andong National University, Andong 760-749, Republic of Korea (jearth@andong.ac.kr)
[2]Division of Earth and Environmental Sciences, Korea Basic Science Institute, Chungbuk 363-883, Republic of Korea (jhchoi@kbsi.re.kr)

* *Corresponding author:* jearth@andong.ac.kr

It is well known that the property of OSL (Optically Stimulated Luminescence) signals in quartz can differ from sample to sample (even in grain-to-grain scale); most of quartz grains have suitable OSL signal properties, for instance, being dominated by fast OSL component, but some others show poorly behaving OSL signatures, with significant contributions from slower OSL components. However, the origin or the cause of the difference in OSL properties of quartz is not well understood. In this paper, we report our experimental observations of continuous wave (CW) and linearly modulated (LM) OSL signals in quartz grains from both fresh bedrocks and their saprolitic (weathering) products, which are considered not to have been exposed to sunlight after crystal formation. Also, the behavioral variations in quartz OSL signals is investigated using quartz grains systematically collected along a streamline in the middle part of Korea. Quartz grains from both unweathered granitic and metamorphic rocks show very weak fast OSL signals, but dominant slower OSL components. The intensity of these slower components varied slightly over the granitic rocks. The OSL signals in quartz grains from sandstones are dominated by fast OSL components. The quartz grains derived from thermally metamorphosed sandstones, however, tend to have weaker OSL signals and more intense slower components than those of unmetamorphsed sandstones. In this study, it is observed that slower OSL components dominate the OSL signals in quartz from near the host granite, and the absolute/relative intensity of these slow components decrease and fast OSL components become distinctive as the transportation distance increases. The results implies that OSL signal characteristics of quartz grains suitable for dating appears to be acquired during sedimentary processes after the liberation from granitic and metamorphic bedrocks; granitic and metamorphic quartz grains should be transported to some distances enough for the fast OSL component to be sensitized and become appropriate for dating, while the OSL signal properties of the quartz grains released from sedimentary rocks, unless they have been affected by post-thermal metamorphism, seem to be suitable for OSL dating, regardless of the transportation distance.

Keywords: Quartz, OSL signal components, lithology, weathering, transportation

OSL dating of aeolian sedimentary stratigraphy in the middle reaches of Yangtze River and its environmental implications

Y. Jia[1], J. Zhang[2], Z. Lai[2,*], Z. Zhang[1]

[1] Key Laboratory of Poyang Lake Wetland and Watershed Research, Institute of Geography and Environment, Jiangxi Normal University, NanChang 330026, China
[2] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, XiNing 810008, China (*Email: zplai@isl.ac.cn)

* *Corresponding author: zplai@isl.ac.cn*

Aeolian deposits (including aeolian sands and loess-like deposits) are widely distributed in the Poyang Lake region in the middle reaches of the Yangtze River. The source materials have been proposed to be from the dry flood river plain and were transported by strong winter monsoon winds from the north. The chronology and its environmental implications of these deposits have been debated for decades. Here we present two sedimentary sections located on the first terrace of the south bank of the Yangtze River. Section A in the sand field of Hongguang village, 66 m thick, mainly consists of sand layers with four/five thin-bedded lacustrine sandy silt and silty sand deposits. Section B (coordinates) is close to the primary school of Hongguang village with a depth of 30 m, and is made up of loess-like deposits in the lower part of the section and sand deposits with interbeded lacustrine sandy silt in the upper part of the section. Quartz optically stimulated luminescence (OSL) dating was employed to construct the chronology of the two sections. Based on the OSL chronology and the sedimentological and grain size analysis, we concluded: (1) The channel of the Yangtze River was far in the north during 70-60 ka in the early Last Glaciation. (2) The channel shifted southward at ca. 50 ka because sandy accumulation originated from the flood plain of the paleo-Yangtze River had started to form at that time. (3) Sandy deposits had ceased during the Holocene which suggested the winter monsoon winds get weak and/or the Yangtze River shifted its channel northward. At present, active sand dunes are only discovered in the south flood plain of the Yangtze River.

Keywords: Aeolian deposits; Channel shift of Yangtze River; OSL dating; Environmental change

Evidence of luminescence dating for a special casting technique in Bronze Age Yunnan*

Z. Jin[1,2*], Y. Wu[1], L. Yan[2,1], G. Chen[2,1]

[1]USTC Archaeometry Laboratory, University of Science and Technology of China, Jinzhai Road 96#, 230026, Hefei, P.R. China
[2] Hefei National Laboratory for Physical Sciences at Microscale, University of Science and Technology of China, Jinzhai Road 96#, 230026, Hefei, P.R. China

* *Corresponding author: zyjin@ustc.edu.cn*

The ancient bronze metallurgy of Yunnan is renowned both for its high artistic achievement as well as for its technical accomplishment. While the Centure Plan bronze technology is spread throuout Sichuan basin and Yunnan, the southwest China, the details of bronze casting techniques such as lost-wax casting in the region is much debated. In a technical investigation we found a lot of quartz sand without adhesive inside of the abdominal of a cow-shaped attachment on a bronze cowrie container from the Dian bronzes. The present study is on the specimen and TL/OSL dating is applied on the sand sample related to a casting technique in the Dian bronze culture for the first time in order to investigate whether the quartz sand belongs to the core mold or be entered after casting or in the burial process.

Keywords: BRONZE AGE YUNNAN; CASTING TECHNIQUE; QUARZT SAND; TL/OSL DATING

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ESR investigation of structure and dynamics of paramagnetic centres in lime mortars from Budinjak, Croatia

R. Krzyminiewski[1], Z. Kabacińska[1*], B. Dobosz[1], D. Nawrocka[2]

[1] Department of Medical Physics, Faculty of Physics, Adam Mickiewicz University, Umultowska 85, 61-614 Poznań, Poland (zuziakab@amu.edu.pl)
[2] Institute of Geology, Department of Dynamic and Regional Geology, Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, Maków Polnych 16, 61-606 Poznań, Poland

* *Corresponding author:* zuziakab@amu.edu.pl

The object of this study is to present the preliminary results of investigation of the types and dynamics of paramagnetic centres in lime mortars from Sveta Petka church in Budinjak, Croatia. We consider the possibility of dating them using Electron Spin Resonance (ESR) spectroscopy. This type of material have not been dated before using ESR, therefore previous careful studies are required to identify the useful paramagnetic centres. The excavation on the remains of a church in Budinjak in Croatia discovered very unique four lobe plan object Sveta Petka. There are no additional finds or reliable historical records about the time of the building of the church. That is why the lime mortars from the church were investigated. Those samples were analysed thanks to cooperation with Žumberak-Samoborsko Gorje Nature Park. All samples were γ-irradiated with the doses of 1, 10, 20, 50, 80 and 100 kGy. The similarities and differences in spectra of irradiated and non-irradiated samples have been analysed. In all spectra signals from Fe^{3+} and Mn^{2+} ions have been observed. Intensities of these signals do not change with the dose of irradiation. The ESR signals intensities of gamma-induced CO_3^{3-} paramagnetic centre were analysed versus the dose of irradiation, using Mn^{2+} signals as a reference. Exponential growth of the curve and saturation for doses above 20 kGy has been observed. Parameters of exponential curve were determined. For the purpose of dating, irradiation with doses smaller than 20 kGy is required to obtain linear growth of amplitude. ESR spectra and the dose response curve will be useful for comparing the age and provenance of the samples.

Keywords: ESR dating, Budinjak, lime mortars, CO_3^{3-} paramagnetic centre

OSL-dating pilot study on Lake Malawi sediment samples

A. Kadereit[1*], R. DeWitt[2]

[1]Geographisches Institut, Universität Heidelberg, Im Neuenheimer Feld 348, D-69120 Heidelberg, Germany, email: annette.kadereit@geog.uni-heidelberg.de
[2]Radiation Dosimetry Laboratory, Department of Physics, Oklahoma State University, 1110 South Innovation Way Drive, Stillwater, OK 74074, USA, email: regina.kalchgruber@okstate.edu

** Corresponding author: annette.kadereit@geog.uni-heidelberg.de*

Lake Malawi holds a tropical sedimentary archive of outstanding quality and duration storing unique information on the climatic and landscape history of the East-African rift area. As OSL-dating could be a key technique to establish a sound chronometry for the paleo-environmental archive, eight samples from two piston cores, kindly supplied by Prof. Dr. T.C. Johnson, University of Minnesota and covering the last ca. 20 ka, were used for material property studies (core M98-3P, 3 samples) and dating (core M98-1P, 5 samples), respectively. The small amounts of sample material (2 – 7 g each) and the lack of coarse grains required a single-aliquot fine-grain technique. As IR-stimulated stable blue and yellow emissions from feldspar were too dim for dating and material was too limited to extract pure quartz separates by the use of conditioned H_2SiF_6 etching off the feldspar component, OSL-ages were gained from the UV-emission (Hoya U340, 7.5 mm) of the polymineral fine-grain fraction (4-11 µm) applying a post-IRSL B-OSL SAR-protocol (Banerjee et al. 2001). Dose rate determination was accomplished by low level gamma spectrometry. OSL-ages were in good agreement with independent radiocarbon ages. Although equivalent doses (D_E) were determined from the very early 0 – 1 s interval of the luminescence signal, differences may be partly due to partial bleaching as indicated by D_E-values rising with increasing readout time and integration interval. Additionally, high uncertainties are caused by the change of moisture in the course of compaction of the lake sediments and by the small sample volumes, which allow only estimates of the natural gamma dose rates. As, however, changes in moisture seem to minimize at depths below ca. 5 m core depth, i.e. beyond ca. 10 ka, this effect should be less significant for older samples. Our pilot study shows that luminescence dating may support the construction of a chronology for Lake Malawi. For further dating attempts, larger samples would be desirable, which would allow better dose rate calculation, the separation of pure quartz fine grains and perhaps the extraction of coarser grain fractions with better potential to scrutinize partial bleaching. Older samples might even provide the possibility to analyze feldspar, if the luminescence signal intensity increases sufficiently with increasing age to enable dating.

Keywords: Lake Malawi, lake sediments, post-IRSL B-OSL SAR, dose rate uncertainties

References

Banerjee, D., A.S. Murray, L. Bøtter-Jensen & A. Lang (2001): Equivalent dose estimation using a single aliquot of polymineral fine grains.- Radiation Measurements 33:73-94.

Towards developments of the multiple-aliquot regenerative-dose protocol in fine-grained quartz OSL dating

S. Kang[1 *], X. Wang[1], Y. Lu[1,2]

[1] State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences, Xi'an 710075, China ([*]kshg@ieecas.cn)
[2] State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China

* *Corresponding author:* kshg@ieecas.cn

The sensitivity-corrected multiple-aliquot regenerative-dose (MAR) protocol (Lu, Y.C., Wang, X.L., Wintle, A.G., 2007. A new OSL chronology for dust accumulation in the last 130,000 yr for the Chinese Loess Plateau. Quaternary Research 67, 152-160) provides a reliable approach for fine-grained quartz optically stimulated luminescence (OSL) dating. For reliable estimation of equivalent dose (D_E), here we investigate some basic aspects related to the fine-grained quartz MAR OSL dating protocol. (1) For suitable bleaching of the natural OSL signal back to zero clock for the following regenerative-dose aliquots, the effect of bleaching duration using sunlight, SOL2 and blue LEDs was studied, and it is found that the most appropriate bleaching ways are short SOL2 (e.g. 5 minutes) or short blue LEDs (e.g. 60 s) bleaching. (2) To select the appropriate magnitude of test dose, the relationship between test dose and D_E was investigated based on three samples, with D_E of about 10, 31 and 136 Gy, respectively. It is suggested that test dose for sensitivity correction should be limited less than about 10-20 Gy. (3) Three popularly fitting modes used for quartz OSL growth curve were compared at three different regenerative dose scales. And it seems that the mode of two saturating exponential functions is the most universal and appropriate way for fine-grained quartz OSL growth curve. (4) By comparison of D_Es derived from OSL approach with those of recuperated OSL (ReOSL) protocol, the dating range using fine-grained quartz MAR OSL protocol may be less than about 300 Gy when using the parameters found here. (5) It is feasible to construct a standardized growth curve (SGC) for fine-grained quartz OSL signal in the whole Chinese Loess Plateau (CLP), which was tested using 18 samples collected from three sites (Weinan, Xifeng and Jingyuan) deposited since the last interglacial.

Keywords: fine-grained quartz; OSL dating; MAR; equivalent dose

The properties of the IR-sensitive trap in feldspar

R. H. Kars[1*], N. R.J. Poolton[2], C. Ankjærgaard[1], M. Jain[3], J. Wallinga[1]

[1]Netherlands Centre of Luminescence dating, Delft University of Technology, The Netherlands (r.h.kars@tudelft.nl)
[2] School of Chemical Engineering and Advanced Materials, Newcastle University, United Kingdom
[3] Radiation Research Division, Risø National Laboratory for Sustainable Energy, DTU, Denmark

* *Corresponding author:* r.h.kars@tudelft.nl

Interest in the use of feldspar for sediment dating has increased since the development of the post-IR IRSL method to select a stable feldspar luminescence signal (Thomsen et al., 2008). However, many unknowns remain about the origin of both the conventional IRSL signal and the post-IR IRSL signal. To confidently use feldspars for dating, profound understanding of trap-depths, recombination centers and recombination routes is needed.

The complexity of the feldspar crystal structure and the abundance of defect states obstruct precise measurement of the trap depth and identification of the recombination route used during IR stimulation. Nevertheless, several models exist that explain how a luminescence signal is generated in feldspar upon IR (1.46 eV) stimulation. Both the resonance peak in the excitation spectra at ~1.46 eV and the estimates of thermal lifetime of the IRSL signal suggest that the trap depth (energy level below the conduction band edge) must be greater than 1.46 eV. Hütt *et al.* (1988) proposed that the likely mechanism to generate IRSL is thermal assistance from the excited state of the trap to the conduction band and subsequent recombination. Later, measurements have shown the presence of a continuum of very shallow states beneath the conduction band, also known as band-tail states, which allow hopping transport beneath the conduction band (Poolton *et al.*, 2009). In the same study evidence was given for tunneling recombination from the excited state after stimulation at 1.46 eV. Exo-electron measurements also confirm that electrons are not excited into the conduction band during IR stimulation (Ankjærgaard *et al.*, 2006).

In this study we focus on the defect energy-level responsible for IRSL using museum specimen of Na- and K-feldspar. Samples were irradiated at room temperature to fill only thermally stable traps. Optical stimulation was performed at low temperature (10 K) to avoid thermal assistance. A photo-transferred TL (PT-TL) signal was measured by stimulating the sample at different energies (1.7-2.9 eV) and subsequently heating it from 10-300 K. This PT-TL signal arises from electrons that have been transferred from the IR trap into the band-tail states; the minimum photo-transfer energy needed to populate these shallow states gives direct information on the trap depth. Earlier research showed that this energy lies between 1.46 and 2.58 eV (Poolton *et al.*, 2009). Additional OSL experiments were carried out to investigate de-trapping and recombination efficiencies at different stimulation energies. The combined results of the experiments will be presented and interpretations discussed.

References

Hütt, G., Jaek, I. and Tchonka, J., 1988. Quaternary Sci. Rev. 7 (3-4), 381-385
Poolton, N. R. J., Kars, R. H., Wallinga, J. and Bos, A. J. J., 2009. J. Phys.: Condens. Matter 21 (48)
Thomsen, K. J., Murray, A. S., Jain, M. and Bøtter-Jensen, L., 2008. Rad. Meas. 43, 1474-1486
Ankjærgaard, C., Murray, A.S., Denby, P.M., Bøtter-Jensen, L., Rad. Meas. 41, 780-786

Beyond catastrophic stripping: response of the Shoalhaven River to high-magnitude, low-frequency flood events, NSW, Australia

S. Kermode[1*], I. Reinfelds[2], T. Cohen[1], G. Nanson[1], B. Jones[1]

[1]GeoQuEST Research Centre – School of Earth and Environmental Sciences, University of Wollongong, Northfields Avenue, Wollongong, NSW, 2522, Australia (skermode@uow.edu.au)
[2]New South Wales Office of Water, PO Box 53, Wollongong, NSW 2500, Australia.

* *Corresponding author:* skermode@uow.edu.au

This study aims to establish the response of the Shoalhaven River to high-magnitude, low-frequency events. The lower Shoalhaven River gorge has seen episodes of catastrophic stripping both in the modern and palaeorecord. This study demonstrates that landscape recovery has taken the form of inset benches. Ortho-rectified aerial photographs, one-dimensional hydraulic modelling (HEC-RAS), stratigraphic analysis and single-grain OSL dating combine to identify that benches along Bull Reach have been extensively eroded and reworked by modern events. Kermode et al (submitted) establish the long-term, polycyclical nature of the higher alluvial surfaces (up to 193 ± 21 ka in age), and this is contrasted with the youth of the lower inset alluvial surfaces, which are shown to be as young as 110 ± 10 years in age. HEC-RAS modelling of floods from 20-100 years ARI shows that velocities and shear stress in the reach surpass that predicted for widespread entrainment and transport of sediments along with re-working of vegetated bars and benches. The Shoalhaven River system is characterised by a highly variable flow regime, with current channel cross-section shaped by high magnitude, low frequency events and associated widespread stripping. There is, however, contention in the literature regarding the relative roles of flood regimes, the impact of European settlement and the role of vegetation (clearance and/or regrowth) on catastrophic stripping episodes. Early European settlement cleared banks along portions of the Shoalhaven River gorge; an alteration influencing the response of the river to high magnitude flood events. Further, the building of Tallowa Dam has altered the flow regime, and although this has little impact on the discharge of infrequent, higher magnitude floods, the retention of bedload sediment has substantially altered the substrate composition of downstream landforms. This study evaluates the relative significance of both flood regime and effects of European settlement on the geomorphic effectiveness of high magnitude events and investigates the characteristics of bench formation in this confined setting. Benches of the lower Shoalhaven River are interpreted to be depositional, recovery landforms based on geochronological and stratigraphical evidence combined with modelling results. Auger holes reveal distinctly finer sediments with increasing distance and elevation from the river. The variety of ages (floodplain age range 3.5 ± 0.24 – 193 ± 21 ka) reported for features of consistent sedimentology and correlation to flood recurrence intervals suggests that these surfaces represent a quasi-equilibrium cross-section for the river. This study finds that benches of the lower Shoalhaven River are recovery landforms, onlapping and adjusting the cross-section of the river to accommodate the current flow regime.

Keywords: OSL, Quaternary, benches

Optical dating of tidal sediments in the western coast of the Korean Peninsula

J. C. Kim*, C. H. Eum, S. Yi

Geologic Environment Division, Korea Institute of Geoscience and Mineral Resources, 92 Gwahang-no, Yuseong-gu, Daejeon 305-350, Republic of Korea E-mail: kjc76@kigam.re.kr

** Corresponding author: kjc76@kigam.re.kr*

Seven samples were collected from a 15 m long core of fine grained tidal sediments at the western coast area of the Korean Peninsula. In this study, we tested the applicability of optically stimulated luminescence (OSL) to the dating of tidal sediments. A single aliquot regenerative dose (SAR) procedure was applied to chemically purified (H_2SiF_6) quartz grains of 4-11 ㎛ diameter. Optical dating results were compared with ages obtained from C^{14} dating of shells, woods and bulk sediments. The suitability of the material for OSL dating was confirmed by the luminescence characteristics. The OSL ages of the tidal sediments range from 13 ka to 1.2 ka, and agree well with the available ^{14}C ages. Also, OSL ages are in stratigraphic order, which suggest a complete resetting before burial. A short period (6~7 ka) of very rapid sedimentation between 4.5 and 10.5m depth is probably the result of a relative sea-level rise and abrupt transgression of the shoreline. This study is new approach to establish a reliable chronology for the tidal sediments, and provides the potential to investigate late Quaternary sea level fluctuations and paleoenvironmental changes of the western coast area of the Korean Peninsula.

Keywords: quartz; OSL; C^{14} dating; tidal sediments; Korean Peninsula; western coast

Development of a small X-ray irradiator relevant to optical dating

M.-J. Kim[1], Y.-S. Jang[1], D.-G. Hong[2,*]

[1] Radiation Technology Institute, Neosiskorea Co., Ltd., Korea.
[2] Dept. of Physics, Kangwon National University, Korea

* *Corresponding author: dghong@kangwon.ac.kr*

Beta irradiation from the radionuclide $^{90}Sr/^{90}Y$, although not always convenient because of the photomultiplier noise due to scintillation induced by bremsstrahlung from a radiation source shielded and difficulty of dose rate adjustment, has been usually employed to the optical dating. As an alternative to the radioactive sources, a small X-ray irradiator (Varian VF-50J, maximum power of 50 W at 50 kV and 1 mA) was studied by several researchers. In this presentation, we introduce a small X-ray irradiator recently developed which was composed of a mini X-ray generator (Varian VF-50J), Pb collimator, delay shutter and Al absorber. From the results, we found the X-ray was homogeneously irradiated onto the area with about 20 mm diameter. Also, in order to remove the low energy X-ray beam, Al absorber with 300 ㎛ thickness was required. Finally, cross-talk effect did not exist when the distance between samples was more than 3 cm and dose rate linearly increased up to 0.8 Gy/s.

Keywords : X-ray irradiator; Optical dating; Cross-talk; Al absorber

References

Andersen, C.E., Botter-Jensen, L. and Murray, A.S., 2003. A mini X-ray generator as an alternative to a $^{90}Sr/^{90}Y$ beta source in luminescence dating. Radiat. Meas., 557-561.

Yawata, T., Hashimoto, T., Takeuchi, T. and Hong, D.G., 2007. Optimal conditions of X-ray irradiation for accurate equivalent dose determination. Nucl. Instr. and Meth. B, 375-380.

X-ray Excited Optical Luminescence (XEOL) of Quartz: Implications for OSL dating

G.E. King[1*], A.A. Finch[1], R.A.J. Robinson[1], R.P. Taylor[12], J.F.W. Mosselmans[2]

[1] Department of Earth Sciences, School of Geography & Geosciences, Irvine Building, North Street, St Andrews, Fife, KY16 9AL, UK
[2] Diamond Light Source Ltd., Diamond House, Chilton, Didcot DE0 11OX, UK

* *Corresponding author:* georgina.king@gmail.com

Quartz is the preferred mineral for OSL due to its relatively well constrained behaviour as a radiation dosimeter, in contrast to feldspar. However, despite the plethora of successful quartz OSL applications, the precise origin of the UV/blue luminescence emission, measured during OSL, remains unclear. Consequently no solution has been found to the problem that some quartz luminesce more brightly than others, which has limited the application of OSL in certain depositional and regional settings. Here we examine the origins of UV-blue luminescence in quartz, by comparing and contrasting excitation techniques and performing emission spectroscopy. X-ray Excited Optical Luminescence (XEOL) is luminescence excited by x-rays. XEOL analyses were conducted upon a suite of quartz samples at the Diamond synchrotron, Great Britain, in October 2009. The sample suite was selected to include quartz of both dim and bright OSL sensitivities, in order that the emission spectra could be contrasted. Two Scottish glacial outwash samples, prepared at St Andrews have dim OSL signals, whereas Risø calibration quartz (Batch 34) has OSL sensitivity typically two orders of magnitude greater than the Scottish samples. A natural hydrothermal macro-crystal of α-quartz was cut parallel and perpendicular to the c-axis and analysed to investigate whether any anisotropy could be detected in its luminescence emission. The XEOL emission spectra comprise major emissions at 3.32, 3.82, 4.12 and 4.42 eV, and a weaker red emission at 1.96-2.0 eV in all samples, although the red emission was absent from one of the Scottish outwash samples. A broad emission at 2.67-2.71 eV was also observed in both macro-crystal orientations, but was absent from the remainder of the sample suite. X-irradiation progressively reduces the UV intensity for all of the samples, whilst increasing the red emission. The qualitative replacement of bright UV-blue light emission with red is consistent with the variable OSL signals from quartz of different provenances which have experienced different degrees of natural radiation. The depletion of the UV emissions can be fitted with a power-law relationship, whereas the increase in the red emission is sigmoidal, exhibiting a linear relationship at low levels of x-irradiation before reaching a plateau at higher doses. These numerical relationships provide insights into the nature of the centres involved.

Using deep-trap luminescence signals to overcome thermal stability limits in dating tropical environments: case studies from Tanzania and Sri Lanka

T. C. Kinnaird[1*], D. C.W. Sanderson[1], P. Bishop[2], B. Downie[3], I. Simpson[4]

[1]Scottish Environmental Research Centre, East Kilbride, G75 0QF, Scotland; Timothy.Kinnaird@glasgow.ac.uk; David.Sanderson@glasgow.ac.uk
[2]School of Geographical and Earth Sciences, University of Glasgow, G12 8QQ, Scotland;
[3] Heritage Oil Plc, London, W1K 2JD, England
[4]Biological & Environmental Sciences, University of Stirling, Stirling, FK9 4LA, Scotland

* *Corresponding author:* Timothy.Kinnaird@glasgow.ac.uk;

Tropical environments present challenges not always experienced in routine luminescence dating work, particularly for older samples where thermal stability at elevated temperatures and saturation limits are pertinent. In this paper, we report on investigations of OSL, TL, IRSL and deep-trap signals from studies in Tanzania and Sri Lanka. We consider the stability of electron traps at a range of ambient temperatures, based on pulsed annealing of natural and regenerated luminescence signals, the impact of elevated temperatures on signal accumulation, and sensitivities to bleaching of deep-trap signals that have been used to extend age-range. The sediments in both cases come from terrestrial tropical environments: southeast Tanzania (latitude ~ 6 ºS, elevation 20-30 m asml) and southwest Sri Lanka (latitude ~ 8 ºN, elevation 120 m amsl). The Tanzanian study aimed to date raised beach ridges extending 10-20km inland from the coast to provide a temporal framework to interpret sea-level change and tectonic uplift. The Sri Lankan study aimed to date the first period of occupation of the Fahian-lena rock-shelter, one of the earliest sites of modern human settlement along the route of late human dispersal to south-southeast Asia.

Each site presents its own set of challenges. The Tanzanian deposits date to the early Pleistocene; with several samples yielding natural quartz OSL values in excess of laboratory saturation levels. Therefore high-temperature quartz approaches and post-IR IRSL deep-trap feldspar signals were used to extend the dating range. Thermal stability analyses were conducted to assess the relationship between IRSL and post-IRSL signals from K feldspars, and to compare TT-OSL, post-OSL TL and OSL signals from quartz. It was concluded that the IRSL signals in this case lack sufficient thermal stability to register dates $\geq$ 50 ka in this tropical environment. Post-IR IRSL signals originate from distinct and deeper traps and can be used for dating beyond the quartz SAR limit. Similarly the TT-OSL and post-OSL TL signals from the quartz phase exhibit both higher saturation levels and greater thermal stability than OSL. In the Sri-Lankan case quartz from Fahien-lena exhibits strong systematic dependence of equivalent dose on preheating temperature. This was subsequently shown to relate to the thermal stability distribution of the contributing signal sources, leading to ambiguous age estimates using standard procedures. Trap lifetimes were modelled based on kinetic parameters obtained through pulsed annealing experiments. At ambient storage temperatures of 30-40 ºC most quartz OSL signals lack sufficient thermal stability to cover the period of interest (> 40 ka). The post-OSL TL approach was utilised as a means of overcoming those limitations.

In both cases, the challenges of dating older Quaternary samples from tropical environments are significantly overcome using these deep-trap approaches. While the signals are harder to reset in daylight OSL or IRSL signals, our experience in these studies confirms their utility for dating older samples from elevated temperature environments.

Optical luminescence dating of eolianite, west Black Sea coast of Turkey

N. G. Kiyak[1*], A. E. Erginal[2], A. Ertek[3], T. Canel[4]

[1]ISIK University, Department of Physics, Archeometry Laboratory, Istanbul, TR-34980, Turkey
(E-mail: kiyak@isikun.edu.tr)
[2]Canakkale Onsekiz Mart University, Department of Geography, Canakkale, TR-17O20, Turkey
[3]Istanbul University, Department of Geography, Istanbul, TR-34459, Turkey
[4]Kocaeli University, Physics Department, Kocaeli, TR-41380, Turkey

** Corresponding author: kiyak@isikun.edu.tr*

In coastal areas, so-called eolianites or fossil dunes are key indicators of wind-blown sand transportation dynamics at Quaternary, especcialy during Late Pleistocene. These cross-stratified cemented carbonate dunes yield clues in both understanding paleoclimatic conditions during the accumulation of quartz-rich dune sands and deciphering the source of amalgamating carbonate polymorphs. To the contrary of numerous studies on world's coastline, to the authors's knowledge, no example has been available on the Black Sea coast so far.

In this study, five samples extracted from bottom to top of an eolianite sequence located in 5 km west of the Sile district of Istanbul (41°11'53" N, 29°26'46" E), northwest Turkey was dated using optically stimulated luminescence (OSL). The mineral composition as well as microfabric characteristics of eolianite sands were examined using X-ray diffractometry and scanning electron microscopy (SEM). The studied sequence is a 6-m thick hard cemented ooid grainstone in petrographic composition and rests unconformably upon Pliocene sediments consisting of red-colored terrestrial clays.

OSL dating studies showed that early period of dune sand accumulation extends back to 53.9 ± 6.3 ka. We presume based on the presence of spherical or ellipsoidal-shaped brownish ooids with $CaCO_3$ and SiO_2 nuclei and binding aragonite cements that the source of carbonates was an emerged sea-floor when sea-level dropped down to -60 m. In Black Sea nomenclature, that period coincides with extremity of the post-Karangatian regression and, in particular, the ~early phase of the Sourozh transgression. Consequently, referring to the isotope chronology, this regression matches exactly the interglacial highstand of OIS-3.

Keywords: Eolianite, carbonate, regression, transgression, interglacial highstand, Black Sea, Sile, Turkey.

Optical dating of sediments in Wadi Sabra (SW Jordan)

N. Klasen[1*], C. Schmidt[1], A. Hilgers[1], M. Bertrams[2], D. Schyle[3], F. Lehmkuhl[2], J. Richter[3], U. Radtke[4]

[1]University of Cologne, Institute for Geography, Albertus-Magnus-Platz, D-50923 Cologne, Germany (nicole.klasen@uni-koeln.de)
[2]RWTH Aachen University, Institute of Geography, Templergraben 55, D-52056 Aachen, Germany
[3]University of Cologne, Institute of Prehistoric Archaeology, Albertus-Magnus-Platz, D-50923 Cologne, Germany
[4]University Duisburg-Essen, Rectorate, Universitätsstraße 1, D-45117 Essen, Germany

* *Corresponding author:* nicole.klasen@uni-koeln.de

The Collaborative Research Center 'Our way to Europe' (CRC 806) is a joint project of the Universities of Aachen, Bonn and Cologne which topics the dispersal of anatomically modern humans from Africa into Europe. Following the Out of Africa II hypothesis two main migration pathways, the western trajectory and the eastern trajectory are discussed. The study site in Wadi Sabra, which is a tributary wadi of the Jordan valley, is part of the presumed eastern corridor. At different sites artefacts of the Upper Palaeolithic and Epipaleolithic are deposited in the wadi sediments (Schyle & Uerpmann 1988). We dated coarse grained quartz by optically stimulated luminescence to investigate if the archaeological history correlates to environmental conditions as it is assumed that the wadi deposits amongst others are remnants of a pluvial period during MIS 3. Our sampling strategy was to collect samples from undisturbed sediments relating to find spots as well as from the artefact bearing layers directly. In total, five profiles (Ansab 1-3, Ansab 6 and Sabra 4) were sampled.
Complex dose distributions were expected as wadi sediments are fluvial deposits that were transported in an erosion environment of high energy. Compared to the catchment area, the sediment transportation distances were comparably short. Due to low quartz luminescence sensitivity small aliquots of 1 mm and 2 mm in diameter instead of single grains were used for dating which is harmful as we expect partial bleaching of the luminescence signal prior to deposition. This is supported by scattering equivalent dose distributions (overdispersion up to 38 %) and may be the case for the samples from the profiles Ansab 3, Ansab 6 and Sabra 4. With the help of the finite mixture model (FMM) of Galbraith & Green (1990) we chose the smallest significant population to calculate mean palaeodoses (cf. Rodnight 2008). Unlike profiles Ansab 3, Ansab 6 and Sabra 4, the profiles Ansab 1, 2 represent find layers. Comparing equivalent doses of 1 mm and 2 mm aliquots reveal that the scatter in the dose distributions does not result from insufficient bleaching of the luminescence signal but from inhomogeneous dose rates. Mean palaeodoses were calculated using the dominant component given by the finite mixture model. The resulting luminescence ages show two clusters, the older one scatters around 30 ka (profiles Ansab1-3, Ansab 6) and the younger one (profile Sabra 4) indicates sedimentation during late LGM.

References

Galbraith, R.F. & Green, P.F. 1990: Estimating the component ages in a finite mixture. Nucl. Tracks Radiat. Meas. 17 (3), 197-206.
Rodnight, H. (2008): How many equivalent dose distributions are needed to obtain a reproducible distribution? Ancient TL 26 (1). 3-9.
Schyle, D. & Uerpmann, H.P. (1988): Palaeolithic sites in the Petra-area. In: Garrard, A.N. & Gebel, H.G. (eds.). The Prehistory of Jordan. The state of research in 1986. Oxford: 39-65.

OSL and pIRIR dating of loess deposits intercalated with tephras from Towada Volcano, northern Japan

R. Kondo[1*], S. Tsukamoto[2], T. Kudo[1], T. Sakamoto[3]

[1]Geological Survey of Japan, AIST, Central 7, Higashi 1-1-1, Tsukuba, Ibaraki, 305-8567, Japan, e-mail: rei-kondo@aist.go.jp
[2]Leibniz Institute for Applied Geophysics, Section 3: Geochronology and Isotope Hydorology, Stilleweg 2, D-30655 Hannover, Germany
[3]Institute of Biogeosciences, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Natsushima-cho 2-15, Yokosuka 237-0061, Japan

* *Corresponding author:* rei-kondo@aist.go.jp

Towada volcano is a large Quaternary caldera volcano and has erupted numerous tephras which cover widely northern part of Japan. These tephras have been used as time marker to correlate various geomorphic surfaces and provide good relative chronologies. However, not all the tephras have been dated by numerical dating methods. In this study, a 12 m thick loess section located ~30 km northeast of Towada volcano was investigated. The section contains more than 20 tephra layers mainly from Towada volcano and 3 of them have independent ages; the Towada Hachinohe tephra which is dated to 15 ka by radiocarbon, the widespread Toya tephra from Toya volcano with a well-known age of 112-115 ka by various dating methods, and Towada Shirobeta tephra with a fission track age of 280 ka. Eleven loess samples were collected for luminescence dating from directly below the major taphra layers. The 3 samples taken from below the known age tephras were used to test the elevated temperature post-IR IRSL SAR protocol for polymineral fine grains and OSL SAR protocol for quartz. The ages of other samples provide new age estimates for the tephras from Towada volcano; these new ages of the tephra will give excellent chronological information for various Quaternary landscapes in northern Japan.

Keywords: loess, tephrochronology, polymineral, OSL, pIRIR, Towada volcano

High temperature thermally transferred optically stimulated luminescence phenomenon in fired geological quartz

D. K. Koul[1,*], P. G. Patil[1], E. O. Oniya[2], G. S. Polymeris[3]

[1]Astrophysical Sciences Division, Bhabha Atomic Research Centre, Mumbai, India *(dkkoul@barc.gov.in)*
[2] Physics and Electronics Department, Adekunle Ajasin University,Akungba Akoko, Nigeria.
[3] IŞIK University, Faculty of Science and Arts, Physics Department, Şile 34980-Istanbul, Turkey

** Corresponding author: dkkoul@barc.gov.in*

Although the behavior of the pre-dosed OSL was reported to be similar to that of the 110 ^{o}C TL peak, it was not found feasible for the equivalent dose estimation (Koul and Chougaonkar, 2007; Koul et al., 2010). To resolve this anomaly a reproducibility test of both the signals was undertaken using fired geological quartz samples. As expected, the pre-dosed 110 ^{o}C TL glow peak showed good degree of reproducibility in case of all the four runs undertaken in this study. But on the contrary, the magnitude of the 1st pre-dosed OSL run was seen to be much larger than the subsequent runs. It was this measurement which suggested the occurrence of charge transfer at 400 ^{o}C and triggered the entire study. The basic transfer has been reported to get completed at ~ 360 ^{o}C heating for 10 s (Li and Li, 2006; Adamiec et al., 2010). So, the transferred signal observed above this temperature, as is the case here, will be referred to as high temperature thermally transferred OSL emission (HTT-OSL) in this paper.

The different features of this phenomenon studied were (i) pulse annealing of the source trap, (ii) sensitization behavior, (iii) relationship between fast and slow component and (iv) growth curve. The results suggest this phenomenon to be operational in the (i) temperature range of ~ 325-500 ^{o}C and (ii) dose range of few tens of mGy to 100 Gy. The pattern of the transferred signal growth curve in both modes (i) sensitized (un-corrected) and (ii) sensitization corrected seems to suggest its applicablility in the equivalent dose estimation up to ~ 100 Gy in general and low dose region, ~ < 5 Gy, in particular. It was observed to be much better than the, conventional, pre-dosed signals in terms of linearity and dynamic range of dose estimation.

The linear relationship observed between the fast and slow component of the signal removed the possiblty of the slow trap as being the source trap for this emission. The sensitization growth curve of this signal was observed to be different from that of the 110 ^{o}C TL and OSL signals. This was undersood to be happening due to the variation in the charge transfer to the receptor trap of the transferred emission with dose, pre-dose, which is not the case with the pre-dosed TL and OSL signals.

The HTT-OSL emission, in principle, looks feasible in applications like dating of ceramics and retrospective dosimetry. However, since this is probably the first study in this direction, further work is needed to establish the credibility of this signal for various applications.

References

Adamiec, G., Duller, G. A. T., Roberts, H. M., Wintle, A. G., 2010. Improving the TT-OSL SAR protocol through source trap characterization. Radiat. Meas. 45, 768-777.

Li, B., Li, S. L., 2006. Studies of thermal stability of charges associated with thermal transfer of OSL from quartz. J. Phys. D: Appl. Phys. 39, 2941-2949.

Koul, D.K., Chougaonkar, M.P., 2007. Pre-dose phenomenon in the OSL signal of quartz. Radiat. Meas. 42, 1265-1272.

Koul, D. K., Chougaonkar, M. P., Polymeris, G. S., 2010. Applicability of OSL pre-dose phenomenon of quartz in the estimation of equivalent dose. Radiat. Meas. 45, 15–21.

OSL dating of three different grain size fractions of quartz -A comparison on loess-palaeosol sequences in Saxony/Germany

S. Kreutzer[1,*], M. Fuchs[1], S. Meszner[2], D. Faust[2]

[1]Geographical Institute, University of Bayreuth, 95440 Bayreuth, Germany
[2]Department of Physical Geography, Technical University of Dresden, 01069 Dresden, Germany

* *Corresponding author:* sebastian.kreutzer@uni-bayreuth.de

Luminescence dating is the leading technique for establishing chronologies and calculating sedimentation rates of loess deposits for the last glacial-interglacial cycle. Although luminescence dating has been documented for different grain size fractions: (1) coarse grain (90-250 µm), (2) middle grain (11-90 µm) and (3) fine grain (4-11 µm), in practice there is a focus on only one fraction, with the general use of the mode sediment grain size. To determine whether there are differences in the OSL age estimates between the different grain size fractions, we carried out a dating study based on optical stimulated luminescence (OSL) of quartz, using three grain size fractions (i.e. coarse, middle and fine grain). For a loess profile in Middle Saxon/Germany we applied a standard SAR protocol (Murray and Wintle 2000) on 60 samples (20/fraction) for age determination. In addition, we systematically investigate the composition of the signal components (fast, medium, slow) for the different grain size fractions, using the linear modulation technique (Bulur 1996, Bulur et. al. 2000). First results show that for D_e values up to 100 Gy, we obtain consisting ages for different grain sizes, whereas for higher D_e values we obtain different ages. Possible reasons and explanations for the discrepancies will be discussed in the presentation.

References

E. Bulur, 1996. An Alternative Technique For Optically Stimulated Luminescence (OSL) Experiment. Radiation Measurements 26, 701-709.

E. Bulur and L. Bøtter-Jensen and A. S. Murray, 2000. Optically stimulated luminescence from quartz measured using the linear modulation technique. Radiation Measurements 32, 407-411.

A. S. Murray and A. G. Wintle, 2000. Luminescence dating of quartz using an improved single-aliquot regenerative-dose protocol. Radiation Measurements 32, 57-73.

Optical and Dosimetric Properties of $CaWO_4$ crystals

N. N. Kristianpoller[1*], R. Chen [1].

[1]Raymond and Beverly Sackler School of Physics and Astronomy, Tel-Aviv University, Tel-Aviv ,Israel 69978

* *Corresponding author:* nahum@post.tau.ac.il

Optical and dosimetric properties of $CaWO_4$ crystals were studied, and in particular optically stimulated luminescence (OSL) was investigated in the present work. The OSL method is known to have several advantages for dosimetric application and is becoming also a major tool in archaeological and geological dating. Measured were also optical absorption, photoluminescence (PL), X-luminescence (XL) and thermoluminescence (TL) of synthetic and natural $CaWO_4$ crystals. Natural Calcium Tungstate crystals are also known as Scheelite minerals. The absorption measurements showed a high transmission in the visible and UV region to about 270nm and a steep increase of optical density below this wavelength. By UV illumination into the long-wavelength tail of the fundamental absorption, broad emission bands could be excited near 420 and 520nm. These PL bands showed an excitation maximum at 260nm, the same bands were also recorded in the XL emitted at liquid nitrogen (LNT) and room temperature (RT) as well at some TL peaks, indicating that the same luminescence centers are involved in the various emissions. The main TL peak above RT was recorded at about 140^oC. The dependence of its intensity on the dose of the β radiation was measured, and the dose dependence was found to be nearly linear up to a dose of about 2000Gy, with a tendency to saturation for higher doses. The TL sensitivity was also compared to that of the well known TLD-100 phosphor. Results showed that the sensitivity of the main TL peak is about an order of magnitude lower than that of TLD-100, when measured for the same radiation dose of 100Gy and when normalized for the same mass. In $CaWO_4$ samples that had previously been X- or β-irradiated, a luminescence emission could be stimulated by wavelengths that could not excite any luminescence in un-irradiated samples, and even by photon energies larger than those of the stimulating light. The present results have shown that in such pre-irradiated $CaWO_4$ samples, emission bands near 420 and 475nm could be excited by red light of 650nm. This is apparently due to a process of optical stimulation (OSL). This conclusion is supported by the fact that these emissions could not be stimulated by 650nm light after annealing to 800^0C. Radiation induced absorption bands at these wavelengths of 650nm and 515nm have previously been reported and were attributed to F- and F^+ centers in $CaWO_4$ crystals. The illumination with 515nm light did not result in any notable luminescence emission in the pre-irradiated $CaWO_4$ crystals. However, during illumination with 715nm light, a 475nm emission band was observed in these pre-irradiated samples, which is apparently also due to an OSL emission.

Keywords: $CaWO_4$, Dosimetry, Optical properties, OSL, TL

Reconstructing the dune evolution in South-East India on a decadal timescale using OSL-dating of quartz

A. Kunz[1,*], B. Urban[2], M. Frechen[3]

[1] Department of Geosciences, National Taiwan University, Taipeh, Taiwan (R.O.C.)
[2] Institute of Ecology, Faculty of Sustainability Sciences, Leuphana University, Lueneburg, Germany
[3] Section S3: Geochronology and Isotope Hydrology, Leibniz Institute for Applied Geophysics, Hannover, Germany

* *Corresponding author:* a.kunz96@yahoo.com

Dunes in drylands and coastal areas are perfect archives for palaeoenvironmental studies. They preserve and reflect changes in climate, human impact and they can preserve palaeo-indicators for hazards, such as floods or extreme dry seasons (bushfires etc.). The impact of events like storms or climatic fluctuations has severe consequences on ecosphere, geosphere and anthroposphere. The knowledge about coastal processes and their timing can help in developing plans for coastal protection, management and risk assessment. The application of dating methods allows establish a chronological framework which can be used to correlate periods of sand movement and soil formation to past dry or wet climate conditions or to estimate the recurrence interval for events.

At the south-east coast of India dunes in the area of Cuddalore have been investigated. They form a belt parallel to the coastline. A transect from the coast to the most western inland dunes was investigated. The dunes show sedimentological features like unconformities, changes in the direction of bedding, erosion features, dewatering structures, remnants of human settlement and soil-like horizons which are indicative for environmental changes.

The aim of this study was to establish a reliable chronological framework for the coastal development of South-East India. This framework can be used to understand the timing of coastal processes and genesis of sediments, and further to connect them with events which are indicative for environmental and climatic changes. Dating of dune sand was done using optically stimulated luminescence (OSL) from quartz. The quartz grains show very good luminescence properties. They are very bright and very sensitive even to low radioactive irradiation with doses of 0.3 Gy. We used the SAR protocol to detect recently deposited dune sands with depositional ages of a few 10 years.

The dating results and sedimentological investigations show a strong relation between the monsoon activity and periods of sand movement and stabilisation of dunes for the last 3500 years. The older dunes in the west reflect strong changes in the environmental conditions about 100 and 300 years ago. The latter events as well mark the termination of settlement activities in the investigated area which must have started about 1500 years ago. The younger dunes show a connection between periods of reduced rainfall and sand mobilisation for the last 200 years. The results of our investigations of the younger dunes indicate that the dune system in the study area reacts very sensitive to changes in rainfall and disturbances in the vegetation cover.

This work demonstrates the application of OSL dating on recently deposited sediments exemplified for the dunes in the area of Cuddalore, revealing great potential for palaeoenvironmental reconstruction.

Keywords: dune, OSL dating, Holocene, environmental change, India

Chronostratigraphy of the Vistulian profiles on the San River middle terrace in the Carpatians marginal zone (Poland)

J. Kusiak*, M. Łanczont

Departament of Physical Geography and Palaeogeography, Maria Curie Skłodowska University,
al. Kraśnicka 2CD, 20-718 Lublin, Poland: kusiak@poczta.umcs.lublin.pl; lanczont@poczta.umcs.lublin.pl

* *Corresponding author:* kusiak@poczta.umcs.lublin.pl

Well-developed system of Pleistocene terraces (75-80 m, 40-60 m, 20-35 m 12-17 m above the valley bottom) occurs in the middle part of the San River valley, in its foothills section (Dynów-Przemyśl) perpendicular to flysch structures. Terraces form steps covered by alluvial deposits and loess of different thickness. Loess profiles are one of main sources of information about environmental changes in the past, from the moment when the terraces became buried. The middle terrace (20-35 m) covers the largest surface in the valley. Its structure was examined in several sites (Bartkówka, Babice, Krasice, Tarnawce, Dybawka Dolna, Buszkowice). Investigations reveal complex structure of river deposit series and long time of its formation (from Mazovian to Eemian). This is rather a set of forms of middle terrace, buried under subaerial cover, mostly loess, representing the last glacial. This cover is thick and stratigraphically differentiated. Its age was determined from pedological evidences, few (reconnaissance) paleobotanical data and few results of TL and 14C dating. More detailed research on structure and chronostratigraphy of the Vistulian profile on the middle terrace was undertaken in the Dybawka Dolna site (oxygen stable isotope, geochemical and malacological analyses were made, and pollen analysis is nearing completion). IRSL and TL age of deposits were determined in several laboratories, and in this paper we present new results of TL dating carried out in Lublin laboratory as a part of research project NN 306 426234. The profile of middle terrace (its top occurs at 223 m a.s.l. and 26 m over the valley bottom) of the San River in the Dybawka Dolna site consists of very thick (almost 22 m) layer of alluvial (about 6 m) and loess (about 16 m) deposits occurring on 4 m high flysch socle. Aeolian series was deposited at first in water-boggy environment (2.5 m thick layer can be correlated with Early Glacial part of MIS 5 and with MIS 4), and then under subaerial conditions (5.5 m correlated with MIS 3, and 8 m – with MIS 2). In the profile we found loess deposits from the youngest stage of accumulation (at the close of Vistulian), which usually were denuded at the turn of Vistulian and Holocene. The deposits correlated with the stage 2 were IRSL dated at 15.8 to 20.6 ka (four dates obtained in Hanover), as well as TL dated at 12.3 to 23 ka (nine ages obtained in Gdańsk) and 14.5-22.2 ka (in Lublin - nine samples). Older sediments were also dated. The following results were obtained in three laboratories. Loess correlated with MIS 3 was IRSL dated at 47.2±3.8 ka, TL dated at 34.6 to 55.6 ka (in Gdańsk) and 46.7-48.1 ka (in Lublin). Early Pleniglacial deposits were dated at 61.3±4.3 ka (in Hanover) and 56.5±7.3 ka (in Lublin). It is commonly accepted that thermoluminescence method gives overestimated results for deposits composed of material transported over a short distance, in it also loess deposits. The research undertaken on the San River middle terrace in the Dybawka Dolna site gives us evidence against such opinion. Local periglacial alluvia and weathered flysch rocks were the main source of loess alimentation in this site as indicated by heavy minerals composition. The results of TL dating (15 dates) obtained in Lublin laboratory correspond very well with the results of IRSL dating (6 dates) obtained in Hannover. The TL results obtained in Gdańsk (16 dates) are also not overestimated. Therefore, in our opinion thermoluminescence method can be applied for dating of "short-transport" loess deposits, accumulated in similar conditions as in Dybawka Dolna.

Keywords: TL dating, IRSL dating, loess, Carpatians marginal zone

Uranium series disequilibrium detection and annual dose determination: a case study on Magdalenian ferruginous heated sandstones.

C. Lahaye*, P. Guibert

CNRS-Université de Bordeaux 3, UMR 5060, Institut de Recherche sur les Archéomatériaux (IRAMAT-CRP2A), Maison de l'Archéologie, F-33607 Pessac, France. christelle.lahaye@u-bordeaux3.fr

* *Corresponding author:* christelle.lahaye@u-bordeaux3.fr

Disequilibria in Uranium series and their consequences on the annual dose determination in luminescence dating studies are now well-known, but only few studies refer to the systematic research of this kind of phenomenon, and eventually how the problem has been misguided. The present work aims at considering a new case study: anciently heated ferruginous sandstones from a Magdalenian archaeological site have been dated by thermoluminescence. In this work, Uranium series disequilibrium has been detected both in samples and surrounding sediments, using high resolution low background gamma-spectrometry measurements. Further investigations, in particular with alpha-spectrometry measurements and geochemical considerations, helped us to understand when and how the disequilibrium began, and it lead us to propose a specific model for the evaluation of the mean annual dose absorbed by the samples dated. This work deals with the results of gamma and alpha-spectrometry as well as the dose variation model proposed and the dating results obtained, in terms of annual dose determination and in terms of age obtained. The difference between our results and the results that would have been obtained without taking into account the disequilibrium can be as high as 10%. Such systematic discrepancies cannot be accepted in luminescence dating studies, particularly when dating recent Palaeolithic periods that require sufficiently precise and accurate results. The detection, the understanding and the modelling of U-series disequilibrium are thus very important when estimating the mean annual dose received by the sample.

When does quartz OSL growth curve saturate

Z.-P. Lai*

Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China (Email: zplai@isl.ac.cn)

* *Corresponding author:* zplai@isl.ac.cn

Quartz is much preferred over feldspars due to its none fading signal and the much simpler trap or combination centre mechanism. However, quartz signal saturates much quicker with a D_0 of ca. 70-100 Gy which limits the maximum reliable equivalent dose (D_e) of ca. 140-200 Gy ($D_e<2D_0$). Assuming a dose rate of ca. 3 Gy/ka for loess, the dating range could be confined to be within 50-70 ka. However, recently a growing body of data show that the quartz OSL SAR growth curve has a linear growth part in the high dose range of >200 Gy, which could allow the D_e determination upto ca. 400 Gy (e.g. Long et al., 2010). When using quartz OSL and SAR protocol to date loess from Luochuan section, a standard loess section in the Chinese Loess Plateau with well-defined independent chronology based on astronomical tuning, it is reported that the agreement between OSL ages and the independent ages is limited to be within 70 ka with a corresponding D_e of ca. 230 Gy, and that the maximum D_e obtained was only 403 Gy (with a corresponding age of 107 ka) for a sample collected below the B/M boundary (780 ka) (Lai, 2010). The reliable D_e of only less than 230 Gy (~70 ka) here seems to imply that the D_e determined using this linear part of a growth curve could be false. Similar observation has also been made by Buylaert et al. (2008). Whether the trap/luminescence combination centre, which is assumed to be responsible for the linear growth part, exists in the nature, or it is created by laboratory irradiation only and cannot be removed by the preheat condition (Lai, 2010)? When investigating quartz OSL dose-response curves at high doses, Lowick et al. (2010) proposed that the most likely explanation for the change in OSL response at high doses is a change in competition for electrons between the UV recombination centres whose emission is seen through the detection windows and recombination centres that do not emit in this spectral region (or are non-radiative). The current study will further examine the saturation characteristics of quartz OSL and the use of linear growth part at high doses in dose-response curves for D_e determination.

Keywords: Quartz OSL; Growth curve saturation; D_e determination; Dating range.

Reference:

Buylaert, J.P., Murray, A.S., Vandenberghe, D., Vriend, M., De Corte, F., Van den haute, P., 2008. Optical dating of Chinese loess using sand-sized quartz: establishing a time frame for Late Pleistocene climate changes in the western part of the Chinese Loess Plateau. Quaternary Geochronology 3, 99-113.

Lai, Z.P., 2010. Chronology and the upper dating limit for loess samples from Luochuan section in the Chinese Loess Plateau using quartz OSL SAR protocol. Journal of Asian Earth Sciences 37, 176-185.

Long, H., Lai, Z.P., Fan, Q.S., Sun, Y.J., Liu, X.J., 2010. Applicability of a quartz OSL standardised growth curve for De determination up to 400 Gy for lacustrine sediments from the Qaidam Basin of the Qinghai-Tibetan Plateau. Quaternary Geochronology 5, 212-217.

Lowick, S.E., Preusser, F., Wintle, A.G., 2010. Investigating quartz optically stimulated luminescence dose-response curves at high doses. Radiation Measurements 45, 975-984.

Single grains and inner grain anomalous fading variability in K-feldspar and plagioclase: implications for modeling anomalous fading and IRSL dating

M. Lamothe*, M. Barré, S. Huot, S. Ouimet.

Laboratoire de luminescence Lux, Département des sciences de la Terre et de l'atmosphère, Université du Québec à Montréal, Montréal, Canada (lamothe.michel@uqam.ca)

* *Corresponding author:* lamothe.michel@uqam.ca

Anomalous fading of feldspar is witnessing a renaissance in our scientific community, which has been increasingly reporting over the last 12 years, on its phenomenology and remedies. However the only solutions to this basic methodological limitation for luminescence dating still involve a leap of faith in extrapolating anomalous fading rates beyond laboratory time scales. Among those earlier approaches that had yielded significant information ubiquity and range of fading is the fadia method in which the variability of fading rates measured on single grains allows extrapolation to the non-fading luminescence component following a laboratory-induced irradiation. There has been other "isochron" approaches developed recently, however, a major limitation for these is that the sample investigated must be composed of a homogeneous grain population in terms of bleaching history.

Recently, we refocused our attention on single grain analysis in order a) to find a potential correlation between fading rate, composition and thermal/chemical treatment, or b) to detect and assess the abundance of feldspar grains in samples from various geological context, exhibiting a stable luminescence behavior (i.e. non-fading) or, otherwise, very low fading rates. This investigation uses a) K-feldspar and plagioclase single grains, b) fragments of crushed grains, mounted as individual aliquots, from which the sensitivity normalized natural luminescence is taken as a measure of inner-grain fading variability and c) feldspar inclusions in quartz. The measurement of natural and regenerated luminescence and of their associated anomalous fading rates is carried out using single aliquots. Their equivalent doses and AF-corrected paleodoses are obtained following a SAR protocol developed in Montréal.

In this presentation, we will integrate these recent results into a larger review of K-feldspar and plagioclase single grains investigations, evaluate their pertinence and usefulness, and finally draw guidelines for future investigation, in order to establish a universal luminescence dating method based on feldspar.

The application of optically stimulated luminescence (OSL) dating to late Quaternary deposits preserved beneath the eastern English Channel

C. L. Mellett, B. Mauz, D. M. Hodgson, A. J. Plater, A. Lang*

University of Liverpool, School of Environmental Sciences, Roxby Building, Liverpool, L69 7ZT

* *Corresponding author:* lang@liv.ac.uk

A stratigraphic model detailing the sequence and nature of processes responsible for sculpting the shallow continental shelf in the eastern English Channel has been developed through the interpretation of high resolution sub-bottom seismic records. The seafloor is an erosional unconformity and large sediment bodies are limited to palaeovalley infills and offshore extensions of present day coastal environments. In simplistic terms the stratigraphic model proposes fluvial incision and deposition during sea-level lowstand with periglacial processes operating on the sub-aerially exposed shelf under cold climate conditions. Subsequent sea-level rise triggers reworking of existing deposits and infilling of the palaeovalleys with shallow marine and coastal deposits that migrate in step with sea-level rise. The frequency and magnitude of sea-level changes during the late Quaternary lends to significant reworking of sediments during each glacial/interglacial cycle and remnants of previous cycles are rarely preserved. This study uses OSL dating to test the validity of the proposed stratigraphic model. Samples for OSL dating were taken from vibrocores tied to known seismic stratigraphic units representing fluvial, coastal and colluvial depositional environments. The single-aliquot-regenerative dose protocol was applied to 1 mm aliquots of fine quartz sand and individual aliquots were rejected following the criteria proposed by Wintle and Murray (2006). All samples exhibited low sensitivity and poor recycling ratios necessitating the rejection of up to 75% of all aliquots measured. A total of 40 to 60 aliquots were accepted per sample. For all samples regardless of depositional environment, normal equivalent dose (D_e) distributions were observed with overdispersion values typically <25% and weighted skewness values of ~0.2 advocating the application of the Central Age Model (CAM) to estimate D_es. The OSL chronology places periglacial reworking of existing estuarine deposits at ~18 ka, deposition of fluvial sediments preserved in palaeovalleys at ~15ka and progradation of a shoreface at ~8 ka. The ages are remarkably consistent with the stratigraphic model and provide the first chronological control on the timing of processes responsible for the morphological evolution of the continental shelf. We demonstrate the successful application of OSL dating to fluvial, coastal and colluvial deposits preserved in the eastern English Channel.

Recent developments of the Risø TL/OSLreader

T. Lapp[1], M. Jain[1], K. J. Thomsen[1], A. Murray[2].

[1] Radiation Research Department, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, 4000 Roskilde, Denmark (tlap@risoe.dtu.dk)
[2] Nordic Laboratory for Luminescence Dating, Department of Earth-Sciences, Aarhus University, Risø DTU, Roskilde, Denmark

* *Corresponding author:* tlap@risoe.dtu.dk

This presentation will give an overview of recently developed attachments and other improvements to the Risø TL/OSL reader, of relevance to applications in luminescence based dosimetry.
The existing RL option [1] has been improved to allow NIR detection (>860 nm) during irradiation by the built-in $^{90}Sr/^{90}Y$ beta source. The RL optical signal is collected by a liquid light guide through an F34-901 interference filter (850-945nm) and detection is based on a separate thermoelectrically-cooled NIR sensitive PMT. The geometry of the detection system has been improved compared to the earlier option so that the radiation source is significantly closer to the sample. Software and electronics have also been modified to allow standard TL and OSL measurements in the same sequence as an RL measurement. Together with a new bleaching source based on a high power bleaching LED (395nm; 700 mW/cm^2), this facility has been used to measure natural dose in feldspar using the decaying NIR RL signal [2]. Results showing the influence of preheat and heating during stimulation will be presented.
The existing Risø TL/OSL reader has separate CW-OSL and Pulsed OSL stimulation boards. These have now been combined into an improved single unit. Amongst other changes resulting from this redesign, the signal gating interval is now user-defined, and a sequence may now contain both CW and pulsed OSL commands. Results illustrating the use of this flexible gating will be presented.
It is well known that the radiation field of the built-in $^{90}Sr/^{90}Y$ beta source it not be spatially uniform across the sample area [3]. Here we present a method for mapping the non-uniformity using radiation sensitive film. This dose-rate map may be used for post-processing of single grain data acquired by the Risø reader. The effect of this correction on a dose distribution measured using a set of uniformly-dosed grains, is presented.
We also briefly summarise other novel additions to the reader that have been used recently to obtain new types of measurement: Time resolved exo-electron detection [3] and UV laser stimulation [4].

References

[1] L. Bøtter-Jensen et al. (2002). Enhancements in Luminescence Measurement Techniques. Radiat Prot Dosimetry 101 (1-4): 119-124
[2] G. Erfurt and M.R. Krbetschek (2003). IRSAR – A single aliquot regenerative-dose dating protocol applied to the infrared radiofluorescence (IR-RF) of coarse-grain K feldspar. Ancient TL 21: 21-28
[3] N.A. Spooner and A. Allsop (2000). The spatial variation of dose rate from $^{90}Sr/^{90}Y$ beta sources for use in luminescence dating. Radiation Measurements 32: 97-102
[4] S. Tsukamoto et al. (2010). Charge recombination processes in minerals studied using optically stimulated luminescence and time-resolved exo-electrons. Journal of Physics D: Applied Physics vol: 43, issue: 32, pages: 325502
[5] M. Jain (2009). Extending the dose range: Probing deep traps in quartz with 3.06 eV photons. Radiation Measurements vol: 44, issue: 5-6, pages: 445-452

Studies on the luminescence behaviour of a yellow stimulated signal (Y-OSL) from potassium feldspar

T. Lauer [1,2,3*], M. Krbetschek[3,4], M. Frechen[2]

[1] Institut für Geographie, Universität Leipzig, Johannisallee 19a, 04103 Leipzig
[2]Leibniz Institute for Applied Geophysics, Stilleweg 2, 30655 Hannover, Germany
[3]Institute of Applied Physics, TU Bergakademie Freiberg, ,Leipziger-Str. 23 , 09596 Freiberg, Germany
[4] Freiberg Instruments, Am St. Niclas Schacht 13, 09599 Freiberg, Germany

* *Corresponding author* tobias.lauer@uni-leipzig.de

In this study we investigated the luminescence properties of a yellow stimulated signal (Y-OSL) from potassium feldspar (410 nm emission) for dating sediments, such as the bleaching behaviour or the stability of the Y-OSL signal. Furthermore dose recovery tests were conducted on a Y-OSL SAR approach. Feldspar samples were collected from different source areas, e.g. dune sands from Israel, fluvial deposits from the Rhine system/Germany. Furthermore museum feldspars have been investigated. We demonstrate that the Y-OSL signal is characterized by a high stability and is only a little less light sensitive than the IRSL (50°C) signal. The dose recovery tests could successfully recover the given dose. Finally, samples for which independent age control is available were dated using the new Y-OSL approach. The results are in good agreement with the age control (Laacher See Tephra) and also fit well to quartz OSL dating results. All together it can be demonstrated that the Y-OSL signal has very good potential to date Quaternary sediments.

Characteristics of quartz and feldspar from southern California, USA

M. Lawson[1], B. Roder[1], D.Stang[1], E. Rhodes[1*]

[1] Department of Earth and Space Sciences, University of California, Los Angeles, 595 Charles Young Drive East, Los Angeles, CA 90095-1567, USA (erhodes@ess.ucla.edu)

* *Corresponding author:* erhodes@ess.ucla.edu

Southern California comprises a wide range of diverse landscapes and environments, from high mountains with glacial and periglacial sediments to deserts with large sand dunes, extensive alluvial fans and ephemeral playas. Highly active tectonic processes have exposed ancient (c. 2 Ga) plutonic and metamorphic basement from deep within the crust, while similar Paleozoic and Mesozoic rocks are also common. A rich array of volcanic lithologies extending into the late Quaternary complement many thick sedimentary sequences that formed in equally diverse ancient environments typical of an accreting active continental margin. In some locations, notably in the Coachella Valley close to Palm Springs and the Salton Sea, low OSL sensitivity and poor characteristics restrict the application of the quartz SAR protocol to date late Pleistocene and Holocene fluvial sediments. In other locations such as the Malibu coastline, high sensitivity of the quartz OSL signal is observed, despite local source rocks being dominated by volcanic lithologies. Problems of poor quartz characteristics, along with uncertainty in predicting quartz OSL behaviour for future dating campaigns poses a problem for projects, in particular for neotectonic contexts. While K-feldspar has been used extensively to date eolian and fluvial sediments in southern California, little information regarding signal stability is available. We explore the characteristics of both quartz and feldspar subsamples from eolian, fluvial, lacustrine environments, as well as samples from active weathering horizons, in order to help develop mineral selection criteria for optical dating applications and clarify these issues. The importance of dose quenching in quartz grains recently eroded from bedrock, and the role of wildfire in enhancing OSL sensitivity are considered. The relative bleachability of quartz and feldspar fractions, along with thermal stability considerations are discussed.

Preliminary study on characteristics of optically stimulated luminescence from $LiAlO_2$:C

J. Lee[1,*], J.-L. Kim[1], I. Chang[1], S. Kim[1], B.-H. Kim[1], K. Chung[2]

[1]Health Physics Team, Korea Atomic Energy Research Institute, PO Box 105, Yuseong, Daejeon, Republic of Korea, E-mail: jilee@kaeri.re.kr
[2]Department of Physics, Gyeongsang National University, Jinju, Republic of Korea, 660-701

* *Corresponding author:* jilee@kaeri.re.kr

Optically stimulated luminescence (OSL) has become a competitive method for personal dosimetry during the last 10 years (Pradhan et al., 2008), since OSL method for personal dosimetry has several advantages such as fast reading and multiple readings (Botter-Jensen et al., 2003). However, there are very limited synthetic materials which can be applicable for personal dosimetry. α-Al_2O_3:C is most widely used OSL material which was originally developed as an high-sensitive TLD material (Botter-Jensen et al., 2003). It has several drawbacks for TLD material (light induced fading and high thermal quenching), however the light induced fading of the TL signal from Al_2O_3:C leads to intensive study to use Al_2O_3:C as an high-sensitive OSL dosimetry material.

These days, neutron dosimety has become an important matter in personal dosimetry due to rapidly increasing numbers of nuclear power plant in the world. An OSL detector for neutron dosimetry made by Al_2O_3:C powder and $^6Li_2CO_3$ (neutron converter) has ~60% of the neutron sensitivity of ^{6}LiF:Mg,Ti (TLD-600) TL material (Yukihara et al., 2008). It may be considered very weak neutron sensitivity because the gamma sensitivity of Al_2O_3:C is over than 50 times higher than TLD-600. Therefore, new studies for development high neutron sensitive OSLD materials are strongly encouraged.

In this study, OSL characteristics of $LiAlO_2$ doped with carbon are presented and the possibility of using this material as an OSL dosimeter is demonstrated. The main motivation of this research is in development of high sensitive neutron OSL dosimeter. The ^{6}Li element can be self neutron converter in $^6LiAlO_2$ at the energy absorption process during neutron irradiation. The $LiAlO_2$:C was grown by using Czochralski method, and it was powdered. OSL measurements were carried out using Risoe TL/OSL-DA-20 with CW-mode. The OSL intensity of $LiAlO_2$:C is around 3 times higher than that of Al_2O_3:C in summation of the OSL in initial two seconds. The decay rate of OSL of $LiAlO_2$:C is steeper than that of Al_2O_3:C.

References:

Botter-Jensen, L., McKeever, S.W.S., Wintle, A.G., 2003. Optically stimulated luminescence dosimetry. Elsevier, Amsterdam.

Pradhan, A.S., Lee, J.I., Kim, J.L., 2008. Recent developments of optically stimulated luminescence materials and techniques for radiation dosimetry and clinical applications. J. of Medical Physics 33, 85-99.

Yukihara, E.G., Mittani, J.C., Vanhavere, F., Akselrod, M.S., 2008. Development of new optically stimulated luminescence (OSL) neutron dosimeters. Radiat. Meas. 43, 309-314.

Luminescence dating of Chinese Loess beyond 130 ka using the non-fading signal from K-feldspar

B. Li*, S.-H. Li

Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China

** Corresponding author: boli@hku.hk*

Optical stimulated luminescence (OSL) dating of Chinese loess beyond 130 ka has long been a challenge for luminescence researchers, mainly due to the early saturation of quartz OSL signal. Feldspar is a promising candidate for extending the luminescence dating limit due to its much higher saturation dose. However, the anomalous fading of the infrared stimulated luminescence (IRSL) signal from feldspar has hampered the successful application of feldspar in optical dating. It is found that a multiple IR stimulation procedure with increasing stimulation temperature is able to isolate the non-fading IRSL signal. A protocol for optical dating of feldspar is proposed, which utilizes the IRSL signals measured by progressively increasing the stimulation temperature from 50 to 250°C in a step of 50°C, and is called multi-elevated-temperature post-IR IRSL (MET-pIRIR) protocol. The laboratory fading test for a K-feldspar sample showed that there are negligible anomalous fading rates (g values) for the MET-pIRIR signals obtained at 200°C (g=0.4±0.7%/decade) and 250°C (g= -0.2±0.6%/decade). Hence, no fading correction is required.

Measurement of modern samples and bleached samples indicates that the MET-pIRIR signals are bleachable and have small residual doses (less than 5 Gy). The growth curve for the MET-pIRIR signal at 250 °C does not show saturation up to ~1000 Gy, which allows reliable equivalent dose (D_e) determination up to ~800 Gy ($2D_0$). Apart from the performance tests using dose recovery, recycling ratio, recuperation and preheat plateau tests, the reliability of the protocol has been tested using various sedimentary samples with different ages from China. It was observed that the MET-pIRIR ages obtained at 200 and 250 °C are consistent with independent or quartz OSL ages.

The MET-pIRIR protocol has also been applied to date loess samples from the Luochuan section from the Chinese Loess Plateau using potassium-rich feldspar extracts. It was observed that the MET-pIRIR ages obtained at elevated temperatures (200 and 250°C) are consistent with independent chronological control for the samples from the Holocene palaeosol layer (S0) to the third paleosol layer (S3, corresponding to the marine isotope stage of MIS 9). Our results indicate that the MET-pIRIR protocol can provide reliable ages for the Chinese loess up to 300 ka. The results suggest that, for young samples (<100 ka), it is preferable to use the MET-pIRIR signal at 200°C due to its low residual age. However, the MET-pIRIR signal measured at 250°C gives the most reliable ages for older samples (>100 ka).

IRSL dating of fluvial, lacustrine, and aeolian sediments from southern Patagonia, Argentina

G.-Q. Li[2,1] G. A. Brook[1*] N. V. Franco[3] H. Zhao[4] F.-H. Chen[2]

[1] *Department of Geography and UGA Luninescence Dating Laboratory, University of Georgia, Athens, GA, USA*
[2] *Key Laboratory of Western China's Environmental Systems (Ministry of Education), Lanzhou University, Lanzhou, China*
[3] *CONICET (IMHICIHU) Departamento de Investigacióne Prehistoricas y Arqueológicas, Universidad de Buenos Aires, Argentina*
[4] *Key Laboratory of Desert and Desertification, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, China*

** Corresponding author: gabrook@uga.edu*

The luminescence dating of the K-feldspar sediment fraction is an alternative for samples that cannot yield a reasonable equivalent dose (D_e) from quartz with a very weak luminescence signal. Anomalous fading of the IRSL signals can lead to age underestimation (Spooner, 1992, 1994) but the g-value method can be used to estimate the age underestimation (Auclair *et al*., 2003; Huntley and Lamothe, 2001; Huntley and Lian, 2006). However, the g-value correction method cannot give reliable ages for Holocene samples due to the large measurement errors. Although a K-feldspar IRSL age measured at 50°C using the SAR protocol is approximately 10% younger than the equivalent quartz age, it can still be used to develop a reasonable chronological framework for sediment deposits (Li *et al*., 2011). Post IR IRSL (Thomsen *et al*., 2008) ages using the signal observed at 225°C after IR measurement at 50°C are apparently closer to true burial ages than IRSL ages, since Post-IR IRSL fading rates are significantly lower than those measured at 50 °C (Buylaert *et al*., 2009). In southern Patagonia the first indications of human presence are dated at *ca*. 9,700 ^{14}C years BP. A major problem in luminescence dating sediments from this area is the paucity of quartz in most samples. To overcome this, the Post IR IRSL method was used to date quartz-poor fluvial, beach ridge, and dune sediments in the Lago Argentina, upper Santa Cruz River, and Gregores areas to obtain Holocene paleoenvironmental information. Most samples were collected near the archaeologically important La Gruta (to 12,895-12,587 cal yr BP) and Rio Bote (to 6635-6408 cal yr BP) rock shelters *(Franco et al.*, 2004/3). Rio Bote was repeatedly used as a burial place between ca. 4228-3985 to 2306-1952 cal yr BP and contains the remains of several human burials. Post IR IRSL ages for feldspar were accordant with quartz SAR ages in well-bleached dune and beach ridge samples containing both quartz and feldspar. However, the Post IR IRSL approach greatly overestimated the ages of incompletely bleached fluvial sediments with IRSL ages proving more reliable. The suite of luminescence ages obtained during this study has provided new information on past wet and dry climatic periods in southern Patagonia and how these influenced human activities during the Holocene.

Keywords: IRSL dating Holocene environment changes Post IR IRSL ages

Holocene environmental changes in Hunshandake desert based on OSL dating and multi-proxy study of dune sands

S.-H. Li[1,*], Z, Gong[1], ,J. Sun[2], L. Xue[2]

[1] Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China
[2] Institute of Geology and Geophysics, Chinese Academy of Sciences, P.O. Box 9825, Beijing 10029, China

* *Corresponding author: shli@hku.hk*

Aeolian deposits from the south part of Hunshandake Desert in northern China were studied to reconstruct the Holocene environmental changes based on Optically Stimulated Luminescence (OSL) dating, magnetic susceptibility and grain size analysis. The results indicate that the sand deposits formed between 11.8 to ~ 9.9 ka ago have relative low magnetic susceptibility and have more coarse grain distribution. These results suggest that the region at that time was mainly controlled by arid climate, mainly affected by strong winter monsoon and weaken summer monsoon. The sand dunes were highly active during that period. Loam soils were developed above the sand layer, which have relative high magnetic susceptibility and have more fine grain distribution. OSL dating results suggest that the soil layer was formed between ~9.9 ka ago to ~4.3 ka ago. These results suggest that the climate became warm and humid between ~9.9 ka ago to ~4.3 Ka ago and this region was dominated by strong summer monsoon and weak winter monsoon at that time, which leads to the stabilization of active sand dunes during that period. The forming of loam soils was associated with Holocene Optimum period. After that, between ~4.3 and ~3.0 ka ago, the soil were weakly developed. Results indicated that this area was mainly controlled by less warm and less humid climate and the summer and winter monsoons were weak between ~4.3 and ~3.0 ka ago. After ~3.0 ka ago, sand deposits were developed again and was interrupted by a weak soil development occurred at ~2.6 ka ago The region generally became arid after ~3.0 ka ago, as it was affected by decreased summer monsoon and enhanced the winter monsoon.

Luminescence chronology of Buha river terrace and aeolian deposits from Qinghai Lake area in Northeastern Qinghai-Tibetan Plateau

X.J. Liu[1,2,*], Z.P. Lai[1], D. B. Madsen[3], Y. Sun[1,2]

[1] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China (*Email: xjliu@isl.ac.cn)
[2] Graduate School of Chinese Academy of Sciences, Beijing 100049
[3] Texas Archeological Research Laboratory, University of Texas, Austin, TX 78712, USA

* *Corresponding author:* xjliu@isl.ac.cn

Since 1960s, Qinghai Lake has been intensively studied for paelaeoenvironmental changes by international geoscience communities due to its unique location and sensitivity to global changes. These studies have focused on core-based multi-proxy reconstructions and shoreline histories covering the last deglaciation to late Holocene period. Aeolian deposits and river terraces in the Qinghai Lake area are also important climatic archives that are independent of lake sediments, and studies of these sediments are relatively rare compared to lacustrine sediment investigations, especially for the chronology. Buha River is the major supplier of water to Qinghai Lake, constituting ~67% of annual run-off. River terrace formation is appears to be associated with rising and falling lake levels that changed the gradient of the river. The aeolian deposits are widely distributed around the lake. In this study, aeolian deposits and Buha river terraces were investigated and dated using quartz optically stimulated luminescence (OSL) employing a single aliquot regenerative-dose (SAR) protocol. The proposes of this investigation are: (1) to reconstruct the chronology framework of aeolian deposition around Qinghai Lake; (2) to date river terraces and fluvial deposits of Buha river for the first time using OSL dating method; (3) to establish the relationship between lake level fluctuations, river terrace formation and aeolian process.

Keywords: Tibetan Plateau; Qinghai Lake; Buha river terrace; Aeolian deposits; Luminescence dating; Palaeoenvironmental changes.

Optical dating of dammed lake sediments from Karakoram Mountains in western Tibetan Plateau

J. Liu*, J. Chen, C. Wang

State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China

* *Corresponding author:* liujf81@sohu.com

The Tashkorgan-Yarkant River, which is the upper reach of the Tarim River, originates from the Karakoram Mountains in the west syntaxis of the Tibetan Plateau. Thick lacustrine sediments are widespread along the Tashkorgan-Yarkant River. The distribution of these sediments suggests that some events blocked the river, forming the dammed lakes. These deposits contain geologic fingerprints that allow identification of the environmental changes and geologic hazards. However, few geochronological data was available on these sedimentations allow us to build an irreproachable age model. 16 samples of fine grains from two lacustrine profiles were dated by means of optically stimulated luminescence (OSL).

In darkroom, fractions of fine grains (4-11μm) were extracted from respective whole samples. All measurements were performed on an automated Daybreak system. The recycling ratio test, recuperation test and dose recovery test of one fine grain Qz samples were performed using the SAR protocol. Identical De plateau in the thermal treat was observed in preheat plateau test. Tests of luminescence characteristics confirm the suitability of the material for OSL dating. Comparison of infrared (IR), post-IR blue, (Post-IR) IR and blue OSL characteristics of the fine grain sediments from the lacustrine deposits were presented here. Based on the above results, we selected the reliable signal as a chronometer to dating the samples. Our results indicated the deposition age for these sediments around mid-Holocene.

The Karakoram Mountains massif is tectonically active and contains the glacierized mountains in western Tibetan Plateau. The steep slopes along both sides of the Tashkorgan-Yarkant River are high-risk regions for slumps, landslides, and debris flows. The occurrence of past geological events such as earthquakes, slumps, ice advancing and landslides might result in the river being blocked, forming dammed lakes.

Optically stimulated luminescence signals in core-top sediment samples from western Arctic Ocean

N. Liu[1]*, L. Zhou[1], R. Wang[2]

[1]Laboratory for Earth Surface Processes, Department of Geography, Peking University, Beijing 100871, China
[2]State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China

** Corresponding author: nkl@pku.edu.cn*

Optically Stimulated Luminescence (OSL) offers a potential tool for dating sediments from the Arctic Ocean, where foraminiferal shells are relatively scarce, hence rendering a difficulty for the establishment of an oxygen isotope-based stratigraphy. One of the key requirements for a successful application of the OSL dating method is the reset of the luminescence signals at the time of deposition. In this study, we examined the OSL signals in 17 core-top samples coming from the western Arctic Ocean. The cores were collected during Chinese Second, Third and Fourth Arctic Research Expedition. Spatially these cores are distributed in Chukchi Plateau, Northwind Ridge and Mendeleev Ridge within the latitude between 74°04.05'N and 88°23.66'N. The water depth of the cores ranges from 320m to 4000m. Fine silt-sized quartz was extracted and the OSL measurements were made on an automated Risø TL/OSL -DA-20 reader equipped with EMI 9235QA photomultiplier tube and 7.5mm Hoya U-340 filters (290-370nm). All samples were found to display non-zero OSL signals, indicating the presence of residual luminescence in the core-top sediment samples. Further experiments were then made to estimate the size of the residual signals. The single-aliquot regenerative-dose (SAR) protocol was applied with a preheat of 10s at 260^{o}C prior to the OSL measurement and a second preheat of 10s at the same temperature prior to the measurement of the test dose. This protocol was chosen as it gives better results than other protocols in both dose recovery test and linearity test. Due to the scarcity of the materials available, only 2-7 aliquots were measured so far for each of the 17 samples. The apparent equivalent dose for the 17 samples varies from 23 Gy to 249 Gy with precisions ranging from 0.8% to 33.1%. Samples from the coarser grained units seem to have larger D_e values than the ones from finer grained units. However, more detailed analysis of the data with respect to their sedimentary processes is ongoing. Overall, our results seem to echo previous warnings on the possible age overestimation for marine sediments from other parts of the Arctic Ocean.

Keywords: the Arctic Ocean, marine sediments, OSL, quartz

Quartz and feldspar luminescence properties from (glacio-)fluvial deposits along the northern Alpine Foreland

J. Lomax[1*], P. Schielein[2], L. Bickel[1], M. Fiebig[1]

[1]Institute of Applied Geology, BOKU Vienna, Peter Jordan Str. 70, 1190 Vienna, Austria (Johanna.lomax@boku.ac.at)
[2] Department of Geography, University of Bamberg, Am Kranen 1, 96045 Bamberg, Germany.

* *Corresponding author:* Johanna.lomax@boku.ac.at

The European Alps and their foreland contain manifold Quaternary sediments - a legacy of the waxing and waning of Alpine valley glaciers. The age of many of these glacial, glaciofluvial and glaciolacustrine sediments is currently unknown due to a lack of appropriate dating techniques. Luminescence dating of the quartz fraction has shown to be difficult in the study area, due to weak and instable signal components, often leading to age underestimation. Feldspar signals are usually bright, thus can be measured more precisely, but the question of fading of this mineral fraction has so far not been answered to full extent. Also, under some circumstances as e.g. short fluvial transport distances, both mineral fractions can be severely incompletely bleached. In this study we explore luminescence properties of both mineral fractions from different sites along the northeastern Alpine Foreland. We try to link these properties and bleaching potential to depositional environments, sediment provenances and sedimentations cycles. Thus, this study may serve as guideline to where sampling for luminescence dating appears feasible and where not in the context of our study area.

Holocene moist period recorded by the chronostratigraphy of a lake sedimentary sequence from Lake Tangra Yumco on the south Tibetan Plateau

H. Long[1,2,3,*], Z.P. Lai[1] , P. Frenzel[4], M. Fuchs[2], T. Haberzettl[5], J.R. Zhang [1,3]

[1] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China ([*]E-mail: longhao@isl.ac.cn)
[2] Geographical Institute, University of Bayreuth, 95440 Bayreuth, Germany
[3] Graduate School of Chinese Academy of Sciences, Beijing 100049, China
[4] Institute of Geosciences, Friedrich-Schiller-University Jena, 07749 Jena, Germany
[5] Physical Geography, Institute of Geography, Friedrich-Schiller-University Jena, 07743 Jena, Germany

* *Corresponding author:* longhao@isl.ac.cn

Palaeolimnological studies together with geomorphological studies of lake shorelines provided valuable palaeoclimate records on the Tibetan Plateau. Radiocarbon dating is the most commonly used method for establishing chronologies of these lake sediments. However, ^{14}C dating of such sediments could be problematic due to the lack of organic matter or a reservoir effect, which appears common in radiocarbon dating of lacustrine sediments from the Tibetan Plateau. Optically stimulated luminescence (OSL) dating is an alternative for dating the lake sediments and also provides the opportunity to independently test radiocarbon chronologies. This study presents a set of three directly comparable paired OSL and accelerator mass spectrometry (AMS) radiocarbon ages for a lacustrine sedimentary sequence (TYC section, a offshore profile at 31°16.083' N and 86°38.120' E) from Tangra Yumco lake on the southern Tibetan Plateau. The fine-grain quartz is extracted for OSL dating. The results suggest that: (1) it is possible to obtain robust OSL age estimates for these lake sediments and the OSL ages of three samples range from ca. 7 ka to ca. 2 ka; (3) The discrepancy between the two dating techniques will be considered, which possibly results from the age overestimate of ^{14}C dating due to the hard water reservoir effect in the study area; (4) the chronostratigraphy of TYC section shows a large lake with a lake level distinctively above the present one during ca. 7-2 ka indicating a wet period in study area.

Keywords: OSL dating; Radiocarbon dating; Lake sediments; Holocene climate change; Tibetan Plateau

OSL and sediment accumulation rate models: understanding the history of sediment deposition

G. I. López[1,2,*], J. W. Thompson[3]

[1] School of Geography & Earth Sciences, McMaster University, 1280 Main Street West, Hamilton, Ontario, Canada, L8S 4K1.
[2] Leon H. Charney School of Marine Sciences, University of Haifa, Mt. Carmel, Haifa, Israel, 31905.
[3] Department of Medical Physics and Applied Radiation Sciences, McMaster University, 1280 Main Street West, Hamilton, Ontario, Canada, L8S 4K1.

** Corresponding author:* lopezgi@mcmaster.ca (lopezgi@sci.haifa.ac.il)

Over the past 8 years, several types of coastal deposits have been successfully dated on different time scales using Optically Stimulated Luminescence (OSL), allowing for the high resolution reconstruction of coastal environments. In some cases, the timing of vertical accretion of dune and/or beach ridges has been successfully obtained when continuous OSL samples have been taken throughout the deposit (e.g. from long vertical sediment cores and/or several short horizontal cores taken from the face of the deposit).

However, little has been done to establish OSL age-based sediment accumulation models that may provide a better interpretation of the sedimentological history of the deposit itself. In general, coastal deposits can be very dynamic systems that may not follow constant linear accumulation rates through time. Hence, the importance of linking more acurately the type of depositional process with the OSL age-based accumulation model implemented.

The low terrestrial dose rate environment leads to an unusual situation in which sample ages depend on the rate of accumulation of the overburden. We have developed a mathematical model in which sample ages are coupled through the cosmic dose rate. These coupled ages provide constraints on the model accumulation profiles.

The dependence of sample age on accumulation rate will be outlined. Sample ages will be compared with leading models of dune and beach ridge formation.

Keywords: OSL, sediment accumulation rates, coastal sediments

A systematic test of an elevated temperature post IR-IRSL protocol for the dating of middle-Pleistocene waterlain sediments

S. E Lowick[1*]; F.Preusser[2]

[1]Institute for Geological Science, University of Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland (e-mail: lowick@geo.unibe.ch),
[2]Department of Physical Geography and Quaternary Geology, Stockholm University, SE-106 91 Stockholm, Sweden (e-mail: frank.preusser@natgeo.su.se)

* *Corresponding author:* lowick@geo.unibe.ch

With the aim of understanding the formation and development of overdeepened valleys in the north of Switzerland, optically stimulated luminescence has been applied to their sediment infill. From palynological evidence within these sediments, it is clear that they are at least 300 ka and so lie beyond the scope of dating using the quartz fraction for this region. While the feldspar infrared stimulated luminescence (IRSL) signal has the potential to reach much further back in time, it is often seen to suffer anomalous fading which results in age underestimations. Recent studies on feldspar have reported promising results where the application of a second IRSL stimulation at an elevated temperature (post IR-IRSL) accesses a signal that appears to suffer significantly less, and possibly no, anomalous fading. Preliminary results on samples from one Swiss site also looked promising and so a systematic test of the protocol was undertaken on a suite of ten samples of waterlain sediments taken from four different sites to the north of the Alps in Switzerland. Using the polymineral fine grain fraction, two protocols were tested using elevated stimulation temperatures of 225º C and 290º C. Measurement of the burial and residual doses was made, as well as conducting dose recovery and fading tests. The results highlight some problems with the post IR-IRSL protocol when applied to these particular samples, and suggest that it may not be appropriate for all types of sediment.

Building on previous OSL dating techniques for gypsum: a case study from salt Basin Playa, New Mexico, USA

S. Mahan[1*], J. Kay[2]

[1]U. S. Geological Survey, Box 25046, MS 974, Denver Federal Center, Denver, CO 80225
[2]Daniel B. Stephens and Associates, Inc., 6020 Academy Road NE, Suite 100, Albuquerque, New Mexico 87109

** Corresponding author: smahan@usgs.gov*

Attempts have been made to date gypsum by means of stratigraphy and radiocarbon on organic material incorporated in the crust (Watson, 1988; Page, 1972; Magee, 1991) or using electron spin resonance (ESR) (Ikeya, 1978; Nambi, 1982; Ikeda and Ikeya, 1992; Mathew et. al, 2004). One of the first references to dating gypsum using blue-light stimulated OSL comes from a combined study on the gypsum from the Thar Desert (India) and the White Sands National Monument (New Mexico, USA) by Singhvi et al (2006), Kocurek et al (2007), and more substantially and methodically by Nagar (2007) who combined OSL with ESR. Nagar's unpublished Ph.D. thesis (2007) contains the complete summary of his groundbreaking methodological work, although at least one paper has resulted from the study (Nagar et al, in press). Heartened by the recent partial successes and suggestions for further research given by Nagar (2007, 2010) and Lepper (2008), we opted to try and date the gypsum where the paucity of quartz and feldspar in the study area seemed to preclude any OSL determinations. We built on the concept that natural gypsum has been shown to yield stable signal characteristics and large recoverable saturation doses (Lepper, 2008). Our samples were collected from the Salt Basin Playa as shallow (less than 1.5 m from the present surface) cores from strategically placed locations. The core samples were primarily composed of crystalline gypsum (*var*. selenite) with minor amounts of calcite, detrital clay, or quartz.

The Salt Basin lies at the far eastern extent of the Basin and Range physiographic province in the southeastern section of the State of New Mexico, USA. Since the Salt Basin is an internally drained "closed" basin, groundwater recharge occurs primarily in the higher elevations at the margins of the basin, and in arroyos or other surface drainage features where a concentration of rainwater occurs. Pre-groundwater development discharge from the basin is thought to have occurred largely as evaporation of shallow groundwater from playa beds located along the east-central portion of the basin floor, in the Salt Basin Playa area. Prior to the 20th century, the Salt Basin was in a state of hydrologic equilibrium. Since historic (steady-state) basin discharge likely occurred primarily as evaporation from the playas then historic and prehistoric playa evaporation can be used to estimate groundwater basin recharge if the gypsum that has precipitated in place can be dated.

Twenty five samples were processed for OSL, but only seven samples had adequate quartz for use in conventional OSL dating. None of the samples had adequate potassium feldspars for IRSL dating (potassium was <0.30 percent in every case). This presentation will introduce the laboratory techniques used to refine the gypsum, and in some cases, to separate the gypsum from the quartz. Results of dose rate calculations, preheat tests, sensitivity and mineralogical changes during preheat, and signal fading for the gypsum will also be presented. A Risoe TL/OSL TL/DA-15 reader fitted with blue LEDs was used for the measurements of equivalent dose for both minerals. We will explore in some detail the effects of the preheating on the transformation of gypsum into hemi hydrate or anhydrite, since this should affect the OSL decay curve due to dehydration. Indirect age estimates for the gypsum were used from the few samples that had quartz. These quartz samples became a "calibration check" if they showed acceptable single aliquot regeneration (SAR) characteristics. These characteristics included a fast OSL component, a bright signal, adequate preheat and recycle ratios, and test dose responses. Finally, we will present the rather vexing results of our gypsum vs. quartz equivalent dose data.

Quartz OSL dating of Quaternary Sediments from Na Noi, a prehistoric site of Northern Thailand

M. Mailliez[1,2*], J-H. Choi[1], N. Mercier[3], V. Zeitoun[4], H. Forestier[5], M. Rasse[6], P. Auetrakulvit[7], C. Tiamtinkrit[8]

[1] Division of Earth and Environmental Sciences, Korea Basic Science Institute, Ochang Centre, Chungbuk 363-883, South Korea
[2] Department of Isotope Geochemistry, University of Science and Technology, Daejeon 305-350, South Korea
[3] Institut de Recherche sur les Archéomatériaux, UMR 5060 CNRS - Université de Bordeaux, Centre de Recherche en Physique Appliquée à l'Archéologie (CRP2A), Maison de l'archéologie, 33607 Pessac Cedex, France
[4] UMR 9993 CNRS-Musée Guimet, 19 avenue d'Ièna, 75116 Paris, France
[5] UMR 208 IRD-Mnhn, 32 rue Varagnat, 93143 Bondy, France
[6] Département de Géographie, Unversité de Rouen, Rue Lavoisier, 76821 Mont Saint-Aignan, France
[7] Department of Archaeology, Silpakorn University, Bangkok, Thailand
[8] 6th Archaeological Division of Fine Arts Department, Nan Museum, Thailand

** Corresponding author: mmailliez@kbsi.re.kr*

In this paper, we report quartz OSL ages of Quaternary sediments from a prehistoric site in Northern Thailand: Na Noi (Nan province), based on coarse and fine quartz grains recovered from sedimentary layers which are related to archaeological stone tools. This site is made up of several flights of Quaternary river terraces and a few hundreds of stone tools, similar to those found in Bose basin (Southern China), were excavated from within the upper layer of the terrace sediments. Four samples were collected in stratigraphic order from a ~1.5 meters thick soil profile, where large pebble tools were found (~70-90 cm from the soil surface). In previous archaeological excavations, choppers, chopping-tools, unifacial tools and transversal cutting edge pebble tools are reported to have been found within or near these sediments, thus, together with pebble tool assemblage excavated, this soil profile has been regarded as corresponding to Middle to Lower Palaeolithic. However, our quartz OSL ages of the sediments seem to indicate considerably younger ages. Indeed, coarse quartz grains OSL ages give us a stratigraphically consistent chronology of the late Upper Palaeolithic, ranging 1-22 ka, from top to bottom; the OSL age of the archaeological layer is estimated to be 12 ka based on coarse quartz grains. Even if our preliminary fine grain OSL ages present systematically higher D_e values (up to ~ 4 times higher for the topmost sample, which is at ~ 15 cm from the surface) than those of coarse grains, which may be due to incomplete bleaching of fine grains at deposition, the age range still stays within the Upper Palaeolithic. These young OSL ages of the sediment layers from the prehistoric site of Na Noi are expected to bring new information on human settlement and activities in South-Eastern Asia, implying that the pebble tool industry may have continued up to Upper Palaeolithic and Neolithic boundary in this area.

Keywords: Na Noi, Thailand, Pebble tools, Quartz OSL dating, Palaeolithic

Radioluminescence of natural and synthetic quartz

M. Martini[1,2*], M. Fasoli[1], A. Galli[2,3], I. Villa[1], P. Guibert[4]

[1]Dipartimento di Scienza dei Materiali, Università degli Studi di Milano Bicocca, via R. Cozzi 53, I-20125 Milano (m.martini@unimib.it)
[2] INFN, Sezione di Milano Bicocca, Piazza della Scienza 1, I-20126 Milano
[3] CNR-IFN, Via R. Cozzi 53, I-20125 Milano
[4] IRAMAT-CRP2A, UMR CNRS 5060, Université Bordeaux III, F-33608 Pessac, France

* *Corresponding author:* m.martini@unimib.it

The assignment of the luminescence emission bands to the responsible defects in quartz is far to be clear. The various emissions are still to be unambiguously identified, partly due to the complex inter-relations between defects. Three main emission bands are always reported, as the red, blue and UV bands, centered at around 650, 470 and 360-380 nm, respectively. We studied the Radioluminescence (RL) of a natural and a synthetic quartz, with the aim of better understanding the origin and the components of these emission bands. The natural quartz, whose origin and impurity composition was known, was submitted to thermal treatments in different controlled atmosphere, in oxygen, in air, in hydrogen and in vacuum and the RL before and after the treatments was measured. The synthetic quartz, manufactured by the French GEMMA Quartz & Crystal Company was submitted by the producer to different "sweeping" procedures: by applying an electric field parallel to the c-axis of the crystal, while maintaining the temperature in the 450-550°C range, it was possible to "sweep in" specific ions and simultaneously "sweep out" others, depending on the electrodes used and on the sweeping atmosphere. Besides the "unswept" samples, hydrogen, lithium, sodium "swept in" samples and "vacuum swept out" samples were studied. The emission spectra obtained from natural and synthetic samples, variously treated, were analyzed and could be de-convoluted, showing always the same four bands, one of them being composite, with different behavior for the two components. The bands were centered at 1.9 eV (650 nm), the "red band" always weak in our samples, at 2.6-2.8 eV (440-480 nm), the "blue band" which was detected as a double emission, at 3.4 eV (365 nm), the "UV band" and at 4.0 eV, a further UV band, unreported so far. The relative intensities of the bands appeared to be related to the variations of the impurity concentrations in the synthetic quartz, giving a clear indication that most of them should be related to the so called "Al centers", where alkali and hydrogen ions move in and out. The effect of the irradiation, during the RL measurements was evident only in the "Li swept in" sample, where the 2.6 eV band increased in intensity and the 2.8 eV decreased, independently, i.e. the total intensity increased. Analogously in the natural sample, variously treated we observed the growth of the 2.6 eV band and a decrease of the 2.8 eV band. The initial intensities of all the emissions were strongly dependent on the different thermal treatments. A huge increase of the intensity of the 3.4 eV band was observed after repeated irradiation and thermal treatments, analogously to the well known pre-dose effect. In the light of the mentioned results, some assignments of the detected emission bands to impurity defects can be proposed.

The effectiveness of alpha radiation in quartz at high environmental doses

B. Mauz[1,*] , Z. Shen[2]

[1]School of Environmental Sciences, University of Liverpool, Liverpool L69 7ZT, UK; mauz@liv.ac.uk
[2]Department of Earth and Environmental Sciences, Tulane University, New Orleans, LA 70118, USA

* *Corresponding author:* mauz@liv.ac.uk

An alpha particle is a nucleus with a high mass and the associated stopping power results in a spatially restricted deposition of energy in matter. At low environmental doses the luminescence effect of an α-particle in quartz is limited to a small grain volume along the track. At higher α-doses tracks overlap and the spatial energy distribution effect of α-particles should disappear (Zimmerman, 1972). In fact, the α-growth curve is linear until higher doses than the β-growth curve (Zimmerman, 1972) but at doses close to saturation the energy distribution should become uniform resulting in an equal luminescence response to α- and β-doses. For the linear dose response the alpha efficiency (quantified by the '*a*-value', Aitken, 1985) should be less than unity, whereas for non-linear dose responses the *a*-value should approach 1 if concentration of luminescence centres were infinite. It was shown by several studies that the quartz *a*-value for linear dose responses is typically around 0.03 and independent of sample origin (e.g. Aitken, 1985; Rees Jones, 1995). If the alpha effectiveness for non-linear dose responses is dependent on the concentration of luminescent defect centres, then the corresponding *a*-value should be >0.03 and ≤ 1. We have conducted a series of experiments following suggestions from Huntley et al. (1988). The *a*-value at high environmental doses was determined and, based on these data, it was assessed if the alpha efficiency at high doses is sample dependent. Three fine-silt quartz samples from different geological regions were used. These were first zeroed by heating to 450 ^{0} C and then irradiated by beta and alpha radiation where the ratio of alpha to beta dose is close to that in nature (i.e. 2.35, Aitken 1985). The doses administered where measured using a TT-OSL protocol which has been tested for each sample using a standard beta dose recovery test. The *a*-value was then calculated using equation $a = \frac{D_{e\beta} - D_{\beta}}{D_{\alpha}}$. In a second experiment the dose response to alpha radiation was measured to determine the track length (*L*) and cross section area (*A*)of tracks using the the exponent [1-e^{-AL}] of a single exponential saturation function. We observe TT-OSL dose-response curves that are perfectly described by a single exponential function and associated D_0 values are around one order of magnitude higher than those of the OSL fast component for all three samples studied. The *a*-values of all three samples increase with increasing alpha- and beta-dose to >0.3. We will be presenting the exponential dose-responses to combined alpha and beta irradiation, show the non linearity of *a*-value growth with given dose and discuss departures from exponential fits.

References

Aitken, Thermoluminescence Dating (1985); Huntley and Berger, Radiation Effects 105, 279 (1988); Rees-Jones, Ancient TL, 13, 9 (1995); Zimmerman, Radiation Effects 4,81 (1972).

In-situ dating of geomorphologic features on the surface of Mars

R. DeWitt[1], S.W.S. McKeever[1,*]

[1]Department of Physics, Oklahoma State University, Stillwater, OK, USA (rkalchg@okstate.edu)

* *Corresponding author:* stephen.mckeever@okstate.edu

On the Martian surface, aeolian, fluvial, periglacial, and volcanic processes appear to have remained active through the present day. Establishing an accurate chronology is critical to addressing many of the outstanding questions regarding the climate of the planet. Our goal is to provide this chronological context for processes that have occurred during the last 1 Ma. In this presentation we summarize progress in our efforts to develop a method for in situ dating of regolith on the surface of Mars. We discuss luminescence properties of various minerals expected to be present on the surface of the planet and we describe the prototype for a robotic luminescence reader currently under development.

Any OSL dating method for Martian regolith must be robust and suitable for the challenges that may be encountered on Mars, including low temperatures, a unique radiation environment, and a variable dose rate. We studied a wide variety of minerals expected to be present on Mars, such as plagioclase feldspars, high calcium and low calcium pyroxenes, sheet silicates, sulfates, iron oxides, as well as andesitic and basaltic rock samples, and 3 Martian soil simulants. We tested their relative OSL and IRSL sensitivities when the UV signal is detected, and calculated their relative contributions to the total signal, based on their mineral abundances. The largest contribution stems from the plagioclase feldspars, which account for 98% of the total IRSL signal and more than 80% of the OSL signal, respectively. Diopside, ilmenite, and sheet silicates contribute to the OSL signal as well. We measured the dose responses of the most important minerals and determined a maximum measurable dose by fitting with a saturating exponential. We also determined the relative OSL fading rates.

Our prototype Optical Dating Instrument (ODIN) performs all standard operations necessary for OSL dating. ODIN is equipped with a soil tumbler assembly to separate magnetic particles and to screen grains smaller than 250µm. Aliquots of a defined volume are deposited into copper cups and transported from the loading position to the measurement position via a stepper-motor-driven turntable. The OSL unit performs optical stimulation and irradiation at the position under the PMT. Subsamples can be stimulated with blue (470 nm) or IR LEDs (870 nm). Broadband interference filters are used to narrow the bandwidth of the stimulation light and to prevent an overlap with the detection band. A photomultiplier with filters is used to detect the luminescence signal in the band 330 to 370 nm. A spring-loaded heater at the position under the PMT allows the temperature to be ramped at computer-controlled rates. The upper temperature limit is 200°C, a stimulation temperature expected to be sufficient for Martian conditions. A MOXTEK Bullet miniature x-ray source (50 kV_p) is used for delivering calibration doses. A copper cover blocks light and x-rays from queued samples in the aliquot disk. A brush disposes of samples after measurement. The expected peak power of the system in operation is 5-6 W. The required sequence of heating, cooling, optical stimulation, OSL measurement and irradiation can be controlled from a notebook computer.

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OSL dating of Quaternary deposits associated with the parietal art of the Tassili n'Ajjer plateau (Central Sahara)

N. Mercier[1*], M. Hachid[2], J.-L. Le Quellec[3], S. Agsous[4], A. Amara[2], L. Beck[5], F. Duquesnoy[6], M. Grenet[7], A. Heddouche[2], E. Kaltnecker[8], S. Merzoug[2], A. Quiles[9], H. Sahnoun[2], H. Valladas[8], D. Vigears[5].

[1] Centre de Recherche en Physique Appliquée à l'Archéologie (CRP2A – IRAMAT UMR 5060 du CNRS) Université de Bordeaux, Maison de l'Archéologie, Esplanade des Antilles, 33607 Pessac Cedex, France. (norbert.mercier@u-bordeaux3.fr)
[2] CNRPAH, Algiers, Algeria.
[3] CEMAf — CNRS — GAES, Johannesburg, South-Africa.
[4] IPH, Paris, France.
[5] C2RMF-CNRS-CEA, Paris, France.
[6] LAMPEA-UMR 6636, Aix-en-Provence, France.
[7] TRACES — UMR 5608, Toulouse, France.
[8] LSCE (CNRS/CEA/IPSL), 91198 Gif-sur-Yvette Cedex, France.
[9] LMC14, CEN Saclay, 91191 Gif-sur-Yvette Cedex, France.

** Corresponding author: norbert.mercier@u-bordeaux3.fr*

The Tassili n'Ajjer plateau (central Sahara) is well known for its parietal art but, since its discovery in the 30', the chronology of this art where were recognised different styles, possibly associated with different populations, is still debated. Considering contextual and environmental data, or stylistic data, at least two chronological hypotheses have been proposed. A part of the art specialists defend the idea of a long chronology, placing the oldest drawings at the end of the Pleistocene period, or at the first beginning of the Holocene. On the other hand, some others propose to date the oldest paintings from the mid-Holocene, at maximum.
In order to get new informations about this question, Quaternary sediments sampled in the close vincinity of some paintings were dated using the OSL method. We will discuss the dating results and their implications concerning the local environmental changes, as well as the most likely ages of this prehistoric art.

Keywords : Tassili desert, OSL dating, parietal art

Single-grain OSL dating of a cryoturbated cave-mouth sediment succession at Vindija Cave, northern Croatia

M. C. Meyer[1,2*], Z. Jacobs[2], R. G. Roberts[2], L. Marjanac[3]

[1] Institut für Geologie und Paläontologie, Universität Innsbruck, Innsbruck, Austria (michael.meyer@uibk.ac.at)
[2]Centre for Archaeological Science, School of Earth and Environmental Sciences, University of Wollongong, NSW, Australia
[3]Croatian Academy of Science and Arts, Institut of Quaternary Palaeontology and Geology, Zagreb, Croatia.

* *Corresponding author:* j michael.meyer@uibk.ac.at

Here we describe the first results from an OSL dating campaign at Vindija Cave, a key archaeological site in central Europe that contains a 12 m-thick sequence of cave-mouth sediments spanning the Middle to Upper Palaeolithic. The cave is famous for its Neanderthal remains (e.g., the Neanderthal Genome Project has relied largely on bones from Vindija to sequence the DNA of our closest evolutionary relatives [1]). Large parts of this clastic sediment succession are affected by cryoturbation, which complicates the stratigraphy at Vindija [2]. Nevertheless, stratigraphic integrity has been claimed for selected sediment sections, and the occurrence of Mousterian and Upper Paleolithic artifacts and human remains in Level G1 (the Middle/Upper Paleolithic interface) has been used as an argument for the spatial and temporal coexistence of modern humans and *Homo neanderthalensis* at Vindija Cave [3]. Most of the existing chronological data (obtained by ^{14}C and U-Th dating of bone) are too scattered and imprecise to resolve the contrasting interpretations of site integrity [2].

We obtained 10 OSL samples from the cave-mouth sediment succession at Vindija Cave, including 5 samples from the contested G complex to check the stratigraphic integrity of the deposit and improve the chronological control, especially at the Middle/Upper Paleolithic interface. To achieve this aim, we measured D_e values for individual quartz grains using the single-aliquot regenerative-dose (SAR) procedure to investigate the existence of any post-depositional disturbance of the archaeological sediments and obtain OSL ages that take mixing and other complicating factors into account. The environmental dose rate was found to be high throughout the entire section (~3 Gy/ka) and the OSL signal of most quartz grains was dim. For multigrain aliquots, the regenerated OSL signals frequently contained a significant contribution from the 'medium' and/or 'slow' components, but numerous single grains are dominated by the 'fast' component. These grains can be isolated for OSL dating. Dose recovery tests demonstrated that a known laboratory dose could be recovered accurately from such grains, while component stripping of continuous wave and linear modulation OSL data indicated that an ultra-fast component was generally absent. The preliminary OSL ages obtained for the upper and middle parts of the Vindija section (deposited ca. 15–60 ka) are stratigraphically sensible. But the lower part of the sediment sequence (which may date to the last interglacial and earlier [2]) is a challenge for OSL dating, because the high environmental dose rate results in many grains having D_e values in the saturated region of the dose-response curve. For these samples, we are selecting individual "supergrains" with especially high saturation doses [4] to constrain the depositional age of the basal part of the Vindija section.

References

[1] Green, R.E. et al. (2010) A draft sequence of the Neandertal genome. Science 328, 710-722.
[2]] Zilhao, J. (2009) Szeletian, not Aurignacian - A review of the chronology and cultural associations of the Vindija G1 Neandertals. In Camps, M. and Chauhan, P. (Eds), A Sourcebook of Paleolithic Transitions. New York: Springer, pp. 407-426.
[3] Karavanic, I. & Smith, F.H. (1998) The Middle/Upper Paleolithic interface and the relationship of Neanderthals and early modern humans in the Hrvatsko Zagorje, Croatia. Journal of Human Evolution 34, 223-248.
[4] Yoshida, H., Roberts, R.G., Olley, J.M., Laslett, G.M. & Galbraith, R.F. (2000) Extending the age range of optical dating using single "supergrains" of quartz. Radiation Measurements 32, 439-446.

Investigation of the Luminescence Properties of Common Glasses for Application to Retrospective Dosimetry

J. E. Moffatt[1*], N. A. Spooner[1,2], D. Creighton[1], B.W. Smith[2]

1 Institute for Photonics and Advanced Sensing (IPAS), School of Chemistry and Physics, University of Adelaide, Adelaide, 5005, Australia
[2] Defence Science and Technology Organisation, Edinburgh, SA 5111, Australia.

* *Corresponding author:* jillian.moffatt@student.adelaide.edu.au

Seventeen domestic and scientific glass specimens were investigated for thermoluminescence (TL) properties suitable to enable application in retrospective population dosimetry. Usefulness for retrospective dosimetry was initially judged by the presence of well-defined TL glow peaks and the absence of irradiation-independent luminescence, and included TL glow peaks having relatively low E values and lifetimes from weeks to months. Samples were crushed and sieved to select grains between 180 and 250 μm in diameter. The natural TL response, dose response after prior heating, and dose response after prior irradiation and heating was measured. Laboratory irradiations were of 10 Gy ^{90}Sr/^{90}Y beta dose, and TL was measured to 400ºC at a heating rate of 5K/second. Measurements were also made using optical stimulation, and results from a survey of the OSL (470 nm stimulation) and IRSL (880 nm stimulation) behaviours will also be reported. Most samples showed identifiable TL, with pyrex in particular, and samples from a jar, a lampshade, and opaque blue beads all showing well-defined TL glow peaks with sensitivities that were not significantly affected by prior irradiation and heating of the sample. A value for <E> was obtained for the pyrex, clear jar and blue bead samples using the Hoogenstraaten heating rate method. A range of <E>-W values were also obtained for the pyrex sample using the fractional glow method, with lifetimes found to be of the order of months to hundreds of years. These are likely to be minimum values as the pyrex sample appeared to exhibit slight thermal quenching. The TL glow curve shapes and the evidence collected from kinetic analysis is consistent with the TL originating from traps possessing a spread of trapping energies.

Keywords: Glass, Thermoluminescence, OSL, Retrospective dosimetry

Cross-check of the dating results obtained by ESR, IR-OSL and U-Th methods: implication for the Pleistocene palaeoenvironmental reconstructions

A Molodkov*

Research Laboratory for Quaternary Geochronology, Institute of Geology, Tallinn University of Technology, 5 Ehitajate Rd, Tallinn 19086, Estonia (molodkov@gi.ee)

* *Corresponding author:* molodkov@gi.ee

Accurate and precise estimation of sediment ages is undoubtedly very important in Quaternary geochronology. Besides the confidence in the theoretical validity of the dating methods, highly desirable is to have practical confirmation that our methods and techniques provide accurate and reliable results in determining the age of geological sediments. Comparison of results of different dating methods applied to samples of various materials taken from the same sampling point can be regarded as one of the best ways for the verification of their applicability and suitability. Unfortunately, it is usually quite difficult to meet these conditions in practice, especially beyond the radiocarbon dating range. Nevertheless, we have succeeded in obtaining such comparative results in three main ways: first, by six parallel ESR and IR-OSL datings on shells and feldspar grains, respectively, taken from the same sediment sample; second, by ESR closed-system (ESR-CS), ESR open-system (ESR-OS) and U-Th dating on the same four shells, and third, by comparison of our IR-OSL dated fine-resolution late Pleistocene pollen record from the Voka site, south-eastern coast of the Gulf of Finland (Molodkov and Bolikhovskaya, 2010) with $\delta^{18}O$ variations in the NGRIP ice-core the chronology of which is based on independent multi-parameter counting of annual layers (Andersen et al., 2006). Overall differences in ages determined on the samples taken from diverse temporal (56 to 110 ka) and geographical (from the Mediterranean to High Arctic) environments between different methods (ESR/IR-OSL and ESR-CS/ESR-OS/U-Th) are in the range from 1.0 to 3.8% (2.0 ± 0.9% in average) for ESR/IR-OSL, from 0.6 to 6.1% (3.6 ± 2.1% in average) for ESR-CS/U-Th, and from 0.2 to 6.5 % (3.2 ± 2.9% in average) for ESR-OS/U-Th. Matching the Voka chronoclimatic pattern between 39 and 33 ka to the Greenland ice-core variations shows a good fit with the palaeoclimatic signals recorded in Greenland ice cores between Greenland Interstadials 8 and 5. The results obtained in this study exemplify the potential of both combined and independent use of palaeodosimetric dating methods applied to two different minerals – feldspar and biogenic carbonate – to chronologically organize the sequence of the late Pleistocene palaeoenvironmental events. In the present study we will also discuss the comparative ESR results from much older sites, such as Acheulian-bearing cave-site deposits correlated to MIS 15 (ca 580 ka in age).

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References

Andersen, K. K., Svensson, A., Johnsen, S. J., Rasmussen, S.O., Bigler, M., Röthlisberger, R., Ruth, U., Siggaard-Andersen, M.-L., Steffensen, J. P., Dahl-Jensen, D., Vinther, B. M., and Clausen, H. B. 2006. The Greenland Ice Core Chronology 2005, 15–42 ka. Part 1: constructing the time scale, Quaternary Science Reviews 25, 3246–3257.

Molodkov, A., Bolikhovskaya, N., 2010. Climato-chronostratigraphic framework of Pleistocene terrestrial and marine deposits of Northern Eurasia, based on pollen, electron spin resonance, and infrared optically stimulated luminescence analyses. Estonian Journal of Earth Sciences 59, 1, 49–62. doi: 10.3176/earth.2010.1.04

ESR chronology of alluvial deposits in the Arlanzon Valley (Atapuerca, Spain): correlation with Gran Dolina archaeological site

D. Moreno[1-3*], C. Falguères[1], A. Pérez-González[2], M. Duval[2], P. Voinchet[1], A. Benito-Calvo[2], A. I. Ortega[2], J.-J. Bahain[1], R. Sala[3], E. Carbonell[3]

[1] Département de Préhistoire, Muséum National d'Histoire Naturelle, UMR7194 du CNRS, Institut de Paléontologie Humaine, 1 rue René Panhard, 75013 Paris, France, (moreno@mnhn.fr, falguere@mnhn.fr; bahain@mnhn.fr, pvoinch@mnhn.fr)
[2] Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Paseo de Atapuerca, s/n, 09002 Burgos, Spain (alfredo.perez@cenieh.es, mathieu.duval@cenieh.es, alfonso.benito@cenieh.es, anaisabel.ortega@cenieh.es)
[3]IPHES (Institut Català de Paleoecologia Humana i Evolució Social). Area de Prehistòria URV, Plaça Imperial Tarraco, 1, 43005 Tarragona, Spain (robert.sala@urv.cat, ecarbonell@iphes.cat)

** Corresponding author: moreno@mnhn.fr*

The Sierra de Atapuerca (Northern Spain) is characterized by a well developed karst system where an almost continuous Pleistocene hominid occupation has been attested, through the discovery of several major archaeological sites, such as Gran Dolina, Sima del Elefante, Sima de los Huesos, Galeria or Portalón, among others. Geomorphological studies showed a connection between the karst system formation and the evolution of Arlanzón river located southwards. However, some absolute datings were missing to get a complete chronostratigraphical framework of the Arlanzón valley's fluvial incision. To overcome this lack, we applied the Electron Spin Resonance (ESR) method to sedimentary quartz grains from several fluvial terraces.
Among the 14 identified terraces, stepped between +97m and +2m above the present-day river level, 6 of them were sampled: $T3_{AZN}$ (+70-78 m), $T4_{AZN}$ (+60-67 m), $T5_{AZN}$ (+50-54 m), $T8_{AZN}$ (+26-35 m), $T9_{AZN}$ (+19-30 m) and $T11_{AZN}$ (+12-13 m). The results are not only stratigraphically coherent but also in agreement with the previous geomorphological observations and geochronological data. As a consequence, they allow the proposal of an ESR chronology for the geological evolution of the Arlanzon valley. By extension, these results can be correlated to Atapuerca Gran Dolina sedimentary infilling and provide major information about the chronology of hominid occupation in this area during Early and Middle Pleistocene period.

Keywords: ESR dating, quartz, Arlanzon valley, Gran Dolina, Pleistocene

Identification of radiation-induced defects involved in IRSL production mechanism in feldspars

P. Morthekai[1*], S. Chawla[2], S. K. Sharma[1], P. S. Rao[3], J. Thomas[3], M. S. Pandian[3], V.Balaram[4], A. K. Singhvi[1]

[1]Physical Research Laboratory, Navrangpura, Ahmedabad, 380 009 India (morthekai@gmail.com)
[2]National Physical Laboratory, K.S. Krishnan Marg, New Delhi, 110 012 India
[3]Pondicherry University, Pondicherry, Puducherry-605 014, India
[4]National Geophysical Research Laboratory, Uppal Road, Hyderabad 400 007, India

* *Corresponding author: morthekai@gmail.com*

Anomalous fading of luminescence signals of feldspars remain enigmatic for more than three decades. This work is based on the premise that investigations on the processes and the radiation-induced defects involved in the production of infra-red stimulated luminescence (IRSL) may provide a better correction or circumvention procedure with a robust physical understanding. With the insights gained from the literature [1, 2, 3] we suggest that during irradiation and IR stimulation the following reactions occur.

During irradiation,

$$Al\text{-}O^{2-}\text{-}Al + Irradiation \rightarrow Al\text{-}O^{1-}\text{-}Al + e^{-}$$

$$Pb^{2+} + e^{-} \rightarrow (Pb^{+})^{*} \rightarrow Pb^{+} + h\upsilon_{IR}\ (RL)$$

Four feldspar mineral specimens and two sedimentary feldspar samples were analyzed for seven observables that can be correlated with the above mentioned radiation-induced defects. Sensitivities, onset of saturation doses (D_0) and fading rates were measured using IRSL signals. Order parameters and Pb concentrations were derived from the XRD and ICP-MS analyses respectively. By Laplace inversion of the fitted IRSL decay curves (compressed hyperbolic function) the distribution of decay rates was obtained. Mott's parameters (hopping energy, hopping length, etc.) were derived from the OFF-time signal of time-resolved IRSL by assuming variable range hopping (VRH) mechanism. Photoluminescence (PL) and electron spin resonance (EPR) studies were performed to probe the presence of Pb^{2+}, Pb^{+} and Al-O^{1-}-Al in the samples. For a 100 Gy dosed sample, the PL emission spectrum for 224 nm excitation resulted in multiple emission bands at 280, 397, 405, 580, 600, 770, 800 and 830 nm where, the 280 nm band corresponds to the presence of Pb^{2+} ions and the bands at 770, 800 and 830 nm correspond to Pb^{+} ions. Either the 397 nm or 405 nm band may correspond to Al-O^{1-}-Al center. The dose dependence and the evolution of new emission bands dictate the finite $Pb^{2+} \rightarrow Pb^{+}$ conversion possibility in irradiated samples. X-band EPR spectra in the irradiated feldspars at 77 K gives g_{eff} value of 1.56 with two satellite peaks at 1.83 and 1.38, suggesting Pb^{+} [1] while 2.002 – 2.05 with 11 equidistant (width of 0.7 – 0.9 mT) super-hyperfine structures, suggesting Al-O^{1-}-Al [2]. The dose response curves of the EPR signals are being compared with that of PL signals and their correlation with the observables is being examined. The detailed analyses, results and their implications in IRSL dating will be discussed in the conference.

References

1. Hofmeister, A. M. and Rossman, G. R., 1985. American Mineralogist 70, 794-804.
2. Hashimoto, et al., 2003. Journal of Radioanalytical Nuclear Chemistry 255, 81-85.
3. Erfurt, G., 2003. phys. stat. sol. (a) 200, 429-438.

High resolution dating of loess profile from Biały Kościół, South-West Poland

P. Moska[1*], G. Adamiec[1], Z. Jary[2]

[1] *Department of Radioisotopes, Institute of Physics, Silesian University of Technology, 44-100 Gliwice, Poland*
[2] *Institute of Geography and Regional Development, University of Wroclaw, 50-137 Wroclaw, Poland*

** Corresponding author:* Piotr.Moska@polsl.pl

The loess–paleosol sequences of the Polish loess have made a contribution to our understanding of local Quaternary climate events, especially the last glacial and interglacial period. The loess stratigraphy of Poland was formed over the past 40 years and is based on lithological, sedimentological and pedological parameters, loess and loess derivatives. A generalised stratigraphy was developed for the last interglacial/glacial record using similar soil characteristics and several hundred TL dates obtained in Polish luminescence laboratories during last 30 years.

Absolute dating using luminescence methods is widely applicable in geology, geomorphology, paleogeography and in archaeology in establishing ages of sediments and archaeological artefacts. Their popularity and versatility come from the fact that in almost any natural environment minerals of quartz and feldspars occurs. On the other hand during the last 10 years we could observe a rapid improvement of the measurement equipment and measurement protocols which allows achieving results of luminescence dating with increasing precision and accuracy. In this work we present result of high resolution OSL dating of one of the largest loess deposits in Poland which are located in an old clay-pit in the vicinity of the village Biały Kościół (South-West Poland).

21 samples were collected from the 9 meter high loess profile and dated in the Gliwice Luminescence Laboratory. Presented OSL results obtained for coarse grained quartz fraction in some cases are quite different them the OSL and TL dates obtained during last 10 years by other authors and presented in previous publications relating to this loess profile.

Comparing quartz and feldspar OSL ages from sediments from permafrost regions of northern Eurasia

A. S. Murray[1*], J.-P. Buylaert[1,2], K.J. Thomsen[2], M. Jain[2]

[1]*Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, University of Aarhus, Risø DTU, Denmark*
[2] *Radiation Research Division, Risø National Laboratory for Sustainable Energy, DTU, Denmark*

** Corresponding author: anmu@risoe.dtu.dk*

There are, in our opinion, no satisfactory methods for identifying incomplete bleaching in older (Pleistocene) samples. Various statistical analytical methods have been proposed, but ultimately they are all based on the assumption that incomplete bleaching contributes significantly to the shape of the dose distribution. A different approach to confirming adequate resetting prior to deposition is to use the different bleaching rates of the quartz and feldspar OSL signals. It is well-known that the OSL signal from feldspars bleaches more slowly than that from quartz. Thus, if quartz and feldspar ages agree with each other, it is highly unlikely that the quartz signal was incompletely bleached at burial. Until recently the uncertainties in feldspar ages arising from anomalous fading made such a comparison relatively inaccurate and so not very informative, but recent developments have reduced these uncertainties to negligible levels, making a quartz/feldspar comparison practical.

By stimulating coarse-grain K-rich feldspar extracts held at 50°C using IR (IR_{50}), and then raising the temperature to 290°C and stimulating again with IR ($pIRIR_{290}$) Buylaert et al. (in prep) have recently demonstrated excellent agreement between $pIRIR_{290}$ feldspar ages and various independent ages including those from quartz OSL. This comparison employed a range of aeolian and shallow marine samples from around the world – all sediments expected to be relatively well bleached. Their comparison confirms that the $pIRIR_{290}$ signal is a reliable chronometer, and that the $pIRIR_{290}$ signal can be fully reset in nature. Here we undertake a similar comparison using periglacial fluvial sediments from large scale rivers in northern Eurasia. We first present data that confirm the differences in relative bleaching rates of the quartz OSL, IR_{50} and $pIRIR_{290}$ signals, and investigate the origins of the difficult-to-bleach residual feldspar signals in laboratory bleached samples (equivalent to ~ 2 Gy for IR_{50}, and ~15 Gy for $pIRIR_{290}$); these residuals are then compared with those implied by the overesimates in age for young Holocene samples. Finally a comparison of both IR_{50} and $pIRIR_{290}$ ages with those from quartz is presented for a range of Weichselian samples of different ages from a variety of sites, and quartz single-grain dose distributions used to discuss the outliers.

Reference

Buylaert, J.P., Jain, M., Murray, A.S., Thomsen, K.J., Thiel, C., Sohbati, R., (in prep). A new broadly-applicable sediment dating method for the last 1 Ma.

Numerical modelling of the effect of water content on dose rate for *in situ* sediments: a comprehensive survey of correction factors

R. P. Nathan[1,2]*, J-L. Schwenninger[2], E. J. Rhodes[3]

[1] CRUK/MRC Gray Institute for Radiation Oncology and Biology, University of Oxford, Old Road Campus Research Building, Oxford, OX3 7DG, United Kingdom,
[2] Research Laboratory for Archaeology and the History of Art, University of Oxford, Dyson-Perrins Building, Oxford, OX1 3QY, United Kingdom
[3] Department of Earth and Space Sciences, University of California Los Angeles, 595 Charles Young Drive East, Los Angeles, CA 90095-1567

* *Corresponding author: roger.nathan@rob.ox.ac.uk*

Water content in sediments is an important potential uncertainty for dose rate assessment in trapped-charge dating. Two main issues need to be addressed: 1) the effects of water on the activity of the regolith and the relative efficiency of energy deposition; and 2) the time evolution of water content over the burial duration. In this paper, we comprehensively address the former with a multivariate tabulation of correction factors that can be readily applied for a wide range of environments. Variables considered include seven different sediments types with various grain shape and size distributions of randomly packed ellipsoids using the Lubachevsky-Stillinger algorithm; packing densities; mean grain sizes; water contents; heterogeneous activity sources; and non-aqueous pore infilling. Both beta and gamma radiations were modelled for individual U, Th and K emissions.
The data were generated using the state-of-the-art Monte Carlo radiation transport code, PENELOPE, that is modified to accept periodic boundaries. Depending on the granular packing type, between 300 and ~3000 grains formed an effective infinite-matrix (since the periodic boundaries provided a continuous tiling of space to avoid untenable numbers of grains having to be modelled). The secondary electron flux is the key consideration for assessing the effects of water content and we elucidate our results with a study of analytical cavity theories that include Bragg-Gray (used by Zimmerman, 1972), Spencer-Attix and Burlin treatments.

Reference
D.W. Zimmerman, Thermoluminescence dating using fine grains from pottery, *Archaeometry* **13** (1971), pp. 29–52.

Investigating Arroyo Cut-Fill Cycles Using Optically Stimulated Luminescence Dating to Kanab Creek Alluvial Deposits, Southern Utah USA

M. S. Nelson[1*], T. Rittenour[1]

[1] Utah State University Luminescence Lab, 1770 N Research Parkway, Suite 123, North Logan, UT 84341 USA (michelle.summa@aggiemail.usu.edu; tammy.rittenour@usu.edu)

* *Corresponding author:* michelle.summa@aggiemail.usu.edu

In the late 1880's and early 1900's, many river channels in the southwestern United States incised and formed deep arroyos. This arroyo cutting event left many historical settlements perched above their water source. Kanab Creek in southern Utah is an excellent example of a mature arroyo, and has incised 30- 40 meters into its alluvium exposing fine-grained sediment packages along the arroyo walls and leaving behind fluvial terraces in upstream reaches. Preserved in the middle to late Holocene stratigraphy are aggraded flood deposits exhibiting multiple cycles of fluvial aggradation separated by periods of non-deposition or incision. To constrain the timing of sedimentation along the Kanab Creek alluvial corridor north of Kanab, Utah, quartz sand grains were analyzed using Optically Stimulated Luminescence (OSL) dating. This is the first application of OSL dating to Kanab Creek sediments. Nineteen OSL samples were processed and analyzed using the Single Aliquot Regenerative (SAR) technique (Murray and Wintle, 2000) on small-aliquots and single-grains at the Utah State University Luminescence Laboratory. OSL ages in addition to new and previous radiocarbon results suggest at least four cycles of fluvial cutting and filling over the last 6k years. The majority of the OSL samples exhibit a strongly positively skewed equivalent dose (De) distribution and overdispersion values are near or greater than 20%. This asymmetric distribution suggests that Kanab Creek sediments were subject to various bleaching conditions during transport, with each sample having some degree of partial bleaching. The modern Kanab Creek has perennial flow, and it episodically floods during rapid snowmelt and intense storms during the summer monsoon season. The rapid transport of sediment-laden water increases the possibility of an incomplete zeroing of the luminescence signal prior to deposition. Aggrading flood deposits are typically massive and/or normally graded, poorly sorted coarse to fine sand, and sometimes contains small pebbles. With the aid of the Minimum Age Model of Galbraith et al. (1999) and fifteen radiocarbon samples for comparison, accurate ages could be estimated for most of the terrace and basin-fill deposits along Kanab Creek. However, for a minority of the OSL samples, the central age model provided reasonable age estimates. These well-bleached samples were fine-grained, well-sorted sand with thin ripple laminated sedimentary structures. Samples that are massive or lack sedimentary structures should be avoided because of the large potential for contamination of partially bleached sediments. Therefore, the depositional environment of fluvial sediments is extremely important when using OSL dating techniques in arroyo systems located in the semi-arid southwestern United States.

Keywords: alluvium, arroyo, Holocene, partial bleaching, radiocarbon, southwestern United States

References

Galbraith, R.G. Roberts, G.M. Laslett, H. Yoshida and J.M. Olley, 1999, Optical dating of single and multiple grains of quartz from Jinmium rock shelter, northern Australia: Part I, Archaeometry 41, p. 339–364.

Murray, A.S., and Wintle, A.G., 2000, Luminescence dating of quartz using an improved signle-aliquot regenerative-dose protocol: Radiation measurements, v. 32, p. 57-73.

Investigating the potential for luminescence dating of individual K-rich feldspar grains using an IR (830 nm) laser

C. M. Neudorf[1*], R. G. Roberts[1], Z. Jacobs[1]

[1]Centre for Archaeological Science, School of Earth and Environmental Sciences, University of Wollongong, NSW, Australia

**Corresponding author: cmn821@uow.edu.au*

Luminescence dating procedures that make use of multigrain aliquots of quartz or feldspar implicitly assume all grains have suitable luminescence properties for dating and have been sufficiently bleached by sunlight before burial, and have not been mixed after burial. Single-grain OSL dating techniques have been available for quartz for more than a decade, enabling the identification and rejection of partially bleached and mixed-age grains, as well as grains with unsuitable characteristics for reliable dose determination using regenerative-dose protocols (Murray and Roberts, 1997; Roberts et al., 1999; Duller et al., 2000). Similar single-grain dating techniques have yet to be developed for potassium-rich feldspars but would also entail measurements of the internal dose rates (due principally to ^{40}K) and anomalous fading rates of individual grains (Duller et al., 2003). Risø readers equipped with a 150 mW infrared (IR) (830 nm) laser allow for the direct stimulation of individual feldspar grains (Bøtter-Jensen et al., 2003). In this presentation, we will describe the use of the IR laser to obtain equivalent dose (D_e) estimates for single K-rich feldspar grains from a sediment sample collected from below a volcanic ash thought to have been deposited ~74 ka ago, in Madhya Pradesh, northern India. The luminescence characteristics, D_e estimates and fading rates of these grains will be reported and compared to those of multigrain aliquots of the same sample stimulated using conventional IR (875 nm) diodes. A comparison with the single-grain OSL chronology will also be made, and the implications for IRSL dating of individual K-feldspar grains will be discussed.

References

Bøtter-Jensen, L., Andersen, C.E., Duller, G.A.T. and Murray, A.S., 2003. Developments in radiation, stimulation and observation facilities in luminescence measurements. Radiation Measurements, 37, 535-541.

Duller, G.A.T., Bøtter-Jensen, L. and Murray, A.S., 2000. Optical dating of single sand-sized grains of quartz: sources of variability. Radiation Measurements, 32, 453-457.

Duller, G.A.T., Bøtter-Jensen, L. and Murray, A.S., 2003. Combining infrared- and green-laser stimulation sources in single-grain luminescence measurements of feldspar and quartz. Radiation Measurements, 37, 543-550.

Murray, A.S. and Roberts, R.G., 1997. Determining the burial time of single grains of quartz using optically stimulated luminescence. Earth and Planetary Science Letters, 152, 163-180.

Roberts, R.G., Galbraith, R.F., Olley, J.M., Yoshida, H. and Laslett, G.M., 1999. Optical dating of single and multiple grains of quartz from Jinmium rock shelter, northern Australia: Part II, Results and implications. Archaeometry, 41, 365-395.

Testing the post-IR IRSL SAR protocol with single K-feldspar grains from fluvial sediment samples

X. Nian[1,2*], R. Bailey[2], L. Zhou[1]

[1]Laboratory for Earth Surface Processes, Department of Geography, Peking University, Beijing 100871, China
[2]Oxford Luminescence Dating Laboratory, Oxford University Centre for the Environment, South Parks Road, Oxford, OX1 3QY, UK

** Corresponding author: nianxiaomei@pku.edu.cn*

Recent studies show that a new protocol with infrared stimulation of K-feldspar at an elevated temperature following a prior low temperature IR stimulation can reduce or even eliminate the laboratory fading of IRSL signal (blue emission region). This post-IR IRSL SAR protocol has previously been applied to aeolian sediments. However, for feldspar from fluvial samples, the post-IR IRSL signal may suffer from incomplete bleaching. In this study, we test this new protocol with coarse K-feldspar single-grains (90-125μm) extracted from fluvial sediment samples. The samples came from a palaeoanthropological site at Dali, Shaanxi Province in northern China. The age of the key unit where a hominid fossil was found has been estimated using various methods, yielding a wide age range from 200ka to 420 ka. In order to reduce the uncertainty in age for this important site, we chose to use K-feldspar rather than quartz primarily due to saturation. A slightly modified post-IR IRSL SAR protocol (PH 320℃ for 60s, IR 60℃ for 2s, post-IR IRSL 290℃ for 2s) was applied. The bleachability of the post-IR IRSL signal of K-feldspar was investigated using different bleaching conditions with IR laser, green laser, blue LED light and daylight. The results showed that almost all the grains after bleaching with IR laser, green laser and blue LED light had significantly remnant doses which could reach up to ~35% of the given dose (520Gy). For sunlight-bleached grains, however, the residual dose was reduced to ~20-30Gy, i.e. relatively small compared with the equivalent dose of the sample. As the residual dose of the grains stimulated by the laboratory light sources may also be caused by thermally transferred signal of the post-IR IR stimulation, a relatively large test dose (~100Gy) was chosen. This seems to have suppressed the effect of thermal transfer of the natural/regenerative dose to the corresponding test dose. Our experiments with over 2000 K-feldspar grains showed that ~30-40% of the grains were bright, but only ~10-15% of which were adopted based on the rejection criteria of the single-grain method. The dose recovery test was acceptable, but we note that there are grains which substantially overestimated or underestimated the given doses. The fading rate was measured for all grains, and while the level of scatter in the L_x/T_x data was considerable, no anomalous fading was observed. Pulse annealing curves also showed no apparent differences in thermal stability for these grains. The form of the decay curves does however vary for different grains, and this may be related to the observed differences in recovered dose ratios. After careful selection on the basis of the relationship of the decay rate of the post-IR IRSL signal, very few grains underestimated or overestimated the recovered dose. We speculate that our K-feldspar grains may be contaminated with other types of feldspars and more systematic investigation is ongoing.

Keywords: post-IR IRSL SAR protocol, single-grain, K-feldspar, fluvial sediment

OSL dating of the Tiszasas (Hungary) sand succession

Á. Novothny[1]*, G. Gábris[1], M. Frechen[2], A. Techmer[2]

[1]Eötvös Loránd University, Institute of Geography and Geology, Department of Physical Geography, Pázmány P. s. 1/c, 1117 Budapest, Hungary.
[2]Leibniz Institute for Applied Geophysics (LIAG), Stilleweg 2, 30655 Hannover, Germany

** Corresponding author: agnes.novothny@gmail.com*

The paleo-river network of the Carpathian basin differed significantly from the modern river network. During almost the entire Pleistocene the paleo-Danube, coming from the Alps, was flowing diagonally across the Danube-Tisza Interfluve resulting in aggradation of fluvial sediments in the whole area. The palaeo-Tisza River coming from the Northeast Carpathians and the Apuseni Mountains was flowing from northeast to southwest, along a tectonically controlled depression. At the end of the Pleistocene the drainage systems of the paleo-Danube and -Tisza Rivers have substantially changed due to the higher rate of subsidence along the margins of the Great Hungarian Plain. The paleo-Danube gradually shifted to the west and occupied its present valley in the Late Weichselian (Nádor et al., 2007, Gábris and Nádor 2007).

The study area is located near Tiszasas, close to the modern channel of the Tisza River. The profile is located in a sand pit and contains mostly fluvial sand layers in a thickness of 6 m. The lowermost sand layers are presumably belong to the alluvial fan of the palaeo-Danube, whereas the overlying layers are deposited by the palaeo-Tisza River. On the top of the fluvial succession aeolian sand layers can be found. 10 sand samples were collected from the profile for luminescence dating and 3 samples for heavy mineral analysis to distinguish between the deposits of the palaeo-Danube and palaeo-Tisza Rivers. The aim of the study is to make age constraints for the re-arrangement of the drainage pattern of the area using luminescence dating.

Single aliquot regeneration dose protocol (SAR) has been applied on coarse grained quartz material for Optically Stimulated Luminescence (OSL) dating to determine the equivalent doses of the samples. Strong feldspar contamination of the quartz samples was observed after careful HF treatment. Therefore, different protocols (OSL, postIR-OSL and pulsed OSL) were tested and compared to find the best way to determine the De-s of the samples. For further measurements the postIR-OSL protocol was chosen. Dose recovery and preheat tests were conducted. The De distributions of the samples are polymodal due to the fluvial origin of the samples. Different statistical models (minimum age model, finite mixture model, central age model) are applied to overcome on the issue of partial bleaching.

Characterization of the thermoluminescence of CaF_2:Mn artificially irradiated to low doses

F. O. Ogundare[1*], M. N. Raji[1], M. K. Fasasi[2]

[1]Department of Physics, University of Ibadan, Ibadan, Nigeria
[2]Centre for Energy and Research Development, Obafemi Awolowo University, Ile-Ife, Nigeria

** Corresponding author: ogun_dare@yahoo.com*

The glow curves of the low dose β-irradiated CaF_2:Mn in the dose range of 0.04 - 7.2 mGy apparently consisted of a single peak. The position occurred at 304.9 ± 3.7 ^oC for thermoluminescence readout made at a heating rate of 5^oC/s. The temperature at which the main peak position occurred was found to be dose independent, an indication that the peak is of first-order kinetics or made up of more than one highly overlapping peaks. The dose response of the peak was perfectly linear with a correlation coefficient of 0.999. The integrated intensity of the peak decreased with heating rate indicating the presence of thermal quenching at the low doses considered. The activation energy of thermal quenching (W) was calculated to be 0.517 eV. The order of kinetics obtained from the kinetic analysis using the glow curve deconvolution, whole glow peak and the peak shape methods showed that the glow peak is non first-order. The activation energy E values obtained compared very well, within experimental uncertainties, with values that have been reported for the sample irradiated to relatively higher doses.

On the predose sensitization of the various components of the LM-OSL signal of annealed quartz; Comparison with the case of 110 °C TL peak

E.O. Oniya[1,2*], G. S. Polymeris[1], N. C. Tsirliganis[1], G. Kitis[3]

[1] Archaeometry Laboratory, Cultural and Educational Technology Institute (C.E.T.I.), R.C. "ATHENA", Tsimiski 58, 67100 – Xanthi, Greece.
[2] Physics and Electronics Department, Adekunle Ajasin University, PMB 01, Akungba Akoko, Nigeria.
[3] Aristotle University of Thessaloniki, Nuclear Physics Laboratory, 54124-Thessaloniki, Greece.

** Corresponding author: eoniya@hotmail.com*

The pre-dose sensitization effect in the 110 °C Thermoluminescence (TL) glow-peak of quartz is a result of a combined action of dose and thermal activation. Recently, Koul and Chougaonkar, (2007) performed a characterization of the luminescence emission of the fast component of the Continuous Wave Optically Stimulated Luminescence (CW-OSL) signal with pre-dose treatment and concluded that it, like 110 °C TL peak, is sustained by the pre-dose mechanism in the pre-dose effective domain. Furthermore, the various features of this pre-dosed signal were observed to be very similar to that of the 110 °C TL peak. Even though it is now widely established that the two processes share the same luminescence centre, Jain et al., (2003) argued that this relationship between the two phenomena may not be valid for other components of the OSL signal. Therefore, the purpose of the present work is multifold: (a) to investigate the separate contribution of the thermal activation in case of the linearly modulated optically stimulated luminescence (LM-OSL) signals, while th~~o~~ese are measured both at room temperature and at 125 °C, (b) to study whether this predose sensitization depends on the heating rate of thermal activation process, and (c) to perform a component resolved LM-OSL analysis in order to correlate the behavior of each component with that of the 110 °C TL peak. The experimental procedure involves the measurements of these two aforementioned quantities (a) after irradiation-thermal activation cycles and (b) after an equal number of thermal activation cycles alone with a test dose at the end of the last thermal activation cycle. The thermal activation was performed using various heating rates between 0.25 up to 10°C/s. The materials under study were two quartz samples previously annealed at ~~8~~900 °C for one hour. The results showed that the pre-dose sensitization factor depends strongly on the heating rate while the contribution of the pure thermal activation is found to be important. In the case of the LM-OSL measured at room temperature the predose behavior of the dominant component is identical to that of the 110 °C TL glow-peak. This is direct evidence that this LM-OSL component and the TL glow-peak at 110°C share the same electron trap and recombination center (Kiyak et al., 2008; Polymeris et al., 2009). Nevertheless, the most important upon the results is the fact that all components of the LM-OSL signal measured at 125 °C follow similar predosed sensitization pattern as the 110 °C TL glow-peak.

References

Koul, D.K., Chougaonkar, M.P., 2007. Pre-dose phenomenon in the OSL signal of quartz. Radiat. Meas. 42, 1565–1572.

Jain, M., Murray, A.S., Botter-Jensen, L., 2003. Characterization of blue-light stimulated luminescence components in different quartz samples: implications for dose measurement. Radiat. Meas. 37, 441–449.

Polymeris, G.S., Afouxenidis, D., Tsirliganis, N.C., Kitis, G., 2009. The TL and room temperature OSL properties of the glow peak at 110 °C in natural milky quartz: A case study Radiat. Meas. 44, 23.

Kiyak, N.G., Polymeris, G.S., Kitis, G., 2008. LM-OSL thermal activation curves of quartz: Relevance to the thermal activation of the 110 ◦C TL glow-peak. Radiat. Meas. 43, 263.

Thermal Stabilities of Radiation-Induced Radicals in CO_2 Hydrate

M. Oshima[1*], A. Tani[1], K. Kitano[2], T. Sugahara[3], K. Ohgaki[3]

[1]Department of Earth and Space Science, Graduate School of Science, Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560-0043, Japan (moto-o@astroboy.ess.sci.osaka-u.ac.jp)
[2]Center for Atomic and Molecular Technologies, Graduate School of Engineering, Osaka University, 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan
[3]Division of Chemical Engineering Science, Graduate School of Engineering and Science, Osaka University, 1-3 Machikaneyama, Toyonaka, Osaka 560-8531, Japan
Keywords: CO_2 hydrate, radiation, HOCO radical, H atom, Mars, electron spine resonance (ESR), ion chromatography

* *Corresponding author: moto-o@astroboy.ess.sci.osaka-u.ac.jp*

Gas hydrate is one of crystalline inclusion-compound, which is composed of hydrogen-bonded water molecules encaging gas molecules. Radiation-induced radicals in hydrocarbon hydrates were investigated. In the case of methane hydrate, methyl radical is mainly formed by gamma rays at 77 K (Takeya et al., 2004). However, it is not stable over 200 K. Since natural methane hydrate is found in deep-sea sediment and permafrost region on the Earth, no methyl radical remains and radical reactions occur in methane hydrate (Tani et al., 2006). Main products in these reactions are ethane and methanol (Ishikawa et al., 2007; Tani et al., 2010).

CO_2 hydrate composed of CO_2 and water molecules is stable at low temperature and high pressure, for example below 220 K at atmospheric pressure (Sloan and Koh, 2008). Max and Clifford (2001) suggested that CO_2 hydrate would exist in Martian surface, based on discussion of the temperature and pressure conditions in Mars. Since water ice may be found in Martian surface sediments (*e.g.* Boynton et al., 2002), we expect that CO_2 hydrate may be formed in the sediments. In that case, Martian CO_2 hydrate should be irradiated by natural radiation from radioisotopes in sediments as well as cosmic rays, which may cause radical formation in CO_2 hydrate. If the radical is stable and accumulated in the hydrate, the amount of the radical may be related to the formation age of CO_2 hydrate. Therefore, we have identified the induced radicals and investigated the thermal stabilities of radicals in irradiated CO_2 hydrate by electron spin resonance (ESR). In addition, the dissociated water of the hydrate has been analysed by ion chromatography to understand the radical reactions.

The synthetic CO_2 hydrate was irradiated by gamma rays at 77 K. HOCO radical and H atom were observed at 120 K in the irradiated CO_2 hydrate. HOCO radical disappeared within 20 min at 195 K, though 80% of HOCO radical remained after 6 hours at 120 K. H atom was not observed at 130 K. These results indicate that no radicals remain in CO_2 hydrate in Martian sediments. Formic acid and oxalic acid were observed in dissociated water of irradiated CO_2 hydrate. The amounts of formic acid and oxalic acid depend on temperature history of the radicals. This means that the decay processes of the radicals will strongly depend on temperature in CO_2 hydrate. It suggests that the radical reactions in Martian CO_2 hydrate might change with seasonal variations of temperature.

Luminescence dating of glacial sediments from the Qinghai-Tibetan Plateau and its bordering mountains

X.J. Ou[1,2,3*], Z.P. Lai[1], S.Z. Zhou[3], B.Zhang[1]

1. Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China (*Email: ouxianjiao@163.com)
2. School of Geography and Tourism, Jiaying University, Meizhou 514015, China
3. School of Geographical Science, South China Normal University, Guangzhou, 510631, China

** Corresponding author: ouxianjiao@163.com*

The Qinghai-Tibetan Plateau (QTP) and bordering mountains, which contain abundant evidences of extensive Pleistocene glaciations, are the most glaciated regions outside the polar realm. In the last 10 years, OSL dating method has been applied to glacial sediments in these regions. However, controversies still occur on the suitability of OSL dating of glacial sediments. The most outstanding problem is insufficient bleaching before deposition, which will lead to age overestimation. We collected ~100 modern and palaeoglacial samples from Tianshan, Kunlun and Hengduan Mountains, aiming to investigate the availability of quartz OSL dating on glacial sediments, especially to checkout whether the luminescence signal could be zeroed. In addition, glacial fluctuations and triggering mechanisms will be discussed. The preliminary results are as follows: Luminescence sensitivity of glacial quartz for most of these samples is too low for single grain and small aliquot measurements. For large aliquot (6 mm), the luminescence characteristics, preheat plateau and dose recovery test show that the SAR protocol is suitable for D_e determination. The results of modern samples show that glaciofluvial and high lateral moraine crest (supraglacial meltout tills dominated) samples are better bleached than that from low terminal moraine and recessional ground moraine deposits, and that the mixture of subglacial, englacial or pre-deposits rises the risk of age overestimation for the low terminal moraine and recessional ground moraine samples, which could be overestimated for more than 10 ka, while age overestimations of glaciofluvial and high lateral moraine crest samples are below several hundred years. The OSL ages of ancient moraines from several sites show good consistent with stratigraphy and other chronological results. We also suggest that glaciofluvial/glaciolucustrine deposits, or supraglacial tills from high moraines should be chosen for OSL sampling. The Last Glacial moraine complex at Yingpu Valley in eastern QTP can be divided into four sets, which were formed during MIS4, MIS3, LGM and Late Glacial stages, respectively. Glacial extent during the four stages decreased successively yet with not much difference. Each moraine set consists of multiple small moraines or sub-ridges, indicating multiple glacier sub-advances during each glacial event. These sub-advances correspond to cooling events of the Last Glacial. Glacier advances were dominantly controlled by Northern Hemisphere cooling cycle or events. However, moisture probably influenced glacial extents during the Last Glacial.

Keywords: Glaciation; OSL dating; Qinghai-Tibetan Plateau and its bordering mountains; Climatic changes.

Origin, age and development of the Early Holocene Lake Lampsilis, St. Lawrence Lowlands, Québec

S. Ouimet[1*], M. Lamothe[1]

[1] Département des sciences de la Terre et de l'Atmosphère, Université du Québec à Montréal, Montréal, Canada, H3C 3P8 (ouimet.stephanie@courrier.uqam.ca)

** Corresponding author: ouimet.stephanie@courrier.uqam.ca*

The Modern St. Lawrence River, a major Canadian waterway, takes its origin more than 8000 years ago. The development of this drainage system followed a complex suite of events that prevailed in Late Pleistocene-Early Holocene time marked by the regional retreat of the Laurentide Ice Sheet, the invasion of the St. Lawrence Lowlands by the waters of the Champlain Sea and the final marine regression due to postglacial uplift. This postglacial isostatic uplift drove out of the Lowlands, the salt waters which were then progressively replaced by the freshwaters of Lampsilis Lake. Lampsilis Lake is known for being the transitional stage between the Champlain Sea and the Proto St. Lawrence River and is responsible for many of the geological deposits and landforms observable in the field between Ottawa and Quebec City. This project is aimed at refining the regional and local Lampsilis Lake geomorphology, particularly the origin of the well-known three levels Lampsilis/Proto-St. Lawrence terraces system. The study of this sedimentary basin focuses on facies analysis, detailed airphoto, DEM interpretation and application of the infrared stimulated luminescence method to some of the Lake deposits. The IRSL method was applied to samples characterised by different grain sizes ranging from silt to coarse sand. Those samples represent two lacustrine deposition settings such as deltaic and beach facies, located on both margin of the Lampsilis Lake. The preliminary results show that an important amount of sand located on the upper Lampsilis territory is probably much older than the lake itself, meaning the Lampsilis Lake would only have induced a weak remobilization of those older sands, preventing these from being zeroed. For well-zeroed samples, preliminary results indicate that in Early Holocene time, depositional rates were probably controlled by the over-spill drainage of one or several glacial lakes into the regional St. Lawrence River basin. The dates obtained on the Lampsilis sand samples will thus provide a new independent and systematic chronology constraining the timing of lacustrine deposition in one of the most climate-sensitive drainage system of North America.

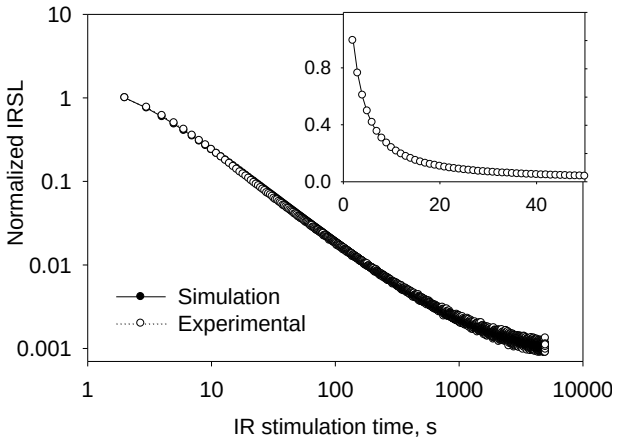
Modeling infrared stimulated luminescence signals and excited state tunnelling processes in feldspars

V. Pagonis[1*], M. Jain[2], A.S. Murray[3], C. Ankjærgaard[4], R. Chen[5]

[1]McDaniel College, Physics Department, Westminster, MD 21157, USA
[2]Nordic Laboratory for Luminescence Dating, Department of Earth Science, Aarhus University, Risø National Laboratory for Sustainable Energy, DK-4000 Roskilde, Denmark
[3]Radiation Research Division, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, DK-4000 Roskilde, Denmark
[4] Netherlands Centre for Luminescence Dating, Technical University of Delft, The Netherlands
[5]Raymond and Beverly Sackler School of Physics and Astronomy, Tel Aviv University, Tel Aviv 69978, Israel

** Corresponding author: vpagonis@mcdaniel.edu*

This paper presents a new numerical model describing infrared (IR) stimulation phenomena in feldspars. In the model electrons from the ground state of an electron trap are raised by infrared optical stimulation to the excited state, and subsequently recombine with a nearest-neighbour hole via a tunneling process, leading to the emission of light. The model explains the experimentally observed existence of two distinct time intervals in the luminescence intensity; a rapid initial decay of the signal within ~200 s, followed by a much slower gradual decay of the signal with time. Several simulations of infrared stimulated luminescence (IRSL) experiments, by varying the parameters in the model are carried out. It is found that the shape of the IRSL signal is remarkably stable when the kinetic parameters are changed within the model; this is in agreement with several previous studies of these signals on feldspars, which showed that the shape of the IRSL curves does not change significantly under different experimental conditions ([1],[2],[3]). The relationship between the simulated IRSL signal and the well-known power-law dependence of relaxation processes in solids is also explored, by fitting the IRSL signal at large times with a power-law type of equation. The coefficient in this power law is found to depend very weakly on the various experimental conditions, in agreement with the results of experimental studies [4]. Good agreement is found between the simulation results and experimental data, as shown in Figure 1 on a log-log scale. The inset of Fig.1 shows the same fitted data for the first 50 seconds of the IRSL signal, on a linear scale. The results from the model are compared with experimental IRSL curves obtained using different preheat temperatures, IR stimulating power and stimulation temperatures. The possibility of extending this model to time-resolved IRSL (TR-IRSL) experiments for feldspars is explored, and preliminary results are presented for fitting experimental TR-IRSL data to a model [3]. The implications of the model for dating are discussed.



References
1. Thomsen, K.J., Murray, A.S., Jain, M., Bøtter-Jensen, L., 2008. Radiat. Meas. 43, 1474-1486.
2. C. Ankjærgaard, M. Jain, 2010. Journal of Luminescence, 130, 2346-2355.
3. M. Jain, C. Ankjærgaard, 2011. Radiat. Meas. In Press
4. Baril, M.R., Huntley, D.J., 2003. J. Phys. Cond Matt 15, 8011-8027.

Optically stimulated luminescence dating of bang berd sand dune , southern Thailand

S. Pailoplee[1,*], P. Nachiangtai[1], M. Choowong[1], W. Lertnok[2], M. K. Jaiswal[3], P. Charusiri[1], Y. G. Chen[4]

[1.] Earthquake and Tectonic Geology Research Unit (EATGRU), c/o Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2.] Geological Resources Conservation and Management Division, Department of Mineral Resources, Rama VI, Bangkok 10400, Thailand
[3.] Department of Earth Sciences, Indian Institute of Science Education and Research, (IISER-Kolkata) Mohanpur campus, West Bengal-741252, India
[4.] Department of Geosciences, National Taiwan University, Taipei, Taiwan (R.O.C.)

** Corresponding author: Pailoplee.S@gmail.com*

Bang Berd sand dunes located in southern Thailand is an important archive for paleoclimatic reconstruction. Optically stimulated luminescence (OSL) dating has been applied widely to date sediments from a variety of geomorphic origin e.g. aeolian, fluvial and colluvial deposit. Since the resetting of the luminescence clock is done by daylight exposure of the sand before burial, sand dunes are considered best for applying OSL dating. However, in some cases it has been found that sand dunes are also heterogeneously bleached and hence can produce erroneous ages. Also, optical dating is mineral dependent i.e. luminescence characteristics of quartz/feldspar minerals in the sediment. Present study focuses on the feasibility of optical dating using single aliquot regeneration (SAR) for the quartz minerals obtained from the dunes for the first time in Thailand vis-à-vis reconstruction of past climate in terms of wind activity. Present studies shows that the quartz can be used successfully to provide high resolution optical ages. The 17 OSL datess from 3 m-thick dune profile illustrate the controversial ages in the stratigraphic point of view. There are 2 series of dates can identify throughout the exposure dune profile. Based on the stratigraphic evidences (i.e., grass layer) including the obtained OSL dates, it is concluded that this dune profile compost of 2 dunes that overlap during the dune migration. However, the OSL dates obtained from the upper part of both overlapping dunes reveal that wind activity was high during 2-3 ka and break the development of dune during 90-120 year before present.

Keywords: Bang Berd; Sand dunes; SAR; OSL Dating; Southern Thailand.

Late Quateranry lake-level fluctuations of the LingGo Co, the Qiangtang plateau, the Third Pole

B. Pan[1*], C. Yi[2,*], G. Hu[3], T. Jiang[4], G. Dong[5]

[1] a Laboratory of Tibetan Environment Changes and Land Surface Processes, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100085, China；Graduate School of Chinese Academy of Sciences, Beijing 100049 (panbaolin516@163.com、pbl@itpcas.ac.cn)
[2] a Laboratory of Tibetan Environment Changes and Land Surface Processes, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100085, China (clyi@itpcas.ac.cn)
[3] a Laboratory of Tibetan Environment Changes and Land Surface Processes, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100085, China；Graduate School of Chinese Academy of Sciences, Beijing 100049 (piaoyinghg@gmail.com)
[4] Key Laboratory of Tectonics and Petroleum Resources of Ministry of Education, China University of Geosciences, Wuhan, 430074, China (taojiang@cug.edu.cn)
[5] a Laboratory of Tibetan Environment Changes and Land Surface Processes, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100085, China；Graduate School of Chinese Academy of Sciences, Beijing 100049 (dongguocheng@itpcas.ac.cn)

** Corresponding author: clyi@itpcas.ac.cn*

Lake level changes are important environmental events, which are related to climatic changes. Datings of these events will let us know the process of the lacustrine geomorphology and help understand the climatic changes. Because of the lack of organic carbonate for radiocarbon dating in extremely high plateau, we know little about the process of lake level changes. The paleoshorelines of a lake record the past water levels and indirectly write down changes of the paleoclimate. We investigated, in this paper, the shorelines the LingGo Co which the Puruogangri ice field (the PIF), the biggest ice field in the Qiangtang Plateau (QTP), drains mainly and collected four samples in four shoreline sequences and one aeolian sand sample which is on the third shoreline for optically stimulated Luminescence (OSL) dating. Using the quartz grains of 90～125 μm in size, the highest/oldest beach ridge (>60 m higher than the current lake level) is dated to 25.28 ka, corresponding to the late stage of the Last Glaciation, probably the marine stage 3 (the MIS 3). The lowest, also the youngest beach ridge is traced back to 1.08 ka. The second and third beach ridges is retrospected to 2.12 ka and 21.2 ka, most likely corresponding to moderately wet late Holocene and earlier phases of the dry early Holocene, respectively. The age of the aeolian sand sample, on the third shoreline, is 17.57 ka, corresponding to the dry early Holocene. The history of these shorelines implies that the highest lake-level occurred after the meltwater of Puruogangri ice field drained the lake in the MIS3.

Keywords: lake-level fluctuation, Late Quateranry, LingGo Co,OSL dating, the Third Pole

Effects of thermal treatments on the luminescence features of three natural feldspars

L. Panzeri[1*], M. Martini[1,2], E. Sibilia[1,2]

[1] Dipartimento di Scienza dei Materiali, Università degli Studi di Milano Bicocca, via R. Cozzi 53, I-20125 Milano (laura.panzeri@mater.unimib.it)
[2] INFN, Sezione di Milano Bicocca, Piazza della Scienza 1, I-20126 Milano

** Corresponding author: laura.panzeri@mater.unimib.it*

The potential of using the feldspars extracted from sediments for OSL dating has been increasingly underlined. At the same time, deep and detailed researches have been stimulated, due to the natural variability of feldspars, the presence of adverse luminescent phenomena like anomalous fading and sensitivity changes, the dependence of the OSL signal on illumination wavelength, illumination temperature, irradiation and thermal history. With the aim of contributing to the knowledge of the luminescent mechanisms in feldspars, we present the results of a study performed on three different feldspar minerals (albite, sanidine and orthoclase) in which the relationships between OSL and TL were investigated. The three natural feldspar samples under study, selected on the basis of their position in the albite-anorthite series, largely differed under the geological, chemical and mineralogical point of view. Differences were also observed in some luminescent properties. For instance, a prior IR illumination did not affect the shape of TL glow curve of albite, while in sanidine and orthoclase it was effective in emptying the high temperature traps and in inducing phototransfer to the low temperature peak. A dose recovery experiment was also performed, varying both pre-heat and temperature of measurement, after erasing the natural signal through IR illumination or by using a solar simulator. Being the results sample-dependent, an appropriate selection of preheat and temperature of measurement appeared to be a crucial point for a correct dose evaluation. In albite the recovery test gave good results, for all preheatings and illumination temperatures. With sanidine the results were more scattered and dependent on preheat temperature. In orthoclase, the situation appeared more complex, without a clear trend. Only when IRSL was performed at high temperature (200°C) acceptable results were obtained with all preheating. This study gave a further confirmation of the complexity and variability of the luminescence processes in feldspars. Whether they mainly depend on the crystalline order of the mineral, on the condition during its geological formation or on the alkaline ions concentration is not a simple question to answer.

Optically stimulated luminescence dating of sediments from Xiaohushan hill in the Pearl River Delta, South China

Z.L. Peng[1*], G.N. Chen[1], N.S.Wang[2], K.Zhang[1], Y.K. Tang[1], W.Y.Hu[1], S.S. Qiu[1]

[1] Luminescence Dating Laboratory, Department of Earth Science, Sun Yat-sen University, Guangzhou, China (eespzl@mail.sysu.edu.cn)
[2] Luminescence Dating Laboratory, School of Geography, Environment and Earth Science, Victoria University of Wellington, New Zealand

** Corresponding author: eespzl@mail.sysu.edu.cn*

It is known that the Pearl River Delta in Southeast China experienced transgression twice in the late Quaternary: once between 40-20ka.BP, and the other between 7-2ka.BP. The Xiaohushan hill located in the central northeastern part of the Delta is one of the key-points for determining the coastline position of the two transgressions mentioned above. The sedimentary sequence recently found at the bottom of the hill consists of two layers: fine sand on the top and medium-coarse sand at the bottom. Analysis of sedimentary facies indicated that one is marine deposit and other is alluvial respectively. UV signals from fine grained (4-11μm) quartz derived from the above two layers were measured using the single aliquot regenerative protocol (SAR) under blue stimulation. The dose rates at these sites are high (3.6-4.5Gy/ka) and the samples have equivalent doses in the range of 19-100Gy. According to OSL dating, the sediments present two age groups: 5.3-5.6ka and 24.2-27.3ka. It is consistent with geological data mentioned above and is helpful for determining the positions of the paleo-coastlines.

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Luminescence dating of a Tisa River terrace near Mužlja (Vojvodina, N Serbia) using K-feldspar

D. Popov[1, 2,*], D. A.G. Vandenberghe[1], S. B. Marković[2]

[1] Laboratory of Mineralogy and Petrology (Luminescence Research Group), Department of Geology and Soil Science, Ghent University, Krijgslaan 281 (S8), B-9000 Ghent, Belgium
[2] Chair of Physical Geography, Faculty of Science, Novi Sad University, Trg Dositeja Obradovica 3 21000 Novi Sad, Serbia

** Corresponding author: dpopov@live.be*

The Tisa (Tisza, Theiß) is one of the major rivers in Central Europe; rising in the Carpathians and flowing into the Danube, it drains the eastern part of the Pannonian basin. The morphological evolution of the lower Tisa is poorly understood in terms of climatic and tectonic forcing owing to the lack of a reliable timeframe. We present results from our first investigations into the potential of luminescence dating to provide a chronology for Upper Pleistocene to Holocene deposits of the Tisa River in Vojvodina (N Serbia). The main objective of our study is to deliver – for the first time – a significant contribution to the timing of fluvial processes in Serbia. In N Serbia, the Upper Pleistocene Tisa River terrace is fully developed in a sandpit near Mužlja. The investigated section is ~4m thick and comprises a sequence of upper aeolian and lower fluvial deposits; 17 samples in total were taken from this exposure at closely spaced vertical and horizontal intervals. Initial investigations showed that the quartz OSL signal is not dominated by a fast component. We therefore used K-feldspar as dosimeter. The characteristics of the IRSL signal measured at 50°C were investigated using a single-aliquot regenerative-dose protocol in terms of recuperation, recycling ratio, dose recovery, thermal transfer, dependence of measured dose on measurement parameters, and anomalous fading. Investigations into the completeness of resetting, as well as the determination of the dose rate, are ongoing at the time of writing. The available results do already suggest, however, that feldspar IRSL-dating holds considerable potential for establishing chronologies for the Upper Pleistocene terrace in Serbia. The final IRSL ages will be present at the meeting and discussed in terms of regional fluvial dynamics in relation to climate change and neotectonics.

Keywords: Tisa river, luminescence dating, quartz, feldspar

OSL dating in multi-strata Tell: Megiddo (Israel) as a Case Study

N. Porat[1*], G. A.T. Duller[2], H. M. Roberts[2], E. Piasetzky[3], I. Finkelstein[3]

[1]. Geological Survey of Israel, 30 Malkhe Israel St. Jerusalem 95501, Israel (Naomi.porat@gsi.gov.il)
[2]. Institute of Geography and Earth Sciences, Aberystwyth University, Aberystwyth SY23 3DB, UK.
[3.] Tel Aviv University, Ramat Aviv, Israel.

** Corresponding author: Naomi.porat@gsi.gov.il*

Megiddo is one of the most important mounds in the Levant. It was inhabited almost continuously from the 7th millennium BC until the Persian Period and the archaeological remains have accumulated to a height of ca. 20 m. The site was excavated in the 1920s and 1930's by the Chicago University and in recent years by Tel Aviv University.
Megiddo features a significant number of destruction levels, some of which can be correlated to well known historical events. Other destruction levels are less well dated, and in order to improve the chronological control, radiocarbon dating was augmented by OSL, particularly for those periods where the radiocarbon calibration curve incorporates large errors on radiocarbon dates.
In the first phase of luminescence dating, 15 samples were collected, mostly from four destruction layers at different excavation areas. Purified quartz was measured using conventional SAR to obtain the equivalent dose (D_e), and gamma and cosmic dose rates were obtained with Al_2O_3 dosimeters that were buried at the site for 2 months. The OSL properties of the samples conformed to all the standard tests: OSL signals are bright and are dominated by the fast component; recycling ratios are well within %5 of unity; no significant feldspar contamination; and broad preheat plateaus. However, the OSL ages are mostly older than the expected archaeological ages and show high scatter on the D_e values. Most likely this is the result of older, unfired brick material that was part of the destruction accumulation.
In the second phase 11 samples were collected mostly from well bedded sediments in courtyards, where only freshly bleached quartz could be incorporated by aeolian deposition. Gamma and cosmic dose rates were obtained by a calibrated gamma scintillator. While the scatter on the D_e values was much lower than the first suite of samples, only a few the OSL ages matched the expected archaeological ages.

The discrepancy between the archaeological and OSL ages could be attributed to various causes such as movement of quartz grains up and down the section and the presence of quartz from older bricks, or to changing dose rates over time due to changes in burial depths and moisture contents.

Megiddo provides an example of the difficulties in OSL dating in a multi-period, complex archaeological site.

Simultaneous application of OSL dating, ^{137}Cs measurement and results of archeological surveys to reconstruct the history of water erosion: study of Holocene colluvium in Świerklany, South-West Poland.

G.J. Poręba[1*], Z. Śnieszko[2], P. Moska[1], D. Abłamowicz[3]

[1]Institute of Physics CSE, Department of Radioisotopes, Silesian University of Technology, . Akademicka 2A str., 44-100 Gliwice, Poland
[2] Katowice School of Economics, Harcerzy Września 3 str., Katowice, Poland
[3] Faculty of Earth Science, Silesian University, ul. Będzińska 60, Sosnowiec, Poland; Upper Silesian Museum, Jana III Sobieskiego 2 str., Bytom, Poland

** Corresponding author: Grzegorz.Poręba@polsl.pl*

Archeological-rescue excavation associated with the construction of the highway in the vicinity of Świerklany village allowed to gather interesting archaeological and geological study material. A large-scale excavation exposed geological material which seems to be extremely interesting from the perspective of quantitative determination of the history of soil erosion during the Holocene in the study area. Colluvial sediments are good archives for past soil erosion. On the investigated area slope, sediment is deposited at the foot of the slope. In one case, on the extension of the slope was located a pound which clearly defined origin by the analysis both archival material and archeological finds. Nowadays this pond is filled by colluvium sediments. In order to quantify the Holocene soil erosion and accumulation processes three sediment profiles located at the key points of the studied area have been collected. Two of them were located at the foot of the slopes where accumulation of colluvia had occured. The last one was located in a pond which was located on the extension of the one of the tested slope. Beside this, 10 soil cores were collected to measure ^{137}Cs activity as a modern soil erosion tracer. In the laboratory, the analysis of ^{137}Cs activity, grain size, iron and humus contents analysis as well as OSL SAR were done. The quartz extracted from the collected colluvia was suitable for age determination based on the OSL SAR protocol.

The obtained results of OSL dating are clearly different for the lower part of the profiles where fossil soil levels were developed (about 10 ka BP) from overlaying colluvia (0.04 ka BP – 1.50 ka BP). Results Archaeological studies indicate no significant traces of prehistoric settlements in the study area. First agriculture was thus related to the period of establishing Świerklany village. OSL dating results are consistent with the archaeological data and indicate that soil erosion in the investigated area has occurred since the Middle Ages deforestation. Results of measurement of the isotope ^{137}Cs show a modern phase of soil erosion acceleration. Generally ^{137}Cs is present on the slope to plough depth with the exception of places where soil accumulation occured. The soil layer which contains ^{137}Cs was dated by the OSL method for a period of 40-50 years, and the results obtained with both methods are in good agreement

Results of investigations of the colluvial sediment in Świerklany area clearly document good bleaching of OSL signal for sediments derived from washing (slope sediment). Obtained results are important for the study of Holocene soil erosion and accumulation of colluvial sediment in Central Europe. In comparison with previously obtained results it could be said that the OSL method can be successfully applied to study the age of modern Holocene colluvia.

The reliability of fading tests for the determination of g-values

S. E Lowick[1], F. Preusser[2*]

[1]Institute for Geological Science, University of Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland (e-mail: lowick@geo.unibe.ch),
[2]Department of Physical Geography and Quaternary Geology, Stockholm University, 106 91 Stockholm, Sweden (e-mail: frank.preusser@natgeo.su.se)

** Corresponding author: frank.preusser@natgeo.su.se*

While the infrared stimulated luminescence (IRSL) signal of feldspar has the potential to reach much further back in time, it is often seen to suffer anomalous fading, leading to age underestimation. For this reason, when measuring a feldspar signal, fading tests are conducted on the sample to identify the presence of anomalous fading and may be used to quantify it. As the signal is seen to decay logarithmically with time, several procedures have been proposed to correct burial doses for fading by extrapolating the loss of the signal back over geological time. The rate of fading is assigned a g-value, identified as the percent fading from the initial signal, per decade, with a decade being an arbitrary interval of time between irradiation of the sample and measurement. While a sample with a g-value of 2 %, and an age of ~ 100 ka, would be expected to underestimate by 10-15 %, the underestimation would increase to ~ 30 % with a g-value of 4 %. It is therefore essential to reliably identify the fading rate of the sample if it is intended to correct a burial age for fading. This study has applied a variety of fading tests to a suite of coarse grain feldspar and fine grain polymineral samples; the tests varied in the length of the stimulation, number of aliquots used, and the delay times before measurement. The results from each of the tests are compared in an attempt to identify a reliable method for the measurement of fading.

Simulating optical bleaching of OSL signal in sediment quartz

A. Chruścińska, K. R. Przegiętka*

Institute of Physics, Nicolaus Copernicus University, Toruń, Poland (przeciu@fizyka.umk.pl)

** Corresponding author: przeciu@fizyka.umk.pl*

The aim of this work was to study the effect of the quality of optical bleaching on the distribution of OSL signal values measured by the Single Aliquot Regeneration (SAR) OSL technique from sediment quartz samples. The daylight bleaching was simulated in laboratory with help of two light sources in two different series of experiments. The coarse quartz grains extracted from geological deposits were used in the studies. Apparently, conditions of optical bleaching in natural environment can vary in wide ranges because they are influenced by many circumstances. Natural sand grains are usually dirty and not so light-transparent as samples used here, which were prepared for measurements in luminescence reader. Anyway, both laboratory light sources are assumed to give some approximations of a daylight exposure. This is sufficient because the absolute efficiency of optical bleaching is not important in the study, but rather relative quality of bleaching. In the first series the Green Light emitted from xenon lamp equipped with excitation filter pack GG-420 (410-580 nm) incorporated in the Riso luminescence reader (model Tl/OSL-DA-12) was used. In every experiment 72 aliquots, each one of 5 mg, were bleached with appropriate distribution of exposure times. The poor and good bleaching conditions were simulated by short and long exposure times respectively, with the scatter governed by the Gaussian distribution. All the aliquots bleached in a single experiment were collected to one container and mixed. Subsequently 24 aliquots of such sample, each one of 5 mg, were prepared and their residual OSL signals were measured. In another series of experiments the massive sample of sediment quartz was bleached in the self-made daylight bleach simulator. The poor or good quality of bleaching was simulated by setting the exposure time short or long, respectively. Subsequently 24 aliquots of such sample, each one of 5 mg, were prepared and their residual OSL signals were measured. The both types of bleaching experiment were repeated. But this time, instead of measuring the residual OSL signal, the prepared aliquots were irradiated form the beta radiation source with appropriate distribution of the irradiation times (72 aliquots, each one of 5 mg, were used). Then, all the aliquots irradiated in a single experiment were collected to one container and mixed. Subsequently 24 aliquots of such sample, each one of 5 mg, were prepared and their OSL signals were measured by SAR OSL technique providing the distribution of the equivalent doses. The obtained distributions of residual OSL signals and equivalent doses are presented and discussed in the relation to the given quality of optical bleaching. The conclusions for dating sediment quartz samples are derived and discussed.

Effects of thermally transferred signals in the post-IR IRSL SAR protocol

J. Qin*, L. Zhou

Laboratory for Earth Surface Processes, Department of Geography, Peking University, Beijing 100871, China)

* *Corresponding author: qinjintang@pku.edu.cn*

The luminescence signal sampled by IR stimulation at an elevated temperature following a preheat at $>250^0$ C and a prior IR stimulation at 50^0 C for feldspar, was reported to show less fading, making it as a promising alternative protocol for dating samples beyond saturation limit of quartz OSL signal. One key step in this new type of protocol involves the use of temperature in excess of 250°C for the preheat. Such a relatively high temperature treatment could induce thermally transferred IRSL (TT-IRSL) and thermally transferred post-IR IRSL (TT-post-IR IRSL) signals which may have some effects on the determination of equivalent doses. In this study, the post-IR IRSL SAR protocol is applied to polymineral medium grains (45-63μm) of samples from Caoxian loess section of northwestern China, of which the quartz OSL ages were shown to display severe age underestimation as early as in the range around 30ka. The post-IR IRSL signal stimulated at 295°C following 320°C - 60s preheat and IR stimulation at 50°C for 100s was used for determining the equivalent dose. However, the TT-post-IR IRSL signals of natural and regenerative doses are found to comprise of substantial part of the measured post-IR IRSL signal of the test doses. Such signals would inevitably affect the sensitivity correction. Experimental results showed that the sensitivity change from natural cycle to regenerative cycles for IRSL signal differs from that for post-IR IRSL signal, but they are the same for regenerative cycles. The difference is attributed to the higher ratio of TT-post-IR IRSL intensity relative to the TT-IRSL intensity for the natural than those for the regenerative doses. As the contribution of TT-IRSL to the IRSL signal of the test dose is substantially smaller than that of the TT-post-IR IRSL signal to the post-IR IRSL signal of the same test dose, we propose to use the prior IRSL signal, instead of the post-IR IRSL signal itself, as a surrogate for sensitivity correction in the post-IR IRSL SAR protocol. The dependence of the relative intensity of TT-IRSL signal on the prior IR stimulation temperature was investigated. Our initial results showed that the proportion of TT-IRSL signal to the IRSL signal of the test dose can be suppressed most at 110°C. Therefore, this temperature instead of the conventional 50°C was chosen for the prior IR stimulation. Dose recovery experiments were carried out to optimize the size of the test dose. It was found that the effect of TT-IRSL signal was further reduced when relatively large test dose was applied. The residual dose was estimated using aliquots bleached by the sunlight for ~7 days and a value of ~10 Gy was obtained. Using the IRSL signal for sensitivity correction, the post-IR IRSL SAR age for a sample located 30 cm above the boundary of the last glacial loess and last interglacial palaeosol (L1/S1) is ~76.6 ka, which is more consistent with the stratigraphic constraint than the age of ~50 ka obtained previously using the quartz OSL signal.

Keywords: post-IR IRSL, thermal transfer, sensitivity correction

Dating the recent past (<500 years) by post-IR IRSL of feldspar – examples from the North Sea and Baltic Sea coast

T. Reimann[1,2*], S. Tsukamoto[1], M. Frechen[1]

[1] Leibniz Institute for Applied Geophysics (LIAG), Stilleweg 2, 30655 Hannover, Germany
[2] Freie Universität Berlin, Department of Earth Sciences, Institute of Geographical Sciences, Physical Geography, Malteserstr. 74-100, 12249 Berlin, Germany

** Corresponding author: Tony.Reimann@liag-hannover.de*

Recently, efforts have been made in identifying a luminescence signal from feldspar which is less affected by anomalous fading. Thomsen et al. (2008) proposed the use of a post-IR IRSL (pIRIR) signal measured at an elevated temperature, and the proposed pIRIR protocol was successfully applied to old sediments (≥100 ka) by Buylaert et al. (2009). Reimann et al (2010) used a modified pIRIR protocol to date Holocene coastal samples (≥1 ka) and obtained pIRIR feldspar ages which agreed with quartz and radiocarbon ages. However, these previous studies showed that a residual dose of ~1 Gy (or more) can be measured in laboratory bleached samples, even if the preheat temperature is reduced to 200 °C. This residual signal has prominent significance when very young samples are dated. Whether this residual is caused by a thermal transfer, is due to unbleachable signal component or have origin from incomplete signal resetting is still an open question. In order to improve the potential of the pIRIR protocol to date very young feldspars (<500 years) and to establish a reliable correction procedure for the residuals pIRIR dose, we investigated (i) thermal transfer, unbleachable components as well as signal resetting in feldspar extracts using three modern dune and beach analogues from the North Sea and the Baltic Sea coast. To test the reliability of a modified pIRIR protocol and the performance of the residual dose correction we dated (ii) feldspar extracts from three very young samples ranging from ~60 years to ~400 years with known depositional ages provided by quartz OSL and historical map evidence. The results of the laboratory experiments and the pIRIR ages from the recent past will be presented and discussed in detail.

Keywords: post-IR IRSL feldspar, modern analogue, thermal transfer, residual doses, dating of sediments < 500years

References

Buylaert, J.P., Murray, A.S., Thomsen, K.J., Jain, M., 2009. Testing the potential of an elevated temperature IRSL signal from K-feldspar. Radiation Measurement 44, 560-565.

Reimann, T., Tsukamoto, S., Naumann, M., Frechen, M., 2010. The potential of using K-rich feldspars for optical dating of young coastal sediments – a test case from Darss-Zingst peninsula (southern Baltic Sea coast). Quaternary Geochronology, doi:10.1016/j.quageo.2010.10.001

Thomsen, K.J., Murray, A.S., Jain, M., Bøtter-Jensen, L., 2008. Laboratory fading rates of various luminescence signals from feldspar-rich sediment extracts. Radiation Measurement 43, 1474-1486.

Implications of single grain OSL sensitivity distributions for the interpretation of multiple grain single aliquot dose values

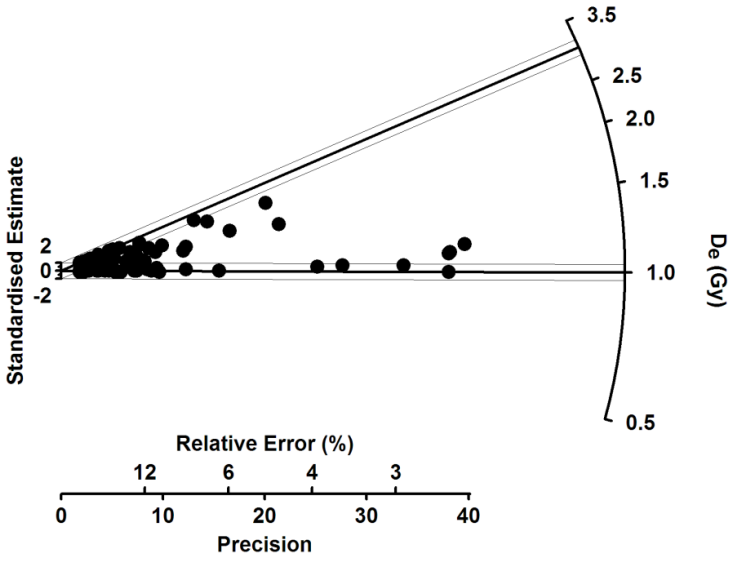
E. Rhodes*

Department of Earth and Space Sciences, University of California, Los Angeles, 595 Charles Young Drive East, Los Angeles, CA 90095-1567, USA

** Corresponding author: erhodes@ess.ucla.edu*

Previous work used a simple probabilistic numerical model to construct synthetic D_e distributions by combining the simulated OSL from grains of different sensitivities and with various simulated dose values (Rhodes, 2007). This was useful for exploring the complex patterns generated by summing the signals from many grains in typical, multiple grain OSL dating scenarios, and examining the ways in which the form of the single grain sensitivity distribution affects multiple grain single aliquot dose values. Since that time, significant numbers of samples have been measured using both single grains and multiple grain single aliquots of quartz, providing an opportunity to assess the utility of this numerical model. I introduce the numerical model and its implementation based on measured quartz single grain OSL sensitivity distributions. I examine the differences between dose values measured using single grains and multiple grain aliquots, both conventional and small aliquot size, and explore ways in which this simple model may be used to enhance the interpretation of multiple grain single aliquot data. The model highlights several interesting and potentially counter intuitive results.

Reference
Rhodes, E.J. 2007 Quartz single grain OSL sensitivity distributions: implications for multiple grain single aliquot dating. Geochronometria 26, 19-29.



Simulated OSL data using a measured single grain sensitivity distribution from sample K0207 using 10 grains per aliquot with 70% of grains having 1 Gy and 30% having a 3 Gy dose (1 and 3 Gy dose values shown by heavy lines, lighter lines show 2 sigma uncertainty limits). Note the significant number of simulated aliquots consistent with the 1 Gy value.

Comparison of TL protocols to determine palaeodoses of heated flint

D. Richter*

University of Bayreuth, Lehrstuhl Geomorphologie 95440 Bayreuth Germany

* *Corresponding author:* richter.hdh@freenet.de

The palaeodose of heated flint from archaeological sites can be determined by Thermoluminescence (TL) analysis by several different protocols. For flint samples with palaeodoses well below the onset of saturation a multiple aliquot additive regeneration (MAAR) is usually employed. If the palaeodose is close to its saturation onset, a multiple aliquot slide protocol (MAAR-slide) with an additive and a regenerated dose response curve has to be used. These protocols measure the signal in an UV-blue wavelength band, where the TL exhibits strong sensitivity changes for repeated heating to high temperatures. However, the orange-red TL emission has been shown to be much less sensitive to heating, which allows the application of a single aliquot (SAR) protocol. The small amount of material needed for SAR allows the TL-dating for samples which are too small for multiple aliquot procedures, and therefore more Palaeolithic sites can be dated. In order to reduce valuable machine time, a SAR procedure based on only two regenerated dose points has been proposed for samples with large palaeodoses. Furthermore, test doses do not appear to be necessary because of the almost complete absence of sensitivity change of the orange-red emission. For all protocols the alpha sensitivity has to be determined for each individual sample, and for some the sensitivity to alpha radiation appears to be different for the two wavelength bands.
Little independent evaluation of the accuracy of ages can be provided, especially because of the scarcity of material for other non-dosimetric dating methods which is related to the same event as dated by TL. Therefore the main verification procedures are dose recovery tests. A comparison of different TL-protocols will be presented for identical archaeological samples, as well as dose recovery test for geological material. Comparisons are made for the palaeodoses obtained, but because of the differences in response to alpha radiation only ages can be compared for archaeological samples for which independent age control (Brunhes/Matuyama) is provided. Furthermore, it is investigated if two regeneration dose points are sufficient and if test doses are needed to determine the correct palaeodose with a short TL-SAR orange-red emission protocol.

Dating polymineral finegrains: Experiences with the Single Aliquot Regenerative technique

U. Rieser*, N. Wang

School of Geography, Environment and Earth Sciences, Victoria University of Wellington, PO Box 600, Wellington, New Zealand

* *Corresponding author: uwe.rieser@vuw.ac.nz*

The choice of the best OSL dating mineral and technique has always been difficult for researchers working in New Zealand. Locally sourced quartz tends to be extremely dim, and any attempts to date it using the well established Single Aliquot Regenerative (SAR) method leads to scattery datasets, which display huge sensitivity change and often unexplained age underestimates.

Accordingly our laboratory has a firm focus on feldspar dating, and infrared stimulated luminescence (IRSL) of fine-grained polymineral samples (4-11μm), using multiple aliquot additive techniques (MAAD) originally developed in the 1990s, remains the most successful OSL dating approach for most types of New Zealand sediments. However, since feldspar tends to have small or even negligible sensitivity change in regenerative protocols, leading to excellent reproducibility of the recycled aliquots, single aliquot protocols like SAR might be advantageous in some situations.

We have, over the past twelve years, routinely used variants of the SAR technique for test-measurements, which allows for excellent irradiation planning for the subsequent MAAD dating. Dose distributions often are very narrow, as would be expected for millions of fine grains where grain-to-grain variability is averaged out. Also, for 'old' samples (>100ka) where the growth curve saturates and extrapolation becomes mathematically difficult, the SAR technique has provided us with an opportunity to cross-check our results. Given the long storage time we use for MAAD (4 weeks), comparison with SAR which naturally is measured shortly after irradiation gives insight into potential anomalous fading of the feldspars.

On the poster we will draw conclusions about the performance of IRSL-SAR for fine-grained sediments of different sedimentary environments and ages, using the treasure trove of more than 800 OSL samples that have been measured in parallel by SAR and MAAD within numerous projects over the years. The large number of samples, some with independent age control, allows to generalise our findings regarding the details of the SAR measurement protocol, and to show usefulness and limitations of the SAR based dating approach.

Application of single-grain quartz SAR to date xenocrysts within a basalt flow from a cinder cone, northern Arizona, USA

T.M. Rittenour[1*], N.R. Riggs[2], L. Kennedy[2], M. Ort[2]

[1] Utah State University, Logan, UT 84322 USA (tammy.rittenour@usu.edu)
[2] Northern Arizona University, Flagstaff, AZ, USA

** Corresponding author: tammy.rittenour@usu.edu*

The San Francisco volcanic field (SFVF) in northern Arizona, USA, contains over 600 volcanoes and vents that have formed over the last 6 million years. The youngest volcanic features are basaltic cinder cones, tuff rings, spatter cones and lava flows. SP Crater is the second youngest cinder cone within the SFVF, older only than Sunset Crater, which erupted 1085 AD and greatly affected Native Americans in the region at the time (Ort et al., 2008). SP Crater is 244 m tall, unvegetated, steep-sided, and visible on GoogleEarth from at least 500 km altitude. Two basalt flows emanate from the northern base of the cinder cone. The flows can be distinguished by the thickness of cinder covering them, with up to 3 cm of cinder on the older flow and an absence of cinder on the younger flow (Kennedy et al., 2008), and by presence of mounds of near-vent material that was carried out by the older lava flow (Weikert et al., 2008). Cinder cones commonly complete eruptive activity within a few years (Wood, 1980) and the small size of SP Crater and its flow suggest this was the case. K-Ar dating of the basalt flow suggests that SP Crater is 70±4 ka (Baski, 1974), but elsewhere in the field, K-Ar ages have proven too old (e.g., Duffield et al., 2006). More recent ^{3}He and ^{21}Ne cosmogenic exposure ages suggest a similar age (70±5 ka) (Fenton et al., 2009). However, these age estimates are anomalously old for the unweathered and youthful appearance of the cinder cone and basalt flow, suggesting these ages may be in error.

The SP Crater basalt flow contains quartz xenocrysts that are 2-3% by volume and are up to 4 mm in diameter (Kennedy et al., 2008). These xenocrysts are thought to have been derived from the Proterozoic basement rock of the region and incorporated into the magma prior to eruption. Heat from the magma (up to 1000^{o}C) annealed the quartz and reset its luminescence signal. It is proposed here that OSL dating of quartz xenoliths encased within the basalt flow provides the age of eruption and cooling of the magma. Three basalt samples were collected and xenoliths isolated for OSL dating by mechanical crushing and physical separation using a Frantz Magnetic separator, heavy liquids (2.7 g/cm^{3} sodium polytungstate) and hand picking.

For age analysis, at least 75 aliquots containing 2-4 quartz xenolith grains (250-495 μm) were hand picked and mounted on stainless steel discs. Large recuperated signal in the zero-dose step and high residual background indicated that a 280ºC bleach should be inserted into the SAR protocol following Murray and Wintle (2003). Addition of this step reduced recuperation of the natural from 70-100% to an acceptable level of <15%. Preheat plateau and dose recovery results indicated that a 240ºC preheat and 220ºC cutheat worked best for these samples. OSL results are consistent with geomorphic character of the cone and suggest a mid- to late Holocene age (~5 ka) for SP Crater (unlike the older 70 ka K-Ar and cosmogenic exposure ages).

References

Baski, A. K., 1974, K-Ar study of the SP flow. Canadian Journal of Earth Sciences 11, 1350–1356.

Duffield, W, Riggs, N, et al, 2006, Multiple constraints on the age of a Pleistocene lava dam across the Little Colorado River at Grand Falls, Arizona: Geological Society of America Bulletin, v. 118, p. 421-429.

Kennedy, L.E., Riggs, N., Rittenour, T., 2008. OSL dating of xenoliths in the SP Flow, San Francisco Volcanic Field, northern Arizona. Abstracts with Programs, v. 40, n. 1, p. 67

Murray, A.S. Wintle, A.G, 2003. The single aliquot regenerative dose protocol: potential for improvements n reliability. Radiation Measurements 37, 377-381.

Ort, M. Elson, M. Anderson, K. Duffield, W. Samples, T 2008 Variable effects of cinder-cone eruptions on prehistoric agrarian human populations in the American southwest. J of Volcanology and Geothermal Research 176, 363-376.

Weikart JL Seligman AN, and Riggs N 2008, Origin of agglutinate material on the SP Crater lava flow and implications for eruptive history of a "simple" cinder cone, San Francisco volcanic field, northern AZ: GSA. Abstracts, 197-1.

Wood, C.A., 1980. Morphometric analysis of cinder-cone degradation. J of Volcanology and Geothermal Research 8, 137-160.

Testing protocols for minimising fading in feldspars, using polymineral fine grains from Alaskan loess

H. M. Roberts*

Institute of Geography and Earth Sciences, Aberystwyth University, Aberystwyth, Ceredigion. SY23 3DB. United Kingdom. (hmr@aber.ac.uk)

** Corresponding author: hmr@aber.ac.uk*

Optical dating of feldspars potentially offers a significant advantage over quartz OSL due to the greater upper age limit which can be achieved using feldspars. However, the single greatest factor which has prevented the widespread uptake of luminescence dating using feldspars is the phenomenon of anomalous fading. Some authors argue that anomalous fading is ubiquitous (e.g. Huntley and Lamothe, 2001), affecting all feldspars, whilst other authors find no evidence for anomalous fading in their studies. The matter is complicated by there being no universally agreed method for detecting and measuring anomalous fading. Conventional methods of luminescence dating using feldspars and polymineral fine grains have tried to measure rates of anomalous fading; where anomalous fading is detected, correction methods are used to counter the loss of signal over time (e.g. as proposed by Huntley and Lamothe (2001), and the Dose Rate Correction (DRC) method of Lamothe et al., 2003). In contrast to this approach, recent efforts have focused on isolating an optical signal from feldspars that minimises fading (e.g. Thomsen et al. 2008; Murray et al., 2009), hence potentially removing the need for such complex signal corrections.

This study investigates the use of post-IR IRSL protocols developed for coarse-grained feldspars and designed to minimise fading rates (Thomsen et al. 2008; Murray et al., 2009), testing these methods using polymineral fine grain samples prepared from Alaskan loess. A key site examined is 'Halfway House', where previous TL/IRSL studies (Berger et al., 1994; Oches et al., 1998; Berger 2003) and fading-corrected IRSL studies (Auclair et al., 2007) have been conducted. Independent age control is provided in the form of key tephra marker beds. Fading rates and signal characteristics are examined, and the ages generated are compared with those of previous studies. Finally, the reliability of these different feldspar dating methods is assessed.

References

Auclair, M., Lamothe, M., Lagroix, F., and Banerjee, S.K. (2007). Luminescence investigation of loess and tephra from Halfway House section, Central Alaska. Quaternary Geochronology 2, 34-38.

Berger, G.W., Pillans, B.J., Palmer, A.S. (1994). Test of thermoluminescence dating of loess from New Zealand and Alaska. Quaternary Science Reviews 13, 309-333.

Berger, G.W. (2003). Luminescence chronology of late Pleistocene loess-paleosol and tephra sequences near Fairbanks, Alaska. Quaternary Research 60, 70-83.

Huntley, D.J.. and Lamothe, M. (2001). Ubiquity of anomalous fading in K-feldspars and the measurement and correction for it in optical dating. Canadian Journal of Earth Sciences 38, 1093-1106.

Lamothe, M., Auclair, M., Hamzaoui, C., Huot, S. (2003). Towrads a prediction of long-term anomalous adding of feldspar IRSL. Radiation Measurements 37, 493-498.

Murray, A.S., Buylaert, J.P., Thomsen, K.J., and Jain, M. (2009). The effect of preheating on the IRSL signal from feldspar. Radiation Measurements 44, 554–559.

Oches, E.A., Banerjee, S.K., Solheid, P.A., and Frechen, M. (1998). High resolution proxies of climate variability in the Alaska loess record. *In:* Busacca, A. (Ed.), Dust Aerosols, Loess Soils and Global Change (Extended Abstracts). Washington State University, 167-170.

Thomsen, K.J., Murray, A.S., Jain, M., and Bøtter-Jensen, L. (2008). Laboratory fading rates of various luminescence signals from feldspar-rich sediment extracts. Radiation Measurements 43, 1474–1486.

Optical dating of fluvial sediments used to reconstruct fault slip rates in southern California, USA

B. Roder[1], M. Lawson[1], E. Rhodes[1*], J. Dolan[2], P. Ganev[2], S. McGill[3]

[1] Department of Earth and Space Sciences, University of California, Los Angeles, 595 Charles Young Drive East, Los Angeles, CA 90095-1567, USA (erhodes@ess.ucla.edu)
[2] Department of Earth Sciences, University of Southern California, Los Angeles, CA 90089-0740, USA[3] Department of Geological Sciences, California State University, San Bernardino, 5500 University Parkway, San Bernardino, CA 92407, USA

** Corresponding author: erhodes@ess.ucla.edu*

Faults in California accommodate most of the relative motion between the Pacific and North American tectonic plates. Whereas most of the slip between the plates is focused (depending on latitude) along either one main strike-slip fault, – the San Andreas fault – or a network of sub-parallel faults (e.g., the San Jacinto, Elsinore and San Andreas faults to the south of Cajon Pass), deformation and slip is also accommodated along many other associated faults and folds. The contemporary relative movements of different fault-bounded blocks is relatively well established on timescales of 10 to 20 years by remote sensing and GPS measurements, and for major features, on timescales of millions to tens of millions of years by recognising offset geologic features that have been dated by radiometric methods. However, on timescales of decades to several hundred thousand years, determining total fault offset and mean fault slip rate is harder. Critical questions include the degree to which fault slip is clustered into episodes of more rapid movement with associated earthquake occurrence, followed by periods of reduced activity, and whether slip is accommodated by different sub-parallel faults within a single system. These issues are important for understanding fault dynamics and improving earthquake risk assessment, as well as helping to understand processes of landscape evolution. In many cases, streams with courses offset by fault movement can be recognised, and in some cases offset terrace surfaces can be located, especially when using LiDAR data to complement field mapping. Radiocarbon and terrestrial cosmogenic nuclides (primarily ^{10}Be) have been used to date these features, but both have limitations of age range and sample suitability. OSL and IRSL have great potential to complement these techniques, though the characteristics of quartz in some parts of southern California are suboptimal, displaying low sensitivity and other limitations. In this presentation, we explore different approaches to date mid- to late Holocene fluvial sediments forming small terrace units within alluvial fans that have been offset laterally by the Garlock fault, a major left-lateral strike-slip system within the Mojave Desert, California. We investigate the OSL and IRSL characteristics of quartz and feldspar fractions, and explore the severity of incomplete bleaching.

OSL dating of coastal post-barreiras sediments from northern Brazil

R. Rojas Rocca[1*], S. H. Tatumi[1,2], S. Watanabe[1], D. Rossetti[3].

[1] Physics Institute, University of São Paulo, São Paulo, Brazil (renerr@usp.br, etoledo@dfn.if.usp.br).
[2] Faculty of Technology of São Paulo, Brazil (tatumi@fatecsp.br).
[3] Earth Observation, National Institute for Space Research, Brazil. (rossetti@dsr.inpe.br).

** Corresponding author: renerr@usp.br*

In the present work we are interested in dating the sediments from state of Maranhão, it will be made comparing the MAR and SAR protocols.
For MAR protocol the results obtained by TL and OSL will be compared.
Discussion about different deposition origins will be showed taking into account single aliquot and single grain dating results.
These sedimentary deposits were chosen due their great importance in reconstruction of the latest Quaternary history along the Brazilian passive margin. Sediments samples were collected along the coast in an extension of about 20 km, choosing 4 places, for each place were collected several samples at different depths, these sediments are sands collected from fluvial terraces, aeolian dunes and marine terraces. Samples have different coloration, from red, brown to light yellow. We observed a deposition of a thin layer of iron oxide, which can be removed by chemical treatment. It was also noted that the content of feldspar crystals is very small, almost zero in some cases, verified by the small K content in the samples.
Quartz grains were separated using H_2O_2, HF, HCl (Gozzi et. al. 2001) and Sodium Polytungstate. These grains were then sieved to retain grain sizes between 75 and 150 μm. TL and OSL measurements were carried out with a Daybreak TL reader (Model 1100) and with a RIS∅ TL/OSL reader (Model DA-A).
TL experiments were made with heating rate of 10 ^{o}C/s, using two filters (Kopp 7-59 and BG-39) in nitrogen atmosphere. OSL experiments were performed by stimulating with blue and green light and with U-340 optical filter. Gamma irradiation was carried out using a ^{60}Co and ^{90}Sr/^{90}Y beta source. Natural radioisotopes elements were determined by gamma-spectroscopy with a NaI(Tl) detector of Canberra and standard soils samples (JR-1, JG-1a, JB-3 and JG-3).
In order to evaluate the accumulated doses by TL the 375 ^{o}C peak of quartz was used, for the OSL the maximum intensity of the decay curve was considered, subtracting the background for both respectively.
The OSL dating shows lower values than TL dating, OSL signals are bleached completely in about 10 minutes, while TL signals showed a residual signal even after 48 hours of bleaching.
Values calculated for the annual dose rate varies from 0.7 to 3 mGy/yr.
Age provided by OSL dating indicates ages ranging from 0.8 to 145 ky for the Post-Barreiras sediments in the State of Maranhão.
The cosmic rays were also experimentally measured at the collection site showing this value 0.26±0.05 mGy/y.
Dating using SAR by single grain is been developed for compare the results.

Keywords: Thermoluminescence; OSL; MAR; SAR; Quartz, Sediment.

OSL dating of a late Pleistocene fluvial-aeolian complex: the upper Senne of the Münsterland Embayment, NW Germany

J. Roskosch[1*], S. Tsukamoto[2], J. Meinsen[1], M. Frechen[2], J. Winsemann[1]

[1] Institut für Geologie, Leibniz Universität Hannover, Callinstaße. 30, D-30167 Hannover, Germany (roskosch@geowi.uni-hannover.de)
[2] Leibniz Institute for Applied Geosciences, S 3: Geochronology and Isotope Hydrology, Stilleweg 2, D-30655 Hannover, Germany

** Corresponding author: roskosch@geowi.uni-hannover.de*

The upper Senne deposits are up to 25 m thick and are exposed at the southern slope of the Teutoburger Wald Mountains in north-western Germany. The origin of this fluvial-aeolian complex is still under discussion and it is still not clear whether the deposition occurred during the penultimate glacial of the last glacial. We collected 17 samples from two localities (Oerlinghausen, Augustdorf) and both coarse-grain potassium feldspar and quartz minerals were used for luminescence dating. For feldspar measurements, an elevated temperature post-IR IRSL (pIRIR) protocol was applied using a preheat at 320 °C (60 s), IR stimulation at 50 °C (100 s) and pIRIR at 290 °C (200 s). For quartz measurements, a SAR protocol was used with a preheat at 180 °C (10 s) and a cutheat at 160 °C (0 s), OSL was measured at 125 °C (40 s). The dating results from both minerals will be presented and their geological implications will be discussed.

Keywords: OSL, pIRIR, fluvial-aeolian, late Pleistocene

Enhancing the chronology of archaeological sequences in Cyrenaica, Northern Libya, using OSL dating: a comparison of single grain and small aliquot dating of fine sand.

N. J. Russell[1]*, S. J. Armitage[1]

[1] Department of Geography, Royal Holloway, University of London, Egham, Surrey, TW20 0EX, United Kingdom

** Corresponding author: Natalie.Russell.2009@live.rhul.ac.uk*

The Cyrenaican region of Northern Libya contains an abundance of climate proxies and internationally significant archaeological sequences. In particular, the climate records preserved in the landscape surrounding the Haua Fteah site offer the opportunity to further our understanding of the local occupation sequence and its relationship to the long term environmental and human history of the southern Mediterranean region. However, the chronology for these sequences is at present poorly understood.

This study reports the results of Optically Stimulated Luminescence (OSL) dating of fine sand-sized quartz from the Haua Fteah and surrounding region. Fine sands (60-125 μm) were used due to the paucity of coarser grained material in all samples. The luminescence properties of each sample were investigated, to determine the optimal measurement conditions. Subsequently, equivalent dose determinations were performed using small aliquots and hand-picked individual grains. Small-aliquot and single-grain datasets yield comparable results, indicating that the former approach may be suitable for application to the majority of samples in this study. However, some discrepancies between the two techniques do exist. We discuss the implications of these results, with specific focus on the potential for using fine-sands in future dating work in Cyrenaica.

Surface exposure dating by luminescence: developing and testing models for surface bleaching rates and erosion rates

D. Sanderson[1*] , M. Smillie[2], R. McCullagh[3], J. Feathers[4], N. Hauser[5]

[1]Scottish Universities Environmental Research Centre, East Kilbride G75 OQF,
[2]Department of Physics, University of Strathclyde, Glasgow,
[3]Historic Scotland, Edinburgh ,
[4]University of Washington, Seattle,
[5]ATSAA, Centennial, Colorado, USA.

** Corresponding author: David.Sanderson@Glasgow.ac.uk*

The potential of using luminescence approaches to date lithic surfaces has been appreciated for some time, based on the principle that surface layers may be bleached by light exposure prior to deposition, and subsequently protected , leading to accumulation of dating signals in interfaces. Such bleached layers have been reported by several authors (e.g. Haberman et al 2000, Greilich et al 2006, Vafiadou et al 2007, Vieillevigne et al 2006) in mainly plutonic and metamorphic rock types, and on bricks. Another approach relates to the progression with time of bleached layers if lithic surfaces are continually exposed to light. Work is needed to further understand the forms and formation dynamics of surface bleaching, to extend the associated measurement techniques, and to assess the prospects of robust dating for a range of lithologies by either approach. Here we present the results of work to extend models of surface bleaching, together with exploratory studies of two rock types of interest to archaeology: quartzite associated with prehistoric quarrying in Arizona, and Devonian sandstones, associated with important ritual monuments within the World Heritage site in Orkney, and with multi-period settlements which can be dated independently. A series of first-order models have been developed to relate rates of retreat of bleached surfaces to external photon fluence rates, optical capture cross sections, optical attenuation coefficients, taking account of dose-rate and weathering rates. The simpler of these can be used to predict the shapes and dimensions of bleached layers in both rock types under short laboratory bleaching and for prolonged bleaching under natural conditions. For continuous bleaching the solutions can be expressed either as age equations or in terms of weathering rate. Scanning IRSL/OSL systems developed for analysis of irradiated foods (Sanderson et al, 2004) have been used to record bleaching profiles from both lithologies. Gamma irradiated samples were bleached in a laboratory light box of known spectral fluence, and scanned to record retreat profiles over timescales up to 10^6 s; the results being broadly consistent with those predicted from initial transparency and cross section measurements. A long term natural bleaching experiment for the Arizona material is underway. Also samples from six known-age archaeological sites in Orkney, ranging from modern to Neolithic in age have been recovered and subject to initial profiling. The results from this work are described together with an appraisal of prospects for further development of luminescence surface exposure dating for archaeological and geological applications.

References

Greilich S.,Wagner G.A., 2006, Development of spatially resolved dating technique using HR-OSL, Radiation Measurements 41:738-743

Haberman J., Schilles T., Kalchgruber R., Wagner G., 2000, Steps towards surface dating using luminescence, Radiation Measurements 32, 847-851

Sanderson, D.C.W., Carmichael, L.A., Murphy, S.D., Whitley, V.H. , Scott, E.M., Cresswell A.J., 2004, Statistical And Imaging Methods For Luminescence Detection Of Irradiated Ingredients. Research Report Project CSA 5240, 40p, UK Food Standards Agency, London.

Vieillevigne, E. Guibert P., Zuccarello, A.R., Bechtel F., 2006, The potential of optically stimulated luminescence for medieval building: a case study at Ternez, Uzbekistan, Radiation Measurements, 41, 991-994

Vafiadou A., Murray A.S., Liritzis I., 2007, Optically Stimulated Luminescence Dating investigations of rock and underlying soil from three case studies, Journal of Archaeological Science, 34:1659-1669

Dating Holocene meanders in the Middle Euphrates River Valley (Syria): relationship with Bronce Age urban settings

J. Sanjurjo-Sánchez[1*], J.L. Montero Fenollós[2], A. I. Rodriguez Fraga[3]

[1]University Institute of Geology "Isidro Parga Pondal", University of A Coruña, Campus de Elviña. 15071, A Coruña, Spain (jsanjurjo@udc.es)
[2]Department of Humanities, University of A Coruña c/Dr Vázquez Cabrera s/n. 1503, Ferrol, Spain (fenollos@cdf.udc.es)
[3]University Institute of Geology "Isidro Parga Pondal", University of A Coruña, Campus de Elviña. 15071, A Coruña, Spain (arodriguezfr@udc.es)

** Corresponding author: jsanjurjo@udc.es*

River terraces provide important records of landscape evolution. They also are well established as an important source of Palaeolithic and Neolithic artefacts. In Syria, humans used and modified more or less strongly the environment and they had to adapt to natural environmental fluctuations and landscape variations. Fluctuations in climate, sea level, sedimentation rates and neotectonic activity have been studied to explain the geological Quaternary evolution of the Euphrates River, including the last 10,000 years. The Quaternary terrace deposits of the River Euphrates have been studied and a large number of terraces have been identified (from 11 to 5) and related to uplift and climate changes. Throughout the Holocene, and namely the Bronze Age period in the near East, complex societies exhibit marked resilience to landscape evolution. In the Middle Euphrates River, the situation of some ancient towns depended on the river meandering, as the river was the main communication way. Meandering is frequent in this part of the river favoured by a low floodplain gradient and floods.
Urban occupation and abandonment during the Bronze Age could be related to social factors or conflicts, but also environmental changes and landscape evolution. The role of the Euphrates River evolution on the evolution of civilization in lower Mesopotamia has been recognized. Some ancient urban settings are closely associated with abandoned courses and meanders of the river. Riversides are suggested as places where urban settlements emerged and were sustained, due to an economy based on agriculture and commerce. Thus, abandoned meanders are places with high probability to found ancient towns. This paper discusses the effect of meandering on the settlement and abandonment of two urban settings of the Bronze Age. The studied sites have been found, studied and dated in the last years. Tell Qubr Abu Al-'Atiq is a city located on a cliff beside an abandoned meander of the Middle Euphrates River (Deir-Ez-Zor, Syria). This is a strategic point to control the transport in the river. It has been inhabited at least from 5 ka to 3 ka BP, considering the absolute chronology established in a previous study. Tall Abu Fahd (near Al-Kasra) was inhabited during a few centuries until 3 ka BP. We have dated the Holocene river deposits filling the abandoned meander of Tall Qabr by OSL. At Al-Kasra, the lower Pleistocene terrace next to the abandoned meander has been sampled and dated. OSL dating results show that the lower Pleistocene terrace correspond to 25 ka BP and the abandonment and infilling of the Holocene meanders begins 3.5 ka BP ago until 1 ka BP. Thus, meandering could be the cause of abandonment of the two sites due to the infill of the river channel.

Keywords: Meandering, OSL dating, Bronze Age, Euphrates River

The ESR measurements and dating of deep sea hydrothermal barite

F. Sato[1*], S. Toyoda[1], D. Banerjee[1], A. Uchida[1], J. Ishibashi[2], S. Nakai[3], A. Takamasa[3]

[1]Okayama university of science(fumihiro.sato.0309@gmail.com),
[2]Kyusyu university, [3]University of Tokyo

* *Corresponding author: umihiro.sato.0309@gmail.com*

At the initial stage of studies on the seafloor hydrothermal activities, their temporal changes were not argued. However, their temporal changes, which are most probably controlled by geothermal conditions, is now an important issue in order to discuss its influence to the biosphere. And since drastic changes of hydrothermal activity on the seafloor have been witnessed in some recent studies, application of geochlonological study for seafloor hydrothermal activity becomes important. For this purpose, new dating techniques are necessary, which are applied to hydrothermal minerals, in addition to conventional dating techniques. Kasuya et al. (1991) pointed out the possibility of ESR (electron spin resonance) dating of barite ($BaSO_4$). Okumura et al. (2010) made the first practical application of this technique to the sea bottom hydrothermal barite where preliminary ages were obtained. However, in this paper, detailed discussion was not sufficient, such as the occurrence of barite included in sulfide chimney, contribution of each natural radiation from surrounding environment, optimum measurement conditions, and the stability of the signal.

In the present study, we investigated three basic issues on ESR dating of barite;(1) Optimum condition for ESR measurement (2) Thermal stability of the signal (3) Inhomogeneity of accumulated doses and dose rates. (4) Practical application of resultant.

Barite ($BaSO_4$) was extracted from hydrothermal chimney samples taken from two sites at Okinawa Trough and at the Southern Mariana Trough. Distribution of the radioactivity in the chimney sample was observed with an imaging plate in one sliced piece of chimney piece to find that radioactivity is concentrated in barite. After cutting into 13 blocks, about 2.0g of each block was crushed and was soaked in 12M hydrochloric acid. The beaker was covered with a watch glass and left for approximately 24 hours. Then, 13M nitric acid was added. Finally, after rinsing in distilled water, the sample was filtered and dried. Impurities were removed by handpicking. The extracted sample was examined by X-ray diffraction to confirm that the grains are pure barite. The dose rate was calculated assuming alpha and beta particles in an infinite system. We ignored the contribution of cosmic rays and considered the shape of the chimney about the gamma ray. As a result, it was found that the signal of SO_3^- in barite starts to saturate at 0.01mW. Annealing experiments revealed that the signal is stable enough for age range of 10^2 -10^3, which are the values we obtained for present samples. The inhomogeneity of accumulated doses and of dose rates, the application will be discussed in the presentation.

OSL sensitivity of quartz as a proxy for sedimentary reworking

A. O. Sawakuchi[1*], C. C. Ferreira Guedes[1], R. DeWitt[2], P. C. Fonseca Giannini[1], M. Blair[3], D. R. do Nascimento Jr.[1], F. M. Faleiros[4]

[1]Departamento de Geologia Sedimentar e Ambiental, Instituto de Geociências, Universidade de São Paulo, Rua do Lago, 562, São Paulo-SP, Brazil - 05508-080 (andreos@usp.br).
[2]Radiation Dosimetry Laboratory, Department of Physics, Oklahoma State University, 1110 South Innovation Way Drive, Stillwater, OK 74074, USA.
[3] Earth and Environmental Sciences Division, Los Alamos National Laboratory, EES-2, MS J495, Los Alamos, NM 8754, USA.
[4] CPRM - Serviço Geológico do Brasil, Rua Costa, 55, São Paulo-SP, Brazil – 01304-010.

* *Corresponding author:* andreos@usp.br

Natural cycles of irradiation (burial) and bleaching (solar exposure during sediment transport) increase the OSL (Optically Stimulated Luminescence) sensitivity of quartz. The relation between the OSL sensitivity and the depositional history of quartz allows discriminating sediments with different sedimentary reworking. To test the OSL as a sediment tracer, we compare the OSL sensitivity of quartz grains from sand samples distributed throughout a Holocene coastal barrier (Ilha Comprida, Southeastern Brazil) with patterns of sediment transport deduced through independent data (heavy minerals and geomorphology). Measurements of OSL sensitivity were performed on thirty seven samples using multigrain aliquots (120-150 μm) and five samples using single-grain (180-250 μm) aliquots of quartz, exposed to 3.98 Gy and 100 Gy of beta radiation, respectively. There is no significant difference between the sensitivity of quartz from wind and wave deposited sands, suggesting minor influence of the mode of deposition on sensitivity. By contrast, there is high variation of sensitivity within the barrier (from 7676 to 20130 counts/s/Gy), characterized by an alongshore decrease of sensitivity to NE. This pattern fits with the relative increase of hornblende grains (THi heavy mineral index) to NE, which is attributed to changes in sediment provenance. Sands rich in hornblende and with low sensitivity (short sedimentary history) derive from proximal inland zones, reaching the coast through the Ribeira de Iguape River at the northeastern end of the barrier. By contrast, sands with low hornblende content and high sensitivity (long sedimentary history) derive from distal southern coastal segments. The proximal sediments of the Ribeira de Iguape River are transported to the barrier during fair weather times (alongshore drift to SW) while more distal sediments from south reach the barrier during storm weather times (alongshore drift to NE). We propose that the OSL sensitivity of quartz permits differentiating sediments with different depositional histories and, therefore, derived from distinct sources. The OSL sensitivity of quartz has advantages for provenance analysis due to the ease in achieving quartz grains and the rapidity in performing measurements.

Keywords: OSL sensitivity, quartz, sand, provenance, sedimentary reworking

Establishing a luminescence chronology for a palaeosol-loess profile at Tokaj (Hungary): quartz OSL versus post-IR IRSL

A.-K. Schatz[1,2*], J.-P. Buylaert[2,3], A. S. Murray[2], T. Stevens[4], T. Scholten[5]

[1] Earth System Dynamics Research Group, Department of Geosciences, University of Tübingen, Germany (ann.schatz@uni-tuebingen.de)
[2] Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, University of Aarhus, Risø DTU, 4000-Roskilde, Denmark
[3] Radiation Research Division, Risø National Laboratory for Sustainable Energy, Risø DTU, 4000-Roskilde, Denmark
[4] Centre for Quaternary Research, Department of Geography, Royal Holloway, University of London, Egham, Surrey TW20 0EX, UK
[5] Chair of Physical Geography and Soil Science, Institute of Geography, University of Tübingen, D-72074 Tübingen, Germany

* *Corresponding author*: ann.schatz@uni-tuebingen.de

The loess-palaeosol sequences in SE Europe are among the longest terrestrial records in Europe and provide important information on local and regional palaeoclimate and palaeoenvironment during the Pleistocene. For the majority of these deposits, independent chronologies have not yet been established, and reliable correlations between different sections, as well as detailed interpretations of proxy records are not possible. In this study we apply SAR OSL dating to fine-grained (4-11µm) quartz and post-IR IRSL dating to polymineral fine grains from the Tokaj site in NE Hungary. This Late Pleistocene, 15 m long section consists of three loess layers and two intercalated palaeosols; the only independent age control is from a single ^{14}C date (27.491±360 BP) from an adjacent section.
In general, the luminescence characteristics of the quartz OSL signal are satisfactory (low IRSL, bright OSL, recycling ratios ~1, low recuperation), although an ultrafast component was observed in some samples – a preheat of 260°C (10s) and a cut-heat of 240°C was used to minimize the latter. The mean dose recovery ratio is 1.09±0.04 (5 samples, n=15). Quartz OSL ages range between ~20 and ~60 ka; for the older samples the natural signals are at or beyond the saturation level ($2xD_0$) of the dose response curve, suggesting these ages should be interpreted with caution.
A post-IR IRSL (pIRIR) SAR protocol was also tested; after a preheat of 320°C (60s) polymineral fine-grains were stimulated at 50°C with IR (200s) and then at 290°C to measure the IRSL (200s). Preheat and stimulation settings were the same for natural/regeneration and test dose measurements. After each SAR cycle the remaining signal was cleaned out by stimulating with IR at 325°C (200s). As expected, the mean fading rate (g-value) of the $pIRIR_{290}$ (1.01 ± 0.06 %/decade, n=16, 4 samples) is significantly lower than that of the IR_{50} signal (2.1 ± 0.2%/decade, n=16, 4 samples). Preliminary SOL2 bleaching experiments on the $pIRIR_{290}$ signal suggest that there is an unbleachable residual dose underlying the D_e of ~10 Gy, consistent with previous work from similar loess sites. After subtraction of this residual dose and without anomalous fading correction the $pIRIR_{290}$ ages are in agreement with the younger set of quartz OSL ages. We report on additional experiments to define the unbleachable residual in $pIRIR_{290}$ dating, discuss the necessity of fading-correction of the $pIRIR_{290}$ ages and the upper dose limit of quartz OSL dating.

Keywords: loess, Hungary, OSL, SAR, post-IR IRSL, bleaching

Radionuclide distribution in silex

C. Schmidt[1*], D. Rufer[2], M. Krbetschek[3], F. Preusser[4], T. Pettke[2], A. Hilgers[1]

[1]Universität zu Köln, Geographisches Institut, Albertus-Magnus-Platz, D-50923 Köln (c.schmidt@uni-koeln.de)
[2]Universität Bern, Institut für Geologie, Baltzerstrasse 1+3, CH-3012 Bern
[3]Freiberg Instruments, Am St. Niclas Schacht 13, D-09599 Freiberg
[4] Stockholm University, Department of Physical Geography and Quaternary Geology, SE-10691 Stockholm

** Corresponding author: c.schmidt@uni-koeln.de*

In TL dating of burnt siliceous artefacts, the common procedure is to crush the bulk sample into coarse or fine grain sizes. However, many silica materials contain non-negligible amounts of radionuclides generating an internal radiation field. Hotspots or non-uniform radionuclide distributions give rise to uneven dose deposition within the sample. Thus, we face similar problems as in OSL dating of heterogeneously bleached sediment grains. As a main contributor to the internal dose rate, alpha emitting nuclides and their spread strongly influence microdosimetry. Furthermore, difficulties arise from the comparison of unbalanced dose distribution among different grains with the uniform artificial irradiation in the laboratory in terms of multiple and single aliquot techniques. Thus, we have to expect enhanced scatter between aliquots using multiple aliquot protocols due to local trap saturation effects. Accordingly, single aliquot regenerative methods yield overdispersed equivalent dose distributions. As a consequence, the conventional approach for TL dating of artefacts suffers both from poor precision and a general trend of age underestimation.
In order to check the degree of even radionuclide spread, we produced alpha autoradiographies of 21 archaeologically relevant silex samples from different provenances. Polycarbonate plates acted as an external detector for alpha particles emitted by a plane sample surface. The pattern of alpha tracks hence reflects the spatial densities of U and Th. Spatially resolved computer-based counting and statistical analyses allowed to quantify the track distribution for different scalings. The data set was completed by LA-ICP-MS measurements. We could then determine absolute concentrations of radioactive elements in selective regions of the sample surface.
Whilst the resolution and discrimination of single alpha tracks is given by their enlarged size after etching (ca. 25 µm), the resolution of the method in combination with the statistical approach is limited to the scale of about 1 to 5 mm, depending strongly on the counting statistics in the region of interest, and thus on the alpha activity of the sample. On the scale of a few mm up to a few cm, most samples show a uniform distribution of alpha emitters, except for eight specimens. The latter contain macroscopically visible inclusions and/or veins with strongly elevated alpha activity. LA-ICP-MS measurements support the findings of alpha autoradiography in general. Inclusions and non-matrix components yield highly fluctuating radionuclide concentrations of up to two orders of magnitude larger than those of the matrix. We could further observe lesser, small-scale variations of U and Th outside irregularities in the samples in the range of 100 µm up to 1 mm. These can also be registered with alpha autoradiography, but are statistically mostly not significant above resolutions of 1 mm.
In terms of luminescence dosimetry, clustering of U and Th in the relevant scales (above 100 µm) is observed in nearly half of the specimens. However, macroscopic appearance of the silex only sometimes serves as an indicator of heterogeneously distributed alpha activity. Consequently, this issue has to be taken into account for dose and dose rate determinations in order to improve the reliability and precision of TL dates.

Keywords: TL; silex; flint; dose rate; microdosimetry

A new U-uptake model for combined ESR/U-series dating of tooth enamel

Q. Shao[1*], J.-J. Bahain[1], C. Falguères[1], J.-M. Dolo[2], T. Garcia[3]

[1] Département de Préhistoire, Muséum national d'histoire naturelle, UMR7194 du CNRS, 1, rue René Panhard, 75013, Paris, France. (shao@mnhn.fr, bahain@mnhn.fr, falguere@mnhn.fr)

[2] CEA, I²BM, 91401 Orsay Cedex, France. (jean-michel.dolo@cea.fr)

[3] CEA, LIST, Laboratoire National Henri Becquerel, 91191 Gif-sur-Yvette Cedex, France. (tristan.garcia@cea.fr)

** Corresponding author: shao@mnhn.fr*

Applying the combined ESR/U-series dating method on tooth enamel has produced many dates for Quaternary research. This method is based on a U-uptake model developed by Grün et al. (1988)[1], which uses both ESR and U-series data sets to obtain single age estimate. This model simulates uranium uptake as a continuous process and excludes the possibility of uranium leaching from teeth during burial, leading to the activity ratios of $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ evolving towards secular equilibrium. The use of this model is so limited to the samples with $^{230}Th/^{234}U < 1$. In order to estimate the age for the sample showing $^{230}Th/^{234}U > 1$, a new U-uptake model was developed, which describes the uranium uptake like an accelerating process (AP), with a parameter n representing the acceleration of U-uptake rate, ($-\infty < n < \infty$). If n equals 0, the AP model is assimilated to linear uptake model (LU), identical to the case of p = 0 in Grün's model. For positive n-values, AP model shows later uptake patterns similar to that of p > 0 in Grün's model. On the other hand, for negative n-values, the AP model considers a slowdown of the U-uptake rate with burial time. The particular case of early uptake (EU), identical to p = -1 in Grün's model, can be modeled by a special value of n (< 0) depending on the sample's U-series data. The two models differ on the modeling of the present U-content in dated tooth. In Grün's model, this value is considered as the highest content through out of burial period, while in the AP model the maximum of U-content could have occurred in the past, and then decreased to the present-day value. Using the AP model, the U-series disequilibria can evolve into the Grün's model "forbidden area", in which $^{234}U/^{238}U < 1$ and/or $^{230}Th/^{234}U > 1$. Some application examples of this newly devised U-uptake model are presented to show its extended possibilities for some archaeological samples out of range of the Grün's model.

Keywords: ESR/U-series dating, tooth enamel, U-uptake model.

Reference

1,Grün, R., Schwarcz, H.P., Chadam, J.M., 1988. ESR dating of tooth enamel: coupled correction for U-uptake and U-series disequilibrium. Nuclear Tracks and Radiation Measurements, 14, 237-241.

Dating young deltaic deposits in the Mississippi Delta with a single aliquot method

Z. Shen[1*], B. Mauz[2], T. E. Törnqvist[1,3]

[1] Department of Earth and Environmental Sciences, Tulane University, New Orleans, LA 70118, USA; zshen@tulane.edu
[2] School of Environmental Sciences, University of Liverpool, Liverpool L69 7ZT, UK; mauz@liv.ac.uk
[3] Tulane/Xavier Center for Bioenvironmental Research, Tulane University, 6823 St. Charles Avenue, New Orleans, Louisiana 70118-5698, USA; tor@tulane.edu

** Corresponding author: zshen@tulane.edu*

The Wax Lake Delta (WLD) was formed as a consequence of sediment deposition in the Atchafalaya Bay, Louisiana due to the creation of the Wax Lake Outlet in 1941. The development of the WLD has been well documented and therefore provides a unique opportunity to explore the potential of OSL dating decadal timescale deposits in the Mississippi Delta. A sediment core taken in AD 2010 on a natural levee formed after 1986 revealed ~3 m sand rich deltaic deposits overlying silty Atchafalaya Bay deposits rich in shell fragments. Three samples from depths of 0.3-0.5m (TU41, expected age <30 yrs), 1.5-1.6 m (TU45, expected age <70 yrs) and 3.6-3.7 m (TU46, expected age >70 yrs) were taken for OSL dating. TU41 and 46 were measured for both silty and sandy quartz while TU45 was measured for sandy quartz only. Sandy quartz was measured on single aliquots (sand covered an area of 1-2 mm in diameter). All equivalent dose (D_e) measurements were conducted with a modified SAR protocol that includes a single regeneration measurement. The D_es were calculated with both the late background subtraction (LBS, channels 1-5 integrated for signal and 201-250 for background, i.e. ratio of 0.1) and the early background subtraction (EBS, channels 1-2 integrated for signal and 3-6 for background, i.e. ratio of 0.5) methods. For silty quartz, decay rates of natural OSL are comparable to that of regenerated OSL. In contrast, for sandy quartz they are significantly lower for natural OSL than for regenerated OSL. Linearly modulated OSL measurements revealed that the natural OSL of sandy quartz typically contains a smaller fast component and a larger medium component than the regenerated OSL. The fine silt quartz yielded ages of ~100 yrs and ~320 yrs for TU41 and TU46 respectively, irrespective of the background subtraction method. For sandy quartz, different results were obtained with the two different background subtraction methods. The LBS method overestimated the expected ages for both TU41 and TU45 when the palaeodose was estimated with either the central age model (CAM), the minimum age model (MAM) or by fitting a Gaussian curve to the lowest peak in the D_e distribution. The EBS method can yield ages that are in agreement with expectation when the palaeodose was estimated by fitting a Gaussian curve to the lowest peak in the D_e distribution. We conclude that fine silt quartz of the WLD is not fully reset and probably contains a residual signal equivalent to <100 yrs in age. The fast component of sandy quartz seems to be fully reset for most of the grains. However, the slower decaying components are not well-bleached, highlighting the necessity of using the fast component only for dating decadal timescale deposits.

Keywords: OSL dating, Mississippi Delta, young deposits, fast component

Establishing an accumulation peat model, for industrial anthropogenic changes, peat bog.

J. Sikorski*

Silesian University of Technology, Institute of Physics. GADAM Centre of Excellence, Krzywoustego 2, 44-100 Gliwice, Poland.

* *Corresponding author: jaroslaw.sikorski@polsl.pl*

The aim of described measurements will be establishing an accumulation peat model, for industrial anthropogenic changes, peat bog.
The main aim of the study is developing and improvement of method of using ^{210}Pb to study peat erosion and accumulation on modern peat land areas.
Important aim is also to use of the technique of the gamma spectrometry measurement in application to measurements of ^{210}Pb isotope concentration especially in peat samples as well as to learn other dating or measurement techniques possible to use to study modern geomorphological processes.
Details of planned activities:
1.General overview of measure procedures used in the gamma spectrometry with special regards on the procedure of measure and calculating ^{210}Pb in environmental samples. Analyzing of the measurement uncertainties for use method.
2. Measure activity of ^{210}Pb in samples taken from peat land located on the south of Poland.
3. Analyzing of the selected physic-chemical properties of peat samples.
4. Analyzing of the spatial variability of ^{210}Pb activity on the study area.
5. Calculating of sample age use lead dating method.
6. Establishing an accumulation peat model, for industrial anthropogenic changes, peat bog.

The co-evolution of arsenic and aquifers: the use of OSL to elucidate Asia's shallow groundwater arsenic heterogeneity

B. Weinman[1], S.L. Goodbred Jr.[2], A. van Geen[3] , A. K. Singhvi[4]

[1]Soil, Water, and Climate, University of Minnesota, St. Paul, MN (bweinman@umn.edu)
[2] Earth and Environmental Sciences, Vanderbilt University, Nashville TN (sgoodbred@vanderbilt.edu)
[3] Lamont-Doherty Earth Observatory, Columbia University, Pallisades NY (avangeen@ldeo.columbia.edu)
[4] Physical Research Laboratory, Ahmedabad India (singhvi@prl.res.in)

* *Corresponding author: singhvi@prl.res.in*

Perhaps nowhere is the problem of arsenic more evident than in the Asian and South East Asian aquifer systems, where it is estimated that millions of people are at risk of ingesting arsenic-laden groundwater (World Bank 2005). Despite its ubiquitous nature and the ever-growing number of countries affected, there is still much uncertainty about world's 'worst calamities on record' (Chakraborti et al., 2002). Amid the many studies trying to understand the groundwater arsenic in Asia, the local-type of groundwater arsenic heterogeneity occurring between individual tube-wells remains poorly understood. Wells located right next to each other, and drilled to the same depth, often have drastically difference concentrations of dissolved arsenic (i.e., <10 vs. 500 μg/L in wells separated by several meters). To better understand the geologic context of this localized-type of groundwater heterogeneity, optical dating was used in dating aquifer deposits along 1-km transects in Nepal, Vietnam, and Bangladesh. In each case, OSL results show that not all aquifer deposits are of the same age, with older deposits consistently corresponding to lower amounts of dissolved arsenic. In Nepal's alluvial Terai, sediments older than 10kyr have low groundwater arsenic (<10 μg/L), while groundwater in younger aquifers are prone to higher amounts of groundwater arsenic (i.e., >10 μg/L in <10kyr sediments). The same was found in the Vietnamese village of Van Phuc, where a Pleistocene-Holocene aquifer age difference also explains the arsenic heterogeneity within the village's riverbend. This new use of OSL gives a better understanding of heterogeneity in the spatial distribution of arsenic and provides new insights in how aquifers form and how their groundwaters are evolving. The application of OSL in groundwater evolution was used in Araihazar, Bangladesh. Using OSL, a weathering rate was calculated from different-aged aquifers (0.4 and 1kyr) and the integrated difference between their labile-sediment-arsenic. The OSL-derived weathering rate remarkably agrees with several other weathering studies (i.e., Stute et al, 2007; Cheng et al., 2004), showing another new application for OSL in the Earth sciences. In areas with the same set of initial conditions, we see OSL as a potential tool for determining arsenic release rates, and other types of geochemical weathering.

References

WB (2005). Towards a More Effective Operational Response: Arsenic Contamination of Groundwater in South and East Asian Countries. Volume 1: Policy Report, World Bank.

Chakraborti, D. et al. (2002). "Arsenic calamity in the Indian subcontinent. What lessons have been learned?" Talanta **58**: 3-22.

Stute, M. et al.,(2007). "Hydrological control of As concentrations in Bangladesh groundwater." Water Resources Research **43**: W09417.

Comparing the geochemical and luminescence characteristics of single-grain feldspars

R. K. Smedley*, G.A.T. Duller, N. J. G. Pearce, H.M. Roberts

Institute of Geography & Earth Sciences, Aberystwyth University, Aberystwyth, SY23 3DB, UK

** Corresponding author: rks09@aber.ac.uk*

In certain depositional environments single-grain analyses have proven to be a valuable approach to dating. Quartz suffers from great variability in signal intensity; feldspars are therefore preferable as they are more consistent from one geographical region to another. Physical separation of the different types of feldspar on the basis of density is difficult because feldspars form a solid solution series ranging from albite ($NaAlSi_3O_8$) to anorthite ($CaAl_2Si_2O_8$) to orthoclase ($KAlSi_3O_8$). Knowledge of the major element geochemistry (particularly K concentrations) is important because of the effect this has upon the dose-rate of individual grains. At the scale of multiple grain aliquots, Huntley and Baril (1997) suggested that the luminescence signal observed in the blue was dominated by K-rich grains and that one could therefore assume a value of 12.5% for the K concentration. However, this approach is unlikely to be appropriate for single grains, and it is therefore important to develop methods for directly or indirectly assessing the major element geochemistry of grain used for dating.

Direct geochemical measurements of individual grains were performed using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) and solution ICP-MS. However, such measurements are logistically challenging, labour intensive and time consuming. Indirect methods using luminescence properties could offer a more practical solution for inferring feldspar composition. For example, Tso et al. (1996) working on multiple grain aliquots observed that K-feldspars had higher thermal stability than Na-feldspars. Subsequent measurements by Li et al. (2011) used thermal stability tests to infer the chemical composition of single grains and thus calculate dose-rates. However, the geochemical data given to support this work was conducted on multiple grain samples. This study compares these direct and indirect measurements to determine the most appropriate method when dating single grains of feldspars.

References

Huntley, D.J. and Baril, M.R. 1997. The K content of the K-feldspars being measured in optical dating or in thermoluminescence dating. *Ancient TL* **15**, 11 – 13.

Li, B., Li, S., Duller, G.A.T. and Wintle, A.G. 2011. Infrared stimulated luminescence measurements of single grains of K-rich feldspar for isochron dating. *Quaternary geochronology* **6**, 71 – 81.

Tso, M-Y.W., Wong, N.W.L. and Li, S-H. Li, 1996. Determination of lifetime of infrared stimulated signal from potassium and sodium feldspars. *Radiation protection dosimetry* **66**, 387 – 389.

Na-rich feldspar as a luminescence dosimeter in IRSL dating

R. Sohbati[1,*], A. S. Murray[1], M. Jain[2], J.-P. Buylaert[1, 2], K. J. Thomsen[2]

[1]Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, Aarhus University, Risø DTU, DK-4000 Roskilde, Denmark (resih@risoe.dtu.dk)
[2]Radiation Research Division, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, DK-4000, Roskilde, Denmark

** Corresponding author: resih@risoe.dtu.dk*

One of the challenges in dating rock surfaces is the choice of the luminescence mineral. Although quartz is the preferred dosimeter in sediment dating, it is often not sufficiently sensitive when extracted from solid rocks. The intensity of signals from feldspars tends to be much less dependent on geological origin and history, but the dosimetry of K-rich feldspar grains extracted from rocks is complicated because the internal dose rate is very dependent on the original feldspar grain size. The 'in situ' grain size information is lost during the crushing process used to separate the grains for measurement. This later problem does not apply to Na-rich feldspar (because of the absence of internal activity) although the external dose rate remains somewhat sensitive to the original grains size (as it does for quartz).

Little is known about the practical usefulness of Na-feldspar as a dosimeter – it has tended to be ignored because it is perceived to fade significantly more rapidly than K-feldspar, and the absence of internal activity is often seen as a disadvantage in sediment dating. Here we investigate the applicability of Na-rich feldspar as a luminescence dosimeter for IRSL dating using a variety of sediment samples from different geological settings for which independent age control exists [in the form of biostratigraphic, quartz (Murray and Funder, 2003) or K-feldspar (Buylaert et al., 2009, 2010) ages]. The blue (7-59 and BG 39) and yellow (OG 515, 730 IK, 2×660IK, and a band-pass interference filter with FWHM 511-563 nm) luminescence emissions are measured for IR stimulation at 50°C, and post-IR stimulation at 290°C. We study the dose response, fading, thermal transfer, and dose recovery for both emissions. D_e estimates based on both IR and post-IR IR signals are compared with each other and with those from quartz and K-feldspar. The results show that for both blue and yellow emissions, the post-IR IR signal measured at the higher temperature (290°C) has a lower fading rate than that for IR at 50°C, consistent with the reports of Thomsen et al. (2008) for both K- and Na-feldspar, Buylaert et al. (2009) for K-feldspar, and Thiel et al. (2010) for polymineral fine-grains. The obtained ages from post-IR IR measured at 290°C are encouragingly consistent with the independent age controls, suggesting that Na-rich feldspar extracts from rocks may be useful as dosimeters.

References

Buylaert J. P., Huot S., Murray A. S., Van den haute P., 2010. Infrared stimulated luminescence dating of an Eemian (MIS 5e) site in Denmark using K-feldspar. *Boreas* (in press).

Buylaert J. P., Murray A. S., Thomsen K. J., Jain M., 2009. Testing the potential of an elevated temperature IRSL signal from K-feldspar. *Radiation Measurements* 44, 560-565.

Murray A. S., Funder S., 2003. Optically stimulated luminescence dating of Danish Eemian coastal marine deposit: a test of accuracy. *Quaternary Science Reviews* 22, 1177-1183.

Thiel, C., Buylaert, J.P., Murray, A., S., Terhorst, B., Hofer, I., Tsukamoto, S., Frechen, M., 2010. Luminescence dating of the Stratzing loess profile (Austria)-Testing the potential of an elevated temperature post-IR IRSL protocol. *Quaternary International* (in press).

Thomsen K. J., Murray, A. S., Jain, M., Bøtter-Jensen, L., 2008. Laboratory fading rates of various luminescence signals from feldspar-rich sediment extracts. *Radiation Measurements* 43, 1474-1486.

Age and accumulation conditions of fluvio-aeolian sediments at the site Józefów (Roztocze Tomaszowskie; Poland)

P. Zieliński[1], R. Sokołowski[2*], S. Fedorowicz[3], J. Kusiak[1]

[1]Department of Physical Geography and Palaeogeography, Maria Curie-Skłodowska University in Lublin, Al. Kraśnicka 2 cd, 20-718 Lublin, Poand. e-mail: pziel@umcs.pl
[2]Department of Marine Geology, Institute of Oceanography, University of Gdańsk, al. Piłsudskiego 46, 81-378 Gdynia, Poland; e-mail: r.sokolowski@ug.gda.pl
[3]Department of Geomorphology and Quaternary Geology, University of Gdańsk, Bażyńskiego 4, 80-952 Gdańsk, Poland. e-mail: geosf@univ.gda.pl

* *Corresponding author:* r.sokolowski@ug.gda.pl

The late glacial deposition in river valleys was dominated by the interchanging fluvial and aeolian processes. This is well visible in Roztocze Tomaszowskie, particularly in the upper parts of river valleys. Depending on local conditions, these processes had different intensity. Not once the Late Pleni-Weichselian - Late Weichselian sedimentation sequence has been the focus of interest for researchers, mainly in the context of the reconstruction of valley evolution, and the characteristics of aeolian forms. In addition, singular age determinations of the studied sediments are known. However in the studies published until now, the sediments located directly at the bottom of dunes have not been described as the ones originating due to aeolian deposition and re-deposited fluvially. Such sediment type in Western Europe is known under the term fluvio-aeolian sediment. Moreover, the stratigraphic position of these sediments has not been established.

In the above presented context, it seems justified to undertake research at sites in which sedimentation succession is recorded, ranging from fluvial deposition to aeolian processes. Such an opportunity is present at the site located within the underslope dune complex, east from Józefowo. The complex is formed, in general, by one dune line oriented in the WNW-ESE direction, and it mainly consists of small parabolic dunes with the longer northern arm. Longitudinal dunes are also found, as an accessory feature. The studied sediment profile encompasses the nose and southern arm of the parabolic dune, and the dune's substrate. The investigations consisted of the lithological characterization of sediments (texture evaluation, the registration of sedimentary structures, the measurements of dimension and frequency of the documented lithofacies, the measurements of structural directional elements, and the registration of periglacial structures) and sample collection for TL dating. The determinations were performed in the laboratories in Lublin and Gdansk.

The studied sediment profile is formed by three lithofacies, as follows:

1. The first, fluvial complex is formed by sands of different grain sizes, and has diagonal, trough-like layering which changes into small grain size sands with ripple-mark lamination. The sands constitute a record of the ebbing flow in the bed of a small river, most likely of braided character.
2. The second, fluvio-aeolian complex is built from small grain size sands that are horizontally layered, with silty sand interbedding of undulating or ascending ripple-mark lamination. Sands with a medium-scale diagonal, trough-like layering are present as an accessory feature. This complex had been most likely deposited in the proximal part of the floodplain, and with a large input from aeolian deposition.
3. The third, aeolian complex consists of two lithofacial units, i.e. low-thickness discontinuous, clayey-sandy rytmith on the floor, and sands with the large-scale diagonal, inclined layering on the roof. The deposition of those sediments initially resulted from alternating accumulation of clay transported in suspension and sand via saltation, followed by the movement of the parabolic dune.

The investigated sediments had been deposited under harsh conditions of periglacial climate, and with the declining input from fluvial deposition which was being outweighed by aeolian deposition. The age of the first complex was determined as Late Pleni-Weichselian, and that of the second one as between Late Pleni-Weichselian and Late Weichselian, while the third one as Late Weichselian.

Optically stimulated luminescence dating of Ili loess, Central Asia and its implication for paleoclimatic change during the last glaciation

Y. Song*, C. Li, X. Wang, S. Kang

State Key Laboratory of Loess and Quaternary Geology,
Institute of Earth Environment, Chinese Academy of Sciences.
(No 10 Fenghui Nan Road, Xi'an 710075, China; * E-mail: syg@ieecas.cn)

** Corresponding author: syg@ieecas.cn*

Loess deposits are widespread on river terraces and intervening foothills in Central Asia. It provides an excellent archive for the study of past climatic and environmental change. The most important requirement for paleoclimatic reconstruction is to establish an accurate chronological framework. The Central Asian loess chronology was previously obtained by palaeomagnetism and thermoluminescence (TL) dating. However, the previous TL results are younger even reversal to stratigraphy, which hamper the high-resolution paleoclimatic interpretation. Several to tens of meters thick loess sediments are exposed along the Ili river terraces and pediment of Tian Shan, northeastern Central Asian, which provides a opportunity to understand the Asian inland aridification and westerly evolution. We present a new optically stimulated luminescence (OSL) and paleoclimatic study of a loess section at Zhaosu county in the Ili basin. The fine-grained (4–11 μm) quartz were isolated and the multiple-aliquot regenerative-dose (MAR) OSL protocol was employed for D_E determination. All OSL measurements were carried out using an automated Daybreak 2200 OSL reader . Particle-size distributions of bulk samples were determined using a Malvern Mastersize S laser-diffraction analyzer. The dating resutls show that OSL ages range from 37 ka±2.7ka to 67 ka±3.2ka, which is in agreement with the lithogical stratigraphy observed in the field. Based on this new OSL dating, a loess chronological framework in the Ili region since the last glaciation was established. The content of grain size >63μm of the Ili loess can be regarded as a proxy of the westerly wind intensity, higher content represents stronger westerly wind. We found that the curve of the content of grain size >63μm is well compared with the oxygen isotope records from Greenland ice core (GISP2). Seven peaks correspond to 6 Heinrich cooling events and the Younger Dryas cold event, respectively; and most of the valleys are similar to Dansgaard-Oeschger (D-O) warm events. The similarity and comparability between the Ili loess and GISP2 confirmed the climatic instability during the last glaciation also exist in the Ili basin, not only recorded in the loess in the Chinese loess plateau and marine sediments. It suggests that the Ili region dominated by westerly wind is likely to be a simultaneous change with the high latitude climate of the Northern Hemisphere since the last glacial period. It is concluded that: (1) the current fine-grained quartz OSL dating techniques as employed in this study can provide a reliable loess absolute chronology; (2) loess deposition in the Zhaosu area in the Ili basin started in the early last glaciation; and (3) Grain size analysis showed that the climatic change in the Ili region was of instability during the last glaciation and similar to those of the North Atlantic Ocean and Greenland.

Keywords: OSL, Ili loess, Paleoclimatic implication, the last glaciation, Central Asia.

Dating deep? Luminescence studies of fault gouge from the San Andreas Fault Zone 2.6 km beneath Earth's surface

J. Spencer[1*], J. Hadizadeh[2], J.-P. Gratier[3], M.-L. Doan[3]

[1]. Department of Geology, Kansas State University, Manhattan, Kansas, USA (joelspen@ksu.edu)
[2.] Department of Geography and Geosciences, University of Louisville, Louisville, Kentucky, USA
[3.] ISTerre, Université Joseph Fourier, Grenoble, France

* *Corresponding author: joelspen@ksu.edu*

This study aims to assess whether luminescence emission from fault gouge samples from the San Andreas Fault Observatory at Depth (SAFOD) can be used to determine the age distribution of distinct deformation microstructures. Such age determination could help constrain some of the proposed micromechanical models for shear localization in fault gouge, in addition to providing more accurate time constraint on the seismic cycle itself. The mechanism by which previously trapped-charge is reset in minerals in fault gouge is thought to be a combination of frictional heating and mechanical deformation, and these processes may be localized to grain surfaces. An added dating complexity specific to deep samples is the high ambient temperature conditions, which act as a barrier to charge storage in lower energy trapping sites. In this work luminescence experiments are being conducted on minerals from whole-rock samples of consolidated fault gouge from the SAFOD Phase III core, and dynamically loaded samples of previously un-deformed Tarn granite. Initial studies indicate (i) the thermal and radiation history of the mineral lattice can be assessed with TL, (ii) trap resetting is evident in both TL and IRSL data, (iii) a small charge-trapping window between drill hole ambient temperature of ~112°C and higher energy lattice excitation via creep or rupture events is evident from TL data, (iv) IRSL data have low natural intensity but good luminescence characteristics, and (v) SAR IRSL D_e data have high over-dispersion but demonstrate ages ranging from 10s to 100s years may be measured. These results will be discussed.

Luminescence from NaCl for application to retrospective dosimetry

N. A. Spooner[1,2*], O. M. Williams[1], I. McCulloch[3], D. Creighton[1], P. Hunter[2], B. W. Smith[2]

[1] Institute for Photonics and Advanced Sensing (IPAS), School of Chemistry and Physics, University of Adelaide, Adelaide, 5005, Australia
[2] Defence Science and Technology Organisation, Edinburgh, SA 5111, Australia.
[3] Research School of Earth Sciences, Australian National University, ACT, 0200, Australia

** Corresponding author: nigel.spooner@dsto.defence.gov.au*

The alkali halide NaCl (Common salt) is an environmentally-abundant phosphor of considerable potential for retrospective dosimetry, capable of displaying high dose sensitivity for Thermoluminescence (TL), Optically-stimulated luminescence (OSL) and Infrared-stimulated luminescence (IRSL). Here we report an investigation into luminescence from NaCl for the purpose of measurement of recent exposure to ionising radiation, for application to retrospective dosimetry and radiological event analysis. The timescale of interest is of weeks to years, hence emphasis is on the detection and characterisation of the TL glow peaks in the 100-300ºC range, and of OSL and IRSL emissions observed following relatively low temperature preheating (160ºC). For this study a set of 19 salt samples was collected from around the world, including rock salt, salt damp crystals, and salt variously produced by evaporation from sea water, saline lake water and saline river water and sold for domestic use. A series of characterisation measurements was performed on each of these samples, including elemental analyses, measurement of TL emission spectra using the University of Adelaide Fourier-transform Thermoluminescence spectrometer, construction of TL, OSL and IRSL dose-response curves, measurement of OSL and IRSL pulse annealing characteristics, and measurement of trap kinetics for selected samples. Aspects of these characterisation measurements will be presented, including a comparison of the dose sensitivities of the UV TL and OSL emissions and the yellow-orange TL and IRSL emissions. Spatially-resolved OSL, IRSL and TL in the wavelength range 200-1050 nm was investigated from multiple-grain aliquots of four selected samples using a Photon-Counting Imaging System. The emissions were observed in three broad wavelength ranges, including red to near-infrared TL emissions, and a range of grain-to-grain sensitivity differences was observed in each case. The OSL and IRSL luminescence from individual grains was isolated and successive frames were analysed to enable comparison of decay curve shapes. The trap kinetics of TL glow peaks identified as having potential value for retrospective dosimetry were analysed using Hoogenstraaten's method, and showed lifetimes useful for this application.

Keywords: TL, OSL, IRSL, Emission Spectra, Spatially-resolved Luminescence, Retrospective Dosimetry, NaCl

Rapid assessment of soil mixing processes and rates using a portable OSL-IRSL reader

D. Stang[1], E. Rhodes[1*], A. Heimsath[2]

[1] Department of Earth and Space Sciences, University of California, Los Angeles, 595 Charles Young Drive East, Los Angeles, CA 90095-1567, USA (erhodes@ess.ucla.edu)
[2] School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287-1404, USA

** Corresponding author: erhodes@ess.ucla.edu*

As landscapes undergo surface lowering by weathering and erosion, soil formation, mixing and transport processes play a key role. Understanding the different mechanisms which modulate this process is important in developing reliable models of hillslope erosion and landscape development. Determining the rates of soil mixing and transport represents a fundamental part of this task. Mixing processes include biological mechanisms such as grains moving by gravity within burrows or root holes (after the root has rotted away), grains being transported upwards by burrowing animals such as moles, gophers, rabbits, spiders, ants and others, or larger scale processes such as tree throw. Non-biological mechanisms include surface wash and other slope transport processes, frost heave, movement caused by wetting and drying cycles, and grain transport by water within sediment pores. These processes can be examined using OSL, as pioneered by Heimsath et al. (2002), who used quartz single grain determinations to detect the time since grains were bleached at the soil surface. In the present study, we examined soil profiles from test pits in the San Gabriel Mountains, California, at locations where cosmogenic isotopes have been used to determine rates of soil formation and surface lowering. Monoliths, that is continuous vertical columns of sediment approximately 10 cm in width and breadth, were collected from the land surface to the granitic bedrock, typically encountered at around 25 to 30 cm depth. After subsampling in the laboratory under luminescence preparation lighting conditions, determinations of OSL and IRSL intensity were made on contiguous untreated samples each around 1cm in thickness. OSL signals were observed to track IRSL signals closely suggesting that both signals were dominated by emissions from feldspar grains. Three monoliths were studied in detail, and in each case the signals from the uppermost samples displayed low intensities, suggesting that relatively recent signal resetting had occurred. Different patterns of signal intensity as a function of depth were observed for the three monoliths, implying a range of different mixing processes are in operation at these closely spaced sites.

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

Optical dating of fine-grain material from the Eastern Alps – potential and limitations

R. Starnberger[1*], H. Rodnight[1], J. M. Reitner[2], P. J. Reimer[3], C. Spötl[1]

[1] Institute of Geology and Palaeontology, University of Innsbruck, AUSTRIA (reinhard.starnberger@uibk.ac.at)
[2] Austrian Geological Survey, Vienna, AUSTRIA
[3] School of Geography, Archaeology and Palaeoecology, Queen's University Belfast, UK

* *Corresponding author:* *reinhard.starnberger@uibk.ac.at*

At various locations in the Eastern Alps and their foreland, fine-grain sediments deposited during the last glacial period (~115 – 11.7 ka) were collected in order to assess their suitability for luminescence dating of the fine-silt (4 – 11 μm) polymineral and quartz fraction. The standard SAR-OSL protocol (Murray and Wintle, 2003; Duller, 2003) was successfully used for dating Alpine foreland loess after removal of feldspar by 30% hexafluorosilicic acid (Roberts, 2007). On the other hand, inneralpine lake sediment samples recorded after the same procedure turned out to have a very dim quartz signal. Consequently, for these samples the signal from feldspar was preferably investigated using a modified SAR-IRSL protocol (Thomsen et al., 2008). The resulting IRSL ages are consistent with independent age control and measurements of fading rates indicate the absence of anomalous fading. In some cases, however, the IRSL ages overestimate the expected ages. For these samples, the lithology of the sediment indicates a glacio-lacustrine sedimentation environment (e. g. dropstones) with short transport distances and, as a result, possibly incomplete bleaching of the fine silt. Anomalous fading was also not detected in alpine foreland loess where OSL and IRSL ages from the same samples are consistent within errors. To summarise, optical dating has been shown to be successfully applied to both fine-grain quartz and polymineral fractions of Alpine foreland loess. In the inneralpine realm, feldspars are the preferred mineral for dating and the effect of incomplete bleaching must be considered.

Keywords: optical dating; Alps; lake sediments; loess; fine-grain samples;

References

Duller, G., 2003. Distinguishing quartz and feldspar in single grain luminescence measurements. Radiation Measurements 37, 161–165.

Murray A. S., Wintle A. G., 2003. The single aliquot regnerative dose protocol: potential for improvements in reliability. Radiation Measurements 37, 377-381.

Roberts, H. M., 2007. Assessing the effectiveness of the double-SAR protocol in isolating a luminescence signal dominated by quartz. Radiation Measurements 42, 1627-1636.

Thomsen, K. J., Murray, A. S., Jain, M., Bøtter-Jensen, L., 2008. Laboratory fading rates of various luminescence signals from feldspar-rich sediment extracts. Radiation Measurements 43, 1474-1486.

The luminescence face of the iDRYAS Project: A contribution for an European Luminescence R&D Network

G. Stella[1,2,*], P. P. Cunha[3], M. Almeida[1], A. A. Martins[4]

[1] iDryas / Dryas Octopetala, R. Aníbal de Lima, 170, 3000-030 Coimbra (Portugal)
[2] Faculty of Science and Technology- University of Coimbra, Portugal
[3] Department of Earth Sciences, IMAR-Marine and Environmental Research Centre, University of Coimbra, Portugal
[4] Centro de Geofísica, Dep. Geociências, University of Évora, Portugal

** Corresponding author: giuseppe.stella@ct.infn.it*

The iDryas project was designed to create a multidisciplinary research centre, financially supported by Dryas' substantial investment both in human resources and technology and co-promoted with several scientific departments of the University of Coimbra (Life Sciences Dep., Earth Sciences Dep., Geography Dep., Mathematics Dep. and Informatics Engineering Dep.). Moreover, because of the collaborative and transparent nature of iDryas, the project is globally oriented towards the creation of a collaborative research network, thus responding to the present call of the European research funding objectives.
The project is based on the construction of the GAP Lab, a research facility located in Coimbra (Portugal) that includes several laboratories grouped into five complementary scientific areas: Geosciences, Archaeosciences, Bioanthropology, Palethnology and Informatics. Within the Archaeosciences disciplinary area of the GAP Lab, Luminescence plays a major role in the global iDryas project and respects the same collaborative, multidisciplinary and transnational approach to scientific research.
While this laboratory will naturally explore the western Iberian record as its primary database, the research focus clearly aims at scientific projects with wider European impact on methodological, archaeological, Cultural Heritage, geological or palaeoclimatological issues.
The inherent multidisciplinarity that represents one of the GAP's main strengths will certainly provide the OSL/TL projects with solid cross-checked sets of data, thus enhancing its interpretative potential. This particular aspect is the key to both the main objectives of the GAP's Luminescence laboratory, apart from routine work:
(1) Contributing to iDryas multidisciplinary projects by providing OSL/TL chronometric references to the anthropic and non-anthropic studied phenomena; and
(2) Fundamental methodological research in the specific field of optically and thermally stimulated luminescence dating.
The methodological focus, which represents a significant objective of the Luminescence lab's scientific program, is primarily oriented to identify optimum measurement conditions of quartz / feldspar OSL separation in a mixed sample using pulsed stimulation and time-resolved OSL and LM-OSL techniques.
In this framework, it seems crucial to establish a network of independent research groups able to work simultaneously on the same samples and on the same geochronological problems, thus cross-checking and inter-calibrating their results.

Keywords: iDryas, GAP Lab, luminescence, pulsed stimulation, time-resolved OSL LM-OSL technique

Developing a single-aliquot protocol for biogenic carbonates

R. J. Stirling*, G.A.T. Duller, H. M. Roberts

Institute of Geography & Earth Sciences, Aberystwyth University, Aberystwyth, SY23 3DB, United Kingdom.

* *Corresponding author: rjs5@aber.ac.uk*

Calcium carbonate offers advantages over quartz and feldspar minerals for luminescence dating because it has the potential to extend the dating range, in addition to being exempt from the issues of incomplete bleaching (Duller *et al*. 2009). Earlier TL studies using calcium carbonate (both inorganic and biogenic) to construct TL growth curves were based upon multiple aliquot techniques with weight normalisation and zero-glow monitoring used to regulate changes in sensitivity (Wintle 1975, Debenham & Aitken 1984, Ninagawa et al. 1992). These studies were conducted using samples that were sufficiently large to make multiple aliquot methods feasible and demonstrated the potential of carbonates for luminescence dating using the TL signal. However, the snail opercula used by Duller *et al*. (2009) were in the range of 2-3mm^3 in size, meaning that multiple aliquot procedures were not possible; and hence a single-aliquot procedure was used. This work builds upon Duller *et al.*'s (2009) pilot study to develop the most appropriate measurement protocol for these small biogenic carbonates. In this study measurements of *Bithynia sp.* opercula have focussed upon sensitivity correction, a key component of any successful SAR protocol. The low temperature peak (~130°C), used for the zero-glow monitoring method, has been seen to be dependent upon regeneration dose. Determination of test dose and regeneration dose within the same TL glow curve is therefore inappropriate for sensitivity correction. Consequently an alternative sequence has been applied, separating the response to the test and regeneration doses and diminishing the dependence of the former on the latter. Further protocols to accurately monitor sensitivity change and improve dose recovery results will be explored, along with additional investigation of the TL characteristics of snail opercula.

References

Debenham, N.C. and Aitken, M.J. (1984) Thermoluminescence dating of stalagmitic calcite. *Archaeometry* 26: 155-170

Duller, G.A.T., Penkman, K.E.H and Wintle, A.G. (2009) Assessing the potential for using biogenic calcites as dosemeters for luminescence dating. *Radiation Measurements* 44: 429-433

Ninagawa, K., Adachi, K., Uchimura, N., Yamamoto, I., Wada, T., Yamashita, Y., Takashima, I., Sekimoto, K. and Hasegawall, H. (1992) Thermoluminescence dating of calcite shells in the Pectinidae family. *Quaternary Science Reviews* 11:121-126

Wintle, A.G. (1975) Effects of sample preparation on the thermoluminescence characteristics of calcite. *Modern Geology* 5: 165-167

Post-IR IRSL dating of a sediment core from the central Sea of Okhotsk: a feasibility study

S. Sugisaki[1,2,*], J.-P. Buylaert[2,3], A. Murray[2], S. Sakai[1], K. Oguri[1], T. Sakamoto[1]

[1] Institute for Biogeoscience, Japan Agency for Marine-Earth Science and Technology, Kanagawa, Japan.
[2] Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, Aarhus University, Risø DTU, DK4000 Roskilde, Denmark
[3] Radiation Research Division, Risø DTU, DK4000 Roskilde, Denmark

* *Corresponding author: saiko1219@gmail.com*

The Sea of Okhotsk is a sedimentary basin with a low sedimentation rate and is known to contain an important paleoenvironmental archive. In our previous study (Sugisaki et al., 2010), we successfully dated back to Marine Isotope Stage (MIS) 5e (~130 ka) using fine-grained quartz extracted from the marine sediment core (MR0604-PC07A), taken in the central Sea of Okhotsk. Radiocarbon dating and the well-established oxygen isotope stratigraphy was used as age control. New unpublished quartz results on MIS 7 and 9 sediments from a deeper part of the core indicate that this technique has reached its upper dating limit and that these older ages should be considered as minimum estimates. Because of the extended dose response curve of feldspar post-IR IRSL (pIRIR) signals compared to that of quartz OSL we investigate here the potential of a pIRIR signal from polymineral fine-grains to date this core beyond MIS5e. A post-IR elevated temperature (290°C) IRSL measurement protocol employing a preheat of 320°C for 60s for both dose and test dose measurements was employed. Prior to the measurement of the elevated temperature IRSL at 290°C for 200 s ($pIRIR_{290}$) an IR bleach at 50°C (IR_{50}) is carried out for 200 s. An elevated temperature IR stimulation at 325°C (200s) was inserted after each SAR cycle to minimize recuperation. Luminescence detection was through a blue filter combination (Schott BG39 and Corning 7-59 filters). Although the IR_{50} and $pIRIR_{290}$ signals from these polymineral fine-grains are relatively weak (quartz dominated sediment), they are strong enough for dose measurements. In the absence of modern analogue samples, we first present laboratory bleaching experiments on selected samples down the core to investigate the bleaching rate of the $pIRIR_{290}$ signal. We then (1) test the suitability of $pIRIR_{290}$ dating in the deep sea environment by comparing the results with the published quartz OSL and the oxygen isotope stratigraphy (2) investigate the potential of $pIRIR_{290}$ to date the layers confidently identified to represent MIS7 and MIS9.

Reference

Sugisaki S., Buylaert J.P., Murray A., Tsukamoto S., Nogi Y., Miura H., Sakai S., Iijima K. and Sakamoto T. (2010) High resolution OSL dating back to MIS 5e in the central Sea of Okhotsk. *Quaternary Geochronology* **5**, 293-298.

Thermally transferred OSL (TT-OSL) dating of Paleolithic sites buried by loess in Hanzhong Basin (Shaanxi Province, central China)

X. Sun[1]*, H. Lu[1], S. Wang[2], S. Yi[1]

[1] *School of Geographic and Oceanographic Sciences the MOE Key Lab of Coast and Island Development, Nanjing University, No.22 Hankou Road, 210093 Nanjing, China;* （*Email*：*xuefeng@nju.edu.cn*）
[2] *Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing 100044, China*

* *Corresponding author: xuefeng@nju.edu.cn*

Newly developed thermally transferred OSL (TT-OSL) dating technique extends the age range more beyond the current limits in OSL dating. Here we attempt using a SAR TT-OSL protocol dating Paleolithic sites buried by loess in Hanzhong Basin which is an important area for hominid evolution since middle Pleistocene in central China. Dating samples were taken from loess or paleosol units where artifacts had been discovered from 3 loess sections. Our results suggest that the chronological framework of these Paleolithic hominid activities is form circa 600 ka to circa 100ka ago, correlated with S5 to S1 in Chinese Loess Plateau and Marine Isotope Stage 15 to 5. On the basis of these results, we deduced that Paleolithic hominids occupied the Hanzhong Basin in both of glacial and interglacial periods, and it demonstrated that these Paleolithic hominids had adapted great environmental changes in this mountain area since middle Pleistocene.

Keywords: TT-OSL dating; Hanzhong Basin; Paleolithic site; loess; environmental change

Luminescence and radiocarbon dating of paleolithic Jiangxigou site in the Qinghai Lake area in NE Tibetan Plateau

Y. J. Sun[1,2], Z.P. Lai[1,*]

[1] Luminescence Dating Laboratory, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China (*Email: zplai@isl.ac.cn)
[2] Graduate School of Chinese Academy of Sciences, Beijing 100049, China

** Corresponding author: zplai@isl.ac.cn*

Archeological research over the past several years has started to provide evidence relevant to understanding both the timing of and processes responsible for human colonization of the Tibetan Plateau, especially in the QingHai Lake area and the Qaidam Basin in the northeastern Tibetan Plateau. However, the chronological data are still limited. Recently, a hearth was discovered in Jiangxigou in the south the Qinghai Lake area, which was likely used by prehistoric hunters. The sites is in the mouth of a canyon approximately 4.5 km to south of Qinghai Lake. Both luminescence samples and radiocarbon samples of charcoals were collected. Here, we present the comparison of the two dating methods. The present study aims to offer the age for paleolithic human inhabitation in this area, and discus the prehistoric occupation patterns on the northern and the central of the Tibetan Plateau. The implication for paleoenvironment changes will also be discussed.

Keywords: Tibetan Plateau; Qinghai Lake area; Paleolithic site; Luminescence and radiocarbon dating; Prehistoric occupation pattern

High resolution OSL dating for understanding centennial to decadal changes of a deltaic coastline

T. Tamura[1,2*], M. D. Bateman[2], Y. Saito[1], N. Van Lap[3], T. T. K.Oanh[3], L. M. Dao[3], D. Matsumoto[1], S. Yamashita[4]

[1] Geological Survey of Japan, AIST, Tsukuba , Japan. (toru.tamura@aist.go.jp)
[2] Sheffield Centre for International Drylands Research, University of Sheffield. Sheffield, UK.
[3] HCMC Institute of Resources Geography, VAST, Ho Chi Minh City, Vietnam.
[4] Department of Earth Science, Graduate School of Science, Chiba University, Chiba, Japan.

** Corresponding author: toru.tamura@aist.go.jp*

Empirical understanding of decadal- to centennial-scale deltaic shoreline changes over the last several millennia is essential for comprehensively predicting changes in the coming decades and centuries. We tested effectiveness of quartz OSL dating to beach ridge for constraining past shoreline changes of the Mekong River delta, southern Vietnam. A large OSL age dataset has been compiled from Tra Vinh lobe in the central delta plain. The beach ridges in Tra Vinh are recurved and branching, showing the hierarchy of shoreline changes, which include rapid discontinuous shifts caused by emergence of an offshore barrier spit, and subsequent shoreline rotation and downdrift progradation of spit. Each of the rapid shift resulted in a cluster of beach ridges. Beach ridge sand has good luminescence properties; age uncertainties are generally *c.* 5 %, and come mainly from dose rate uncertainties. OSL ages show that the beach ridges have formed since 3600 yrs BP, clearly illustrating the coastal progradation. Due to the relatively small OSL age uncertainties, within an individual beach ridge cluster is it possible to discern downdrift ridges to be younger. This is concordant with spit progradation. This trend is recognizable in a cluster that shows OSL ages ranging from 1530 ± 90 yr BP to 1030±50 yr BP. Another beach ridge cluster, of which age ranges from 200±10 yr BP to 400±20 yr BP, shows the youngest age in its updrift part, but this represents coastal retreat and reworking of beach sediment as evidenced by beach ridge morphology. A major anti-clockwise rotation of the shoreline, which caused downdrift and updrift coasts to move seawards and landwards, respectively, occurred around 500 years ago, suggesting strengthening of the northeasterly winter monsoon related to the Little Ice Age. In summary, detailed OSL dating of deltaic beach ridges, if with good luminescence properties, works well for constraining centennial- to decadal-scale shoreline changes during the late Holocene.

Radiation-induced radicals in hydrated sulphate salts

A. Tani[1*], N. Hasegawa[1], K. Norizawa[2], T. Yada[3], M. Ikeya[1]

[1]Department of Earth and Space Science, Graduate School of Science, Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560-0043, Japan (atani@ess.sci.osaka-u.ac.jp)
[2]The Institute of Scientific and Industrial Research, Osaka University, 8-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan
[3]The Shimane Nature Museum of Mt. Sanbe (Sahimel), 1121-8 Tane, Sanbe, Oda, Shimane 694-0003, Japan

** Corresponding author: atani@ess.sci.osaka-u.ac.jp*

Electron spin resonance (ESR) dating is proposed to determine a formation age of icy materials in extraterrestrial environments (Ikeya 1993). Radicals are formed by natural radiation from radioisotopes, cosmic rays, and solar wind, and accumulated if they are stable at ambient temperature. The thermal stability of the radiation-induced radicals were reported in H_2O, CO_2, SO_2, and CH_4 that would be found on Europa, Mars, Io, and Titan in our solar system (Tsukamoto et al., 1993; Kanosue et al, 1996; Kanosue et al., 1997; Norizawa et al., 2000). Some radicals in these icy materials are stable at low temperature and may be accumulated in extraterrestrial environments.

Hydrated sulphate salts are important evaporate minerals on the Earth and Mars, as well as maybe rock-forming minerals on icy planets and satellites. For example, kieserite ($MgSO_4 \cdot H_2O$) was found on the Martian surface by OMEGA (Mars Express orbiter) (Arvidson et al., 2005) that was a strong evidence of Mars's watery past. In Europa, one of the Jovian moons, ocean water under the icy crust may contain magnesium sulphate (Kargel et al., 2000) because reflectance spectra obtained by Galileo's Near Infrared Mapping Spectrometer (NIMS) show distorted water absorption bands and indicate the presence of hydrated magnesium sulphate (McCord et al., 1999). These findings suggest that hydrated sulphate salts may be on the surface of planets and moons and give us a question of when and how the sulphate salts formed. In this study, the thermal stabilities of the radiation-induced radicals have been studied in epsomite ($MgSO_4 \cdot 7H_2O$) and quenched samples of magnesium sulphate solution.

Atomic hydrogen and SO_3^- radical were observed at 77 K in gamma-irradiated epsomite. Although atomic hydrogen is unstable over 90 K, SO_3^- radical are stable up to 190 K. The surface temperature of Europa is between 90 and 130 K. SO_3^- radical in epsomite can be accumulated in epsomite, though atomic hydrogen disappears. Formation age of epsomite on the surface of Europa will be estimated by ESR.

Keywords: hydrated sulphate salts, epsomite, Europa, SO_3^-, Electron spine resonance

Synthesis and characterization of AlNd nanocrystals on the surface of Al_2O_3 grains.

A. Ventieri[1], J. C. Ramirez Mittani[2], J. F. de Souza Bitencourt[1], K. A. Gonçalvez[1], S. H. Tatumi[1,2*]

[1] Escola Politécnica da Universidade de São Paulo, Avenida Luciano Gualberto, 380, 05508-970, São Paulo, Brazil, (alexandreventieri@hotmail.com).
[2] Faculdade de Tecnologia de São Paulo, Praça Cel. Fernando Prestes, 30, 01124-060, São Paulo, Brazil, (tatumi@fatecsp.br).

* *Corresponding author: tatumi@fatecsp.br*

The present paper describes the morphogical and luminescent characterization of nanocrystals of Nd_2O_3 embeds on Alumina - Al_2O_3. The samples were prepared using the sol-gel technique and thermal treated to high temperatures.The phase of alumina as well as the morphology of the nanocrystal were characterized using X-ray diffraction (XRD), scanning transmission electron microscope (STEM) together with an energy-dispersive X-ray spectroscopy (EDS) and the luminescence using Thermoluminscence (TL) and Optically Stimulated Luminescence (OSL) techniques.The XRD results show intense peaks corresponding to the pattern of Al_2O_3 α-phase and to Al-Nd (Aluminum – Neodymium), resulting the sample in Al_2O_3 - AlNd composition, on other hand, STEM images show the growth of AlNd nanocrystal (100-120 nm) on surface of Al_2O_3 grains (70-90 μm) and confirmed by EDS measurements on the nanocrystal which show a predominance of Al, Nd and O atoms.The thermoluminescence measurements were done in two regions of the spectra, one between 280 and 380 nm using a UV filter (U-340) and the other between 360 and 600 nm using a blue filter (BG-39). In both regions of the spectra all the doped samples presented an intense peak at 200^{o}C and peaks with low intensity at high temperatures. Among all the doped samples, the sample with 2,5% of Nd_2O_3 shows an intense luminescence in both regions of the spectra being 9 times in the visible region and 1,5 times in the UV region when compared to the undoped sample, already, samples doped with Nd_2O_3 above of 2,5% presented a diminution on the intensity in all the measurements due to the concentration quenching phenomena. The optically stimulated luminescence (OSL) was measured using a blue stimulation (LEDs 470 nm) and the luminescence detected in UV region using a U-340 filter. Same as TL measurements for UV region, OSL measurements show a similar behaviour, this is, a high intensity signal to the sample doped with 2,5% of Nd_2O_3 and the signal 1,5 times intense compared to undoped sample. An analysis of dose response were done also on alumina doped with 2,5% of Nd_2O_3 and undoped sample, this last for comparison. The analyses were done for TL measurements on visible region and for OSL. Both samples presented a linear response to the dose between 1 and 20 Gy for TL and OSL. The minimum detectable dose found for TL were 760 mGy for undoped sample and 54mGy for alumina doped with 2,5% of Nd_2O_3 while for OSL 260 mGy for undoped sample and 76 for alumina doped.

Keywords: nanocrystals, aluminium oxide, aluminium neodymium, luminescence and sol-gel.

New luminescence age data of Late-Pleistocene sediments in the border areas of the Great Hungarian Plain

E. Thamó-Bozsó[1*], Á. Magyari[1], G. Csillag[1], L. Fodor[1], A. Nagy[2]

[1] Geological Institute of Hungary, Stefánia út 14, 1143 Budapest, Hungary
[2] Eötvös Loránd Geophysical Institute of Hungary, Homonna utca 1, 1118 Budapest, Hungary

** Corresponding author: bozso@mafi.hu*

Correlation of sediments in the basins and the joint hilly or mountain areas is often a very difficult task because the coeval sedimentary environments are frequently different on these areas. In many cases only absolute age data could help to solve the problems. To correlate the Late-Pleistocene-Holocene sediments on the Great Hungarian Plain and on its border areas we used OSL and post-IR IRSL dating methods. A new and some earlier published radiocarbon ages give independent age control to luminescence ages.

Samples were collected from seven outcrops in the northwestern, western and northern margins of the Great Hungarian Plain. Fluvial sands (Lovasberény, Vértesacsa, Forna, Paks), alluvial fan sediments (Csákvár, Apc), lacustrine sands (Forna) and eolian sediments (Lovasberény, Paks) were studied.

The separated quartz and feldspar fractions were suitable for luminescence dating by SAR protocol according to the various luminescence tests. Distributions of equivalent doses measured on quartz with small and medium aliquots show that some of the studied sediments were not totally bleached before deposition. Statistical characteristics of the D_e distributions indicate that using central age model (CAM) is appropriate for age calculation in most cases.

The oldest dated sediments are fluvial sands in the northwestern margin of the Great Hungarian Plain, on a terrace at Lovasberény and on an alluvial fan at Csákvár. They were deposited 40-50 ka ago. At Lovasberény the lower part of the loess section is 20-30 ka old, and here the OSL ages are in good agreement with the earlier published radiocarbon age data. Fluvial sedimentation also took place about 19-23 ka ago on this area at Vértesacsa and on the western margin of the Great Hungarian Plain at Paks. The youngest dated sediments with 6-13 ka old ages are aeolian sands at Paks, lacustrine and fluvial sediments at Forna. On the last place we also have independent radiocarbon age control. The luminescence dating of fluvial and eolian samples on the northern margin of the plain is in progress.

In Hungary we have radiocarbon and luminescence ages from fluvial and eolian sands, loess-like and marshy sediments from different parts of the Great Hungarian Plain. The new age data help in the correlation of the sediments of the last 50 ka on the plain and its border areas.

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Optically Stimulated Luminescence dating of alluvial infills at a Roman necropolis in NE Crete: the timeline of a riverbed diversion

K. Theodorakopoulou[1*], C. Athanassas[2]

[1] Department of Geography, Harokopio University, 70 El. Venizelou st, 17761, Athens, Greece
[2] Archaeometry Laboratory, Institute of Materials Science, N.C.S.R. 'Demokritos', Aghia Paraskevi, 153 10, Athens, Greece.

** Corresponding author: ktheodo@hua.gr*

The Late Hellenistic-Roman cemetery of Kamara in Agios Nikolaos is considered as one of the largest burial sites of Crete (Davaras, 1968). A large part of the ancient necropolis is currently found beneath thick fluvial deposits, generated by the function of the nearby Xeropotamos creek. Specifically, the presence of more than twenty graves in the modern riverbed strongly indicates a shift in the river's channel position possibly due to major alluviation events occurred in different prehistoric and historic periods. In the course of multidisciplinary investigations, a number of geoarchaeological methods, such as lithostratigraphic analysis, mapping of the excavated tombs and geophysical survey based on georadar and electrical resistivity, were successful in determining the location of the river channel at the time of the establishment of the cemetery, as well as in designating intermediate phases of riverbed diversion (Theodorakopoulou et al., 2008). Nonetheless, a basic question of this research was the deduction of a chronological outline for channel migration. With the intention of working out a chronological framework at the Cretan necropolis, this study engaged Optically Stimulated Luminescence (OSL) dating. Quartz aliquots extracted from the studied fluvial sequences were subjected to the Single Aliquot Regenerated (SAR) dose protocol (Murray and Wintle, 2000). The validity of the estimated equivalent doses was examined by preheat tests, recycling of fixed doses, recovery of known doses, IR-OSL tests for feldspar contamination (Duller, 2003) and recuperation checks. On the other hand, calculation of dose rates involved measurement of the radioisotope content by means Neutron Activation Analysis (NAA). Our calculated OSL ages seem to be in concordance with the local archaeological record, pointing out that Xeropotamos Creek has been in operation since at least the Fourth Millennium BC. Its riverbed had been progressively migrating in a north-east course before it reached its present position in the last quarter of the First Millennium AD. Current luminescence dating results have been further exploited to reconstruct certain phases of local Holocene fluvial paleogeography.

Keywords **:** OSL dating, fluvial deposits, Hellenistic-Roman cemetery, Crete

References

Davaras, K. 1968. *Archaeological Deltion*, 23, 404-410.
Duller, G.A.T. 2003. *Radiation Measurements*, 37, 161-165.
Murray, A.S. and Wintle, A.G.. 2000. *Radiation Measurements*, 32, 57-73.
Theodorakopoulou, K. et al. 2008. *Bulletin of the Geological society of Greece*, XLII/1, 140-147.

Establishing the chronology of marine terraces on the Cap Bon peninsula, N-E Tunisia using TT-OSL and post-IR IRSL

C. Thiel[1*], J.-P. Buylaert[1,2], A. S. Murray[1], N. Elmejdoub[3]

[1] Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, University of Aarhus, Risø DTU, 4000-Roskilde, Denmark (thielchristine@gmail.com; jabu@risoe.dtu.dk; anmu@risoe.dtu.dk)
[2] Radiation Research Division, National Laboratory for Sustainable Energy, Risø DTU, 4000-Roskilde, Denmark
[3]Unité de Recherche Hydrosciences Appliquées, Institut Supérieur des Sciences et Techniques des Eaux de Gabès, Université de Gabès, Zrig 6072, Gabès, Tunisia (n.elmejdoub@yahoo.com).

** Corresponding author: thielchristine@gmail.com*

The raised marine platforms (terraces) on the Cap Bon peninsula are the result of an interplay between Pleistocene sea-level changes and progressive uplift during the Quaternary. The two oldest and highest platforms, found at +100 m and +60 m, have been attributed to Marine Isotope Stage (MIS) 11/13 and 9/11, respectively, and the youngest platform (+40 m) associated with MIS 5e and MIS 7 (Elmejdoub and Jedoui, 2009). However, unequivocal age attribution is not possible due to a lack of absolute chronology. Thus, the record of eustatic fluctuation on the Tunisian coast remains largely a matter of debate. In this study we make use of both quartz and feldspar luminescence dating to test the tentative correlation of the platforms with the MIS record.

We have investigated the potential of the TT-OSL signal for dating the platforms. All coarse-grained samples seem to have sufficiently bright TT-OSL signals and TT-OSL growth curves extend to very large doses (D_0 >1kGy). However, our measurement protocol seems to suffer from poor sensitivity correction (recycling ratios >>1.3); recycling ratios without test dose correction (simple L) are very close to unity. It seems that although the TT-OSL of the test dose does not successfully monitor sensitivity changes, a test dose correction may not, in fact, be necessary. We report on the results of our investigations to adjust our measurement protocol to meet the standard laboratory tests (recycling, recuperation, dose recovery).

We have used an elevated temperature post-IR IRSL protocol on K-feldspar extracts to test the reliability of the TT-OSL ages. After a preheat of 320°C for 60 s, the coarse-grained K-feldspar extracts were IR stimulated at 50°C (200 s), followed by post-IR IRSL readout at 290°C (200 s). We present a comparison of TT-OSL and post-IR IRSL ages for the marine sediment sequences found on the three platforms. The resulting ages are discussed in relation to sea level high stands along the Tunisian coast during the Middle to Late Pleistocene.

Keywords : marine terraces ; TT-OSL; post-IR IRSL

Reference

Elmejdoub, N., Jedoui, Y., 2009. Pleistocene raised marine deposits of the Cap Bon peninsula (N-E Tunisia): Records of sea-level high stands, climatic changes and coastal uplift. Geomorphology 112, 179-189.

The dose dependency of over-dispersion of quartz single grain dose distributions

K. J. Thomsen[1*], A. Murray[2], M. Jain[1]

[1] Radiation Research Department, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, 4000 Roskilde, Denmark (krt@risoe.dtu.dk)
[2] Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, Aarhus University, Risø DTU, Roskilde, Denmark

** Corresponding author: krt@risoe.dtu.dk*

The use of single grain quartz OSL dating has become more widespread over the past decade, particularly in samples likely to have been incompletely bleached at burial. By reducing the aliquot size to a single grain the probablility of identifying the grain population most likely to have been well-bleached at deposition is maximised and thus the accuracy with which the equivalent dose can be determined is – at least in principle - improved.
However, analysis of single grain dose distributions requires knowledge of the dispersion of the well-bleached part of the dose distribution. This can be estimated by measurement of a suitable analogue, e.g. a well-bleached aeolian sample, but, as well as the availability of the analogue, this requires the assumption that the sample is in fact a) well-bleached, and b) has a similar dose rate heterogeneity. Finally, it is an implicit assumption in such analysis that the over-dispersion is not significantly dose dependent.
In this study we have undertaken laboratory invesigations of the dose dependency of over-dispersion using a well-bleached modern sample with an average dose of 36 ± 3 mGy. This sample was split into two portions. One portion was heated to 750°C for 1 h and the other was bleached using a daylight simulator for 1 h. Both portions were further split into 12 fractions; these were then given different gamma doses ranging from 100 mGy up to saturation, in such a manner that the grain-to-grain variation in dose was negligibly small.
Here, we report on the variation of over-dispersion with given dose and dose analysis of various physical mixtures of these dosed samples, both with and without a subsequent added gamma dose. Finally, we discuss the implications of these and other experiments on the estimation of natural doses using single grains of quartz.

Investigations on the reliability of SAR-OSL equivalent doses obtained for quartz samples displaying dose response curves with more than one component

A. Timar-Gabor[1*], Ş. Vasiliniuc[1,2], D.A.G. Vandenberghe[2], C. Cosma[1], A.G. Wintle[3,4]

[1] Faculty of Environmental Science, Babeş-Bolyai University, Fântânele 30, 400294 Cluj Napoca, Romania
[2] Laboratory of Mineralogy and Petrology (Luminescence Research Group), Department of Geology and Soil Science, Ghent University, Krijgslaan 281 (S8), B-9000 Ghent, Belgium
[3] Institute of Geography and Earth Sciences, Aberystwyth University, Aberystwyth SY23 3DB, UK
[4] McDonald Institute for Archaeological Research, University of Cambridge, Downing Street, Cambridge CB2 3ER, UK

* *Corresponding author:* alida.timar@ubbcluj.ro

In this work we report our continuing investigations on the potential of quartz optical dating for establishing a reliable chronology for Romanian loess-palaeosol sequences. Our previous investigations on silt-sized (4-11μm) and sand-sized (63-90μm) quartz samples from the section near Mircea Vodă showed that the OSL signals from both grain-size fractions are dominated by a fast decaying component that is thermally stable. The suitability of a SAR protocol for dating these samples was confirmed through recycling, recuperation and dose recovery tests. Although each grain-size fraction yielded an internally consistent set of optical ages, the equivalent doses (D_e) obtained for coarse quartz grains were higher than those for the fine grains, resulting in a significant age discrepancy. This study aims at improving our understanding of this phenomenon using silt and sand-sized quartz samples (n=19) collected from the L1, S1 and L2 units of a section near Mostiştea lake. Our preliminary results, based on applying the SAR protocol with a preheat of 10 s at 220°C, a cutheat to 180°C and a hot bleach at the end of each cycle for 40 s at 280°C, confirm that our previous observations apply more generally to Romanian loess. The equivalent doses obtained on the investigated samples for the fine (4-11μm) fraction range from ≈110 Gy to ≈300 Gy, while the values for equivalent doses obtained on the coarse (63-90 μm) fraction are up to 40% higher for all samples and range from ≈130 Gy to ≈400 Gy. High resolution (5°C interval) pulse anneal experiments confirm that the OSL signal used for dating from both grain size fractions originates from traps that are thermally stable over geological time (i.e. traps that are rapidly emptied above 300°C), while dose recovery tests confirm the ability of the SAR protocol to precisely measure laboratory doses up to at least 500 Gy. Investigations of the saturation characteristics of the OSL signals by constructing dose response curves up to 5000 Gy show that the dose response of our samples can be best described as a sum of two saturating exponential functions. The saturation characteristics of the dose response curves for fine and coarse grains do not vary with sample age. However, the OSL signal from fine quartz extracted from Romanian loess (D_{01}≈100 Gy, D_{02}≈1000 Gy) seems to saturate at much higher doses than the signal from the sandy grains (D_{01}≈50 Gy, D_{02}≈500 Gy). We are currently documenting the behavior of the quartz TL signals, the appropriateness of the SAR sensitivity correction procedure, and the athermal stability of the OSL signals. However, as all the equivalent doses obtained on our samples (at least for the coarse grains) are obtained by interpolating on a region of the dose response curve where the first exponential component is already in saturation, we caution on the reliability of using this region of the dose response curve for SAR quartz OSL dating.

Keywords: quartz, OSL, dose response, saturation characteristics

The alpha efficiency of ESR signals in barite

S. Toyoda[1*], F. Sato[1], H. Nishido[2], J.-I. Ishibashi[3]

[1]Department of Applied Physics, Okayama University of Science, 1-1 Ridai-cho, Kita-ku, Okayama 700-0005, Japan (toyoda@dap.ous.ac.jp),
[2]Research Institute of Natural Sciences, Okayama University of Science, 1-1 Ridai-cho, Kita-ku, Okayama 700-0005, Japan,
[3]Department of Earth and Planetary Sciences, Kyushu University, 6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan

** Corresponding author: toyoda@dap.ous.ac.jp*

Since drastic changes of hydrothermal activity on the seafloor have been witnessed in some recent studies, application of geochlonological study for seafloor hydrothermal activity becomes important. Moreover, geochlonological study of submarine ore deposits should be important, since the ore formation usually requires long-time duration of hydrothermal activity (Urabe, 1995). A systematic geochronological study of hydrothermal activities has not been possible due to the lack of methods which cover the age ranges of interest. In light of this, Electron Spin Resonance (ESR) dating of barites ($BaSO_4$) has been recently attempted in chimneys deposited from hydrothermal vents at the Archean site in the South Mariana spreading center and at Hakurei site in the Okinawa Trough (Okumara et al. in press).

Kasuya et al. (1991) investigated the ESR signals from five natural barite samples and found that the ESR signals arising from electron centers had greater thermal stability in comparison to hole centers. They also suggested that the ESR signals from these electron centers could be used for ESR dating of hydrothermal veins. The ESR ages of the chimney samples 903-R7-2 and 220-E were first practically obtained to be ~470 and ~5670 years respectively (Okumara et al. in press). One of the most important parameters for dose rate is the efficiency factor of ESR signal formation by alpha particles because more than 50% of the dose comes from internal alpha particles. Okumura et al. (in press) simply assumed the value to be 0.1 and 0.25. In the present paper, we implanted He ion accelerated by a Tandem accelerator into sliced barite samples, in order to investigate the formation efficiency of the SO_3^- signal relative to that by gamma ray irradiation. As results, the efficiency factor for 4MeV He ion was obtained to be 0.0089 and 0.043 depending on the sample.

Using single grains of K-rich feldspar for luminescence dating

M. Trauerstein[1,*], F. Preusser[2], F. Schlunegger[1]

[1]Institute of Geological Sciences, University of Bern, Baltzerstrasse 1-3, 3012 Bern, Switzerland
[2]Department of Physical Geography and Quaternary Geology, Stockholm University, 106 91 Stockholm, Sweden

* *Corresponding author:* trauerstein@geo.unibe.ch

Using single quartz grains for OSL dating has been shown to be a helpful tool to deal with partial bleaching in sediments. However for some geological sites the quartz OSL signal shows anomalies that make it unsuitable for dating (e.g. an unstable fast component; Steffen et al. 2009). For these cases IRSL dating of potassium-rich feldspar offers a promising alternative, although this signal may be affected by anomalous fading. Recently, a number of fading correction models for feldspar IRSL has been developed (e.g. Huntley & Lamothe 2001, Lamothe et al. 2003). These models seem to yield reliable ages for Multiple-Grain IRSL data, but there is just a very limited number of studies correcting single grain feldspar data for fading (e.g. Li et al. 2011). Therefore, test measurements were carried out on 2 well-bleached samples - aeolian sands from the Rub al Khali, previously dated with quartz OSL and TT OSL. The De was determined using a modified SAR-protocol for Single-Grain IRSL measurements. For a large number of grains very high recuperation values could be observed. Rejecting grains with a recuperation that exceeds a certain threshold leads to a significant reduction of the dataset. From the individual De values an average De was determined for both of the samples using the Central Age Model. The resulting ages underestimate the control ages, which was expected as the feldspar most probably is affected by fading. Fading tests based on the SAR-protocol were carried out on the whole Single-Grain discs (containing ~100 grains each) and additionally on each grain individually. Fading rates determined on the whole discs were about 3.5 % per decade for both samples. The corrected age of the first sample is in good agreement with the control age, whereas the corrected age of the second sample is still underestimating the expected age. The determination of reliable fading rates for the individual grains turned out to be problematic due to the poor signal reproducibility of Single-Grain measurements. Fading rate errors were larger than 1.5% per decade for more than half of the grains. Those fading rates were considered to be unreliable. Nonetheless grains of the same sample with fading rate errors of < 1.5% per decade showed a wide variation of fading rates. Plotting the fading rates for each grain against its previously obtained De shows clearly that there is a negative relationship. This lead to the conclusion, that fading rates do not just vary from sample to sample but from grain to grain, even within the same sample.

References

Huntley, D.J. & Lamothe, M. (2001) Ubiquity of anomalous fading in K-feldspars and the measurement and correction for it in optical dating. Canadian Journal of Earth Sciences, 38, 1093-1106.

Lamothe, M., Auclair, M., Hamzaoui, C., Huot, S. (2003) Towards a prediction of long-term anomalous fading of feldspar IRSL. Radiation Measurements, 37, 493-498.

Li, B., Li, S.H., Duller, G.A.T., Wintle, A.G. (2011) Infrared stimulated luminescence measurements of single grains of K-rich feldspar for isochron dating. Quaternary Geochronology, 6, 71-81.

Steffen, D., Preusser, F., Schlunegger, F. (2009) OSL quartz age underestimation due to unstable signal components. Quaternary Geochronology, 4, 353-362.

A comparative study of the luminescence characteristics of polymineral fine grains and coarse grained K-, Na- and Ca-rich feldspars

S. Tsukamoto[1], M. Jain[2], A. Murray[3], C. Thiel[1,3], E. Schmidt[1], L. Wacha[1,4], M. Frechen[1]

[1] Leibniz Institute for Applied Geophysics, Section 3: Geochronology and Isotope Hydorology, Stilleweg 2, D-30655 Hannover, Germany, e-mail: Sumiko.Tsukamoto@liag-hannover.de
[2] Radiation Research Division, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, DK-4000 Roskilde, Denmark
[3] Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, Aarhus University, Risø DTU, DK-4000 Roskilde, Denmark
[4] Croatian Geological Survey, Sachsova 2, HR-10000 Zagreb, Croatia

* *Corresponding author:* Sumiko.Tsukamoto@liag-hannover.de

Recently, the elevated temperature post-IR IRSL signal measured at 290°C ($pIRIR_{290}$) has been found to show little or no anomalous fading in both K-feldspar and polymineral fine grains (Thiel et al., 2011, submitted; Thomsen et al., 2011; Buylaert et al., submitted; Schmidt et al., submitted). A preheat of 320°C (60s) and the pIRIR stimulation temperature of 290°C were chosen because the IRSL signal at 50°C from K-feldspar may be associated with a trap at 410°C (Murray et al., 2009). However, polymineral fine grains are a mixture of different kinds of feldspars, and little is known about the origins of the IRSL and pIRIR signals. In this study the luminescence characteristics of six polymineral fine grain samples are compared with those of coarse-grained K-, Na- and Ca-rich feldspar extracts; the samples are taken from different regions of the world. The measurements of thermal stability and TL signal loss after illumination for both IRSL and post-IR IRSL are combined with time-resolved measurements (Jain and Ankjærgaard, 2011) to understand the nature of the IR dosimetric trap and recombination processes in these different samples. The comparison of coarse-grained mineral extracts with the fine grains will enable understanding of the origins of the luminescence signals in the polymineral fine grained samples; the implications resulting from these measurements will be discussed.

Keywords: feldspar, polymineral, IRSL, pIRIR, thermal stability, time resolved IRSL

Intercomparison of gamma ray doses calculated from U, Th, K concentrations and those measured by a NaI detector

A. Uchida[1*], S. Toyoda[1], H. Tissoux[2], C. Falguères[2], K. Ninagawa[1]

[1] Department of Applited Physics Okayama University of Science, Japan
[2] Department of Prehistory, Muséum National d' Histoire Naturelle, France

** Corresponding author: s09rd01ua@std.ous.ac.jp*

It is an important issue to obtain consistent results with different methods for dose rate determination. In the present study, the natural gamma ray dose rate calculated from U, Th, K and water contents in the sediments was compared with the value obtained by in-situ measurement with a NaI detector (JSM-102, Aloka).

Compressed powder sample was left for 14 days or more after packing to have radioactive equilibrium of radon attained. Then, the sample was measured for 7 days by a low background pure Ge detector. The concentrations of U, Th and K were calculated from the peak intensities of ^{226}Ra, ^{214}Pb,^{214}Bi,^{212}Pb,^{228}Ac,^{208}Tl,^{212}Bi,^{208}Ti and ^{40}K , after subtracting background, in comparison with those of a standard sample, a GSJ Geochemical Reference sample, JG-3.
The NaI detector probe of 3" diameter (Aloka JSM-102) was placed in a hole of the sediment of interest and a spectrum is obtained for 30 min. The spectrometer has 240 channels where the maximum energy to be detected was set to 3.6 MeV.

The dose rate was calculated from the obtained gamma ray spectrum by the special software made by Aloka (G(E) function and Unfolding). We also employed the "threshold" technique (Mercier and Falguères, 2007) for the spectrum obtained by NaI detector to obtain the gamma ray dose rate.

Keyword : NaI detector・the gamma ray dose rate "threshold" technique

Comparison of Radiometric dates for the early Middle Palaeolithic sequence of Orgnac 3 (Ardèche, France)

H. Valladas[1*], J. J. Bahain[2], N. Mercier[3], J.L. Joron[4], C. Falguères[2], L. Froget[1], J.M. Dolo[5], L. Ayliffe[6], H. Masaoudi[2], M. H. Moncel[2]

[1]Laboratoire des Sciences du Climat et de l'Environnement (LSCE/IPSL), CEA/CNRS/UVSQ, Bât. 12, Avenue de la Terrasse, 91198 Gif-sur-Yvette Cedex. Helene.valladas@lsce.ipsl.fr
[2]Département de Préhistoire, Muséum national d'Histoire Naturelle, UMR7194 du CNRS, Institut de Paléontomogie humaine, 1 rue René panhard, 75013 Paris.
[3]Institut de Recherche sur les Archéomatériaux , UMR 5060 CNRS - Université de Bordeaux , Centre de Recherche en Physique Appliquée à l'Archéologie (CRP2A) , Maison de l'archéologie , 33607 Pessac cedex.
[4]Groupe des Sciences de la Terre, Laboratoire Pierre Süe, CEN, Saclay, 91191 Gif-sur-Yvette, France.
[5]CEA-I[2]BM 91401 Orsay Cedex, France.
[6]Research School of Earth Sciences, Australian National University, ACT 0200, Australia.

** Corresponding author: Helene.valladas@lsce.ipsl.fr*

The site of Orgnac 3 located in Ardèche (Southeastern France) yields a long stratigraphic sequence whose archaeological layers allow studying the evolution of "techno-complexes" and subsistence strategies from the final Lower Palaeolithic to the emergence of the Early Middle Palaeolithic in the Rhône valley. Stalagmitic formations deposited respectively on layers 6 and 5 at the base of the sequence were dated by uranium series method (alpha spectrometry and TIMS) from ca. 370 to 270 ka. Twelve burnt flint specimens collected in the same layers 6 and 5 were dated by TL between *ca.* 300 and 250 ka and seven mammal teeth from layers 7 to 1 yielded ESR-U series ages ranging from 400 to 250 ka. The external dose-rates used for these latter methods were measured by *in situ* dosimetry. Fission tracks method on zircon grains from layer 2 gave an age of 298 ± 55 ka. These dating results suggest that the "Levallois débitage", which appeared in the middle part of the sequence, occurred some 300 ka ago. Standardization of the lithic production developed at the top-levels after *ca*. 280 ka with both a main "Levallois débitage" and an abundance of scrapers. Comparison with the neighbouring Middle Palaeolithic site of Payre shows that Middle Paleolithic-type behavior took place early in southern France, around 300-250 ka ago.

Keywords : Orgnac 3, Middle Palaeolithic, TL, ESR/U series, teeth, burnt flint

The Late Pleistocene loess deposits at Lixhe/Visé (NE Belgium): new light on an old stratotype

D.A.G. Vandenberghe[1,#,*], P. Van den haute[1], J.-P. Buylaert[2, 3]

[1] Laboratory of Mineralogy and Petrology (Luminescence Research Group), Department of Geology and Soil Science, Krijgslaan 281 (S8), B-9000 Gent, Belgium (dimitri.vandenberghe@ugent.be).
[2] Nordic Laboratory for Luminescence Dating, Department for Earth Sciences, Aarhus University, Risø DTU, DK-4000 Roskilde, Denmark.
[3] Radiation Research Division, Risø national Laboratory for Sustainable Energy, Technical University of Denmark, DK-4000 Roskilde, Denmark.
[#] Postdoctoral Fellow of the Research Foundation – Flanders (FWO-Vlaanderen).

** Corresponding author: dimitri.vandenberghe@ugent.be*

The Late Weichselian loess sequence at Lixhe/Visé (NE Belgium) comprises the most important stratigraphical markers of the area: the present soil, the Nagelbeek Tongued Horizon and the Eltville tephra. The Nagelbeek Tongued Horizon is a typical cryoturbated horizon that is found all across the Belgian loess belt. The Eltville tephra is a widespread tephra layer in Germany, the Netherlands and Belgium; especially in loess sections, it has been widely used as a tephrostratigraphical marker. The sequence at Lixhe has long been the only section in Middle Belgium where these three marker horizons were exposed and it was therefore considered as the stratotype for the Late Weichselian loess. To our knowledge, the chronology for the sequence has been based on a single thermoluminescence (TL) date of 15.8±1.3ka, which was obtained more than two decades ago for the Nagelbeek Tongued Horizon, and indirect age information derived from correlation with comparable successions elsewhere in NW Europe. In this paper, we use the single-aliquot regenerative-dose (SAR) protocol in combination with optically stimulated luminescence (OSL) signals from fine-sandy (63-90μm) quartz to establish an absolute chronology for the sequence. The luminescence characteristics are investigated to some extent. In general, the samples behave well in the SAR-protocol: recycling ratios are close to unity, growth curves pass very close to the origin, and a laboratory dose given prior to any heat treatment can be measured to within 10%. Examination of linearly modulated OSL (LM-OSL) signals demonstrates that the samples are dominated by a fast component. The equivalent dose is independent of preheat temperature, and a pulse anneal experiment is used to further confirm that the dosimetric signal is thermally stable. Dose rate determination has not yet been completed for all samples. However, the optical ages already available are consistent with the stratigraphic position of the samples. Dates for the loess units over- and underlying the Eltville tephra bracket the age of this marker horizon between 33±4ka and 30±1ka. These age constraints are significantly older than the age of ~20ka that was previously established at other localities, mainly through TL and infrared stimulated luminescence (IRSL) dating of polymineral silt-sized (4-11μm) grains. It remains to be confirmed as to whether this reflects a similar problem as recently observed in the dating of Romanian loess, where significantly higher optical ages were obtained for sand-sized quartz in comparison to silt-sized quartz. Investigations into this matter are underway (such as SAR-IRSL analysis of polymineral fine grains). They will be presented as available at the meeting, together with the full set of quartz-based SAR-OSL ages and their chronostratigraphic implications.

The potential of luminescence signals from polymineral fine grains for dating Romanian loess

Ş.Vasiliniuc[1,2,*], D.A.G. Vandenberghe[1], A. Timar-Gabor[2], C. Cosma[2]

[1] Laboratory of Mineralogy and Petrology (Luminescence Research Group), Department of Geology and Soil Science, Ghent University, Krijgslaan 281 (S8), B-9000 Ghent, Belgium
[2] Faculty of Environmental Science, Babeş-Bolyai University, Fântânele 30, 400294 Cluj Napoca, Romania

** Corresponding author: stef.vasiliniuc@ubbcluj.ro*

We present the results of our continuous investigations into the potential of luminescence dating for establishing a reliable chronology for Romanian loess-palaeosol sequences. In this paper, we direct the research efforts towards luminescence signals from polymineral fine grains. Using samples collected from the sequence near Mircea Vodă, we investigate IRSL measured at 50°C (IR_{50}; blue detection) and 125°C (IR_{125}; UV detection), post-IR_{50} elevated temperature IRSL (post-IR_{50} IR; blue detection), and post-IR_{125} OSL (UV detection).

We first document the behavior of these signals in a SAR protocol. For all signals, sensitivity changes occurring throughout repeated measurement cycles are accurately corrected for (recycling ratio's within 0.9-1.1), and the growth curves pass close to the origin (recuperation negligible). Dose recovery tests show that preheat temperatures (for 60s) in excess of 115°C do not allow accurate dose measurement using IR_{50}; for higher preheats, the given dose is increasingly overestimated (up to ~100% at 250°C). The (in)ability to recover a known given dose is not dependent on the duration of the preheat nor the bleaching agent, and we show that the overestimation is caused by initial sensitivity changes which are temperature and dose dependent. For IR_{125}, post-IR_{125} OSL and post-IR_{50} IR, the given dose can be recovered to within 5-10%, without any dependence over the temperature range examined.

For all signals, we then examine the dependence on preheat temperature of equivalent dose (D_e), fading rate (g-value) and the resulting age. For both the IR_{125} and the post-IR_{125} OSL signals, there is no systematic dependence on the thermal pre-treatment of D_e, g-value and age. For IR_{50}, the increase in D_e with preheat is not entirely counterbalanced by a decrease in g-value; the increase in age with preheat temperature probably reflects initial sensitivity changes (see higher). Post-IR_{50} IR measurements are ongoing; our first results indicate that signals measured after preheats of 250°C and 325°C exhibit comparable fading rates (~1%/decade), but it remains to be established whether they also yield the same age results.

Despite a good dose recovery, fading-corrected ages obtained using IR_{50}-signals measured after a preheat at 115°C significantly underestimate previously-obtained quartz-based SAR-OSL dates. Pulse anneal and combined IR/TL experiments indicate that this IR_{50} signal relates to three regions of the TL glow curve (at ~130°C, 250°C and 320°C), which confirms that the age underestimation is caused by a contribution from a thermally unstable signal. Similar experiments for post-IR_{50} IR signals suggest that, depending on the stimulation temperature, they originate with TL peaks at ~320°C or 380°C.

Although our investigations are still ongoing, we can already conclude that conventional SAR-IR_{50} dating of polymineral fine grains is unlikely to yield accurate ages for Romanian loess, either owing to initial sensitivity changes, thermal instability of the signal, and/or a combination of both phenomena. IRSL signals measured at higher temperatures (IR_{125}, post-IR_{50} IR) or post-IR_{125} OSL are more promising, and a more complete account on their potential will be presented at the meeting.

Keywords: polymineral fine-grains, post-IR IRSL, OSL, thermal stability, pulse annealing, fading

Investigation on non-optically bleachable components of ESR aluminium signal in quartz

H. Tissoux[1,2], P. Voinchet[2,*], F. Lacquement[1], F. Prognon[1], D. Moreno[2], C. Falguères[2], J.-J. Bahain[2], S. Toyoda[3]

[1]Bureau de Recherches Géologiques et Minières, GEO/G2R, BP 36009, 45060 Orléans cedex 2, France (tissoux@mnhn.fr).
[2]Département de Préhistoire, Muséum National d'Histoire Naturelle, UMR 7194 du CNRS, 1 Rue René Panhard, 75013, Paris, France.
[3]Department of Applied Physics, Okayama University of Science 1-1 Ridai, Okayama, 700-0005, Japan.

** Corresponding author: pvoinch@mnhn.fr*

Electron Spin Resonance (ESR) can be used as a method to estimate the age of sediment deposition using a signal related to aluminium impurities in quartz structure. The so-called Al-center can be partially optically bleached as its signal intensity decreases versus exposure to solar light, until it reaches a plateau value. The bleachable component of Al-center, commonly used for dating Pleistocene quartz sediments, is generally determined by subtracting this plateau intensity obtained after bleaching natural sediment from the intensities of natural and irradiated fractions of quartz. This residual signal can be attributed to traps which can not be reset by an exposure to sunlight, or "deep aluminium traps" (DAT). In this study, we investigated the behaviour of the DAT signal in samples from different origins and ages; Pleistocene fluvial sediments from Cher and Creuse River Valley (France), Neogene Fluvio-deltaic sediment from Sologne Basin (France), Pleistocene fluvial sediment from Neckar River associated with the archaeological site of Mauer (Germany), Pleistocene fluvial sediment from Arlanzon River Valley (Spain) and Pleistocene volcanic tephras from Aizu region (Japan). As results, we observed that the absolute intensity of the DAT signal of quartz, isolated by exposure to simulated solar light for more than 1500h, is sample dependant and then have to be calculated for each sample when dating sediments. Isochronal annealing experiments, performed on natural and irradiated aliquots, indicate that DAT signal can be totally reset by heating the quartz grains. Finally, natural and irradiated up to 25000 Gy quartz aliquots were optically bleached for more than 1500h. The normalized intensities don't increase with gamma laboratory irradiation, and thereby validate the ESR dating of quartz sediment protocol used so far.

Keywords: ESR dating, Quartz, Deep-Aluminium-Traps, Bleaching,

Assessing the robustness of OSL ages obtained on young fluvial deposits

J. Wallinga[1*], A.C. Cunningham[1], N. Hobo[2,3], A.J. Versendaal[1], B. Makaske[3], H. Middelkoop[2]

[1] Netherlands Centre for Luminescence dating, TUDelft, The Netherlands (j.wallinga@tudelft.nl).
[2] Department of Physical Geography, Utrecht University, The Netherlands.
[3] Alterra, Wageningen University and Research Centre, The Netherlands.

** Corresponding author: j.wallinga@tudelft.nl*

The accuracy and robustness of optically stimulated luminescence (OSL) age estimates may be jeopardized if light exposure prior to burial is too limited to completely reset the OSL signal of all grains. For young and subaqueous deposits, OSL ages may depend on the age model used for interpretation of the equivalent-dose distribution. In consequence, ages may be inaccurate while uncertainty estimates may be unrealistic.

We recently proposed a method to obtain more robust OSL chronologies on sequences of samples from poorly bleached deposits (Cunningham & Wallinga, submitted). This method relies on repeated application ('bootstrapping') of the minimum age model (MAM; Galbraith et al., 1999) using slightly varying input, resulting in a probability density function (PDF) of OSL ages. This PDF can then be fed into a Bayesian model (e.g. OxCal) to combine the OSL dates with other age information (e.g. the sequence order or age constraints).

In many cases, however, there are too few samples in a sequence to make full use of the bootstrapping – Bayesian approach. Hence, there is a need to assess the robustness of OSL age estimates obtained on a sample. In this study, we propose a bleaching parameter that allows the comparison of the degree of bleaching of samples of different age. This bleaching parameter can be combined with the bootstrapping OSL age PDF to assess the robustness of the OSL age obtained. We discuss how well the proposed method predicts the quality of OSL ages obtained on a suite of over 20 samples obtained from young (< 500 years) fluvial deposits from channel and overbank sediments in an embanked floodplain.

In addition, we use the same dataset to assess whether the degree of bleaching depends on the depositional environment within this system, e.g. is there a difference in bleaching between channel and overbank deposits. Results of this analysis shed light on bleaching mechanisms in fluvial systems and help optimize sampling strategies for optical dating of young fluvial systems.

Keywords: OSL dating, quartz, fluvial, poor bleaching

References

Cunningham, A.C. & Wallinga, J. Submitted. Realizing the potential of fluvial archives using robust OSL chronologies. Submitted to Quaternary Geochronology.

Galbraith, R.F. *et al*. 1999. Optical dating of single and multiple grains of quartz from Jinmium rock shelter, northern Australia, part 1, Experimental design and statistical models. Archaeometry 41, 339-364.

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Luminescence dating of fine grained sediments from a New Zealand site using various protocols

N. Wang[1,*], U. Rieser[1], R. Langridge[2]

[1] Luminescence Dating Laboratory, School of Geography, Environment and Earth Sciences, Victoria University of Wellington, New Zealand (Ningsheng.Wang@vuw.ac.nz)
[2] GNS Science, New Zealand

** Corresponding author: Ningsheng.Wang@vuw.ac.nz*

The fine-grain (4-11μm) polymineral derived from the degradation terraces at Maruia River, South Island of New Zealand, produced no blue luminescence signals (410 nm) under infrared stimulation, indicating the absence of K-feldspar. Therefore, we attempted to date quartz instead of feldspar, but immediately realised that we were faced unique problems with these samples.

OSL dating of New Zealand quartz in general is a challenge because it is characteristically dim and has a high sensitivity change (e.g. Frank Preusser et al.2006). As a result we employed several protocols. The first approach was to measure the UV signal of the fine-grain polyminerals under blue stimulation after infrared bleach (post-IR OSL) based on the single aliquot regenerative protocol (SAR). The second was to measure the UV signal of fine grain quartz chemically extracted from the fine grain polymineral also based on SAR.

It was found that fine grained quartz showed bright luminescence signals but also had a high sensitivity change. In order to check for undetected sensitivity change in the natural cycle (first cycle), a single aliquot regenerative and added dose protocol (SARA) (Murray and Mejdahl, 1999) and a multiple aliquot additive dose protocol (MAAD) were then applied to the fine-grained quartz for D_e comparison. In conjunction, we also measured yellow emissions of the polymineral using IR stimulation to determine the plagioclase feldspar equivalent dose.

On the poster we compare the various datasets of feldspar/quartz from different protocols (SAR/SARA/MAAD) for blue/IR stimulation and for different detection wavelength bands. The equivalent doses, even for the same mineral fraction, scatter wildly by more than two times, leaving us somewhat puzzled. On the poster we attempt an interpretation of what the real age might be and why most established OSL techniques failed.

Reference

Murray, A., Mejdahl, V., 1991: Comparison of regenerative-dose single-aliquot and multiple-aliquot (SARA) protocols using heated quartz from archaeological sites. Quaternary Chronology 18

Preusser, F., Raseyer, K., Schluchter, C., 2006: Characterisation of low OSL intensity quartz from the New Zealand Alps. Radiation Measurements

Recovering laboratory doses using fine-grained quartz from Chinese loess

X.L. Wang[1,*], A.G. Wintle[2,3], J.H. Du[1], S.G. Kang[1], Y.C. Lu[1]

[1] SKLLQG, Institute of Earth Environment, Chinese Academy of Sciences, Xi'An 710075, China
[2] Institute of Geography and Earth Sciences, Aberystwyth University, Aberystwyth SY23 3DB, UK
[3] McDonald Institute for Archaeological Research, University of Cambridge, Downing Street, Cambridge CB2 3ER, UK

** Corresponding author: wxl@loess.llqg.ac.cn*

Here we report the results of dose recovery experiments carried out on fine-grained quartz from a Holocene sample in Chinese loess. Optical bleaching prior to giving a 9.35 Gy dose in the laboratory was carried out using artificial light sources, namely blue light emitting diodes (LEDs) and a solar simulator. Stimulating the quartz with blue LEDs at room temperature resulted in overestimation of the recovered dose, whereas using the same stimulation time at temperatures above 150°C resulted in the correct value for the recovered dose. Exposure to the solar simulator for times less than 200 min resulted in overestimation of the dose, whereas progressive underestimation was found for longer bleaching times. When doses of up 5333 Gy were given ahead of a 200 minute exposure to the solar simulator, the dose recovered depended upon the magnitude of the previous dose, thus questioning the general application of a simple dose recovery experiment.

Keywords: OSL, quartz, SAR, loess, optical bleaching

Study on extending measurement range of the TL reader

Y. Wang*, H. Li, D. Liu, X. Ma, C. Zhou, T. Sun, J. Zhao

Solid Dosimetric Detector and Method Laboratory,P.O.Box 1044 EXT.200,Beijing 102205, PR.China.,

** Corresponding author: wy2576@sina.com*

The TL measurement technology has been used in geological samples and artifacts of ancient ceramics dating with its high sensitivity, measurement accuracy, convenience and practical advantages. Compared with OSL, the main drawback for TL is that its information can not be repeated readings. It may cause loss of data on the consequences if the equipment failures or the signal is over-range when the TL reader is measuring. As a result the TL reader must be very high reliability, and the TL measurement range of the requirement is more widely as possible.

In this paper, the methods of how to extend the TL reader range limit, and how to avoid loss of high-dose sample information are studied. The methods have been used in the newly developed type RGD-6 TL reader on the experimental verification. The results show that the instrument's linear range is up to 7 orders of magnitude. When the sample being measured is over the range of the TL reader, the reader will automatically stop measuring to avoid loss of information, and give tips for users to change optical filter to continue measuring by computer programs. If a suitable neutral optical filter is used, the linear range can be extended to 10 orders of magnitude.

Keywords: TL reader Extending measurement range

Thermoluminescence dating of quaternary sediments from Llha (Island) do Mel in southeastern coast of Brazil

S. Watanabe[1,*], R.J. Angulo[2], M.S. Souza[2], N.F. Cano[1]

[1]Insitute of Physics, University of São Paulo, São Paulo, Brazil
[2]Department of Geology, Federal University of Paraná, Curitiba, Brazil

* *Corresponding author: etoledo@dfn.if.usp.br*

12 samples of sediments (non-superficial) from Ilha do Mel have been collected and dated by thermoluminescence method. As received samples presented somewhat overestimated ages compared to the expected geological ages. This is due to residual TL after exposure of sediments to sunlight. We carried out TL residual measurements of 12 samples submitted to UV light from calibrated 60 W Hg lamp and of three samples to sunlight. The correction due to TL residual yielded geologically acceptable ages. On the other hand sunlight and Hg lamp UV light produced quite different effect due to the fact that main UV lines have different spectra in Hg lamp and sun light, for example the most energetic line around 220 nm in much stronger in Hg lamp spectrum than in sunlight spectrum.

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The OSL Age inversion of sand-bed braided river deposits in the Toruń Basin (Poland)

P. Weckwerth[1,*], K. R. Przegiętka[2], A. Chruścińska[2]

[1]Institute of Geography, Nicolaus Copernicus University, Toruń, Poland. pweck@umk.pl
[2]Institute of Physics, Nicolaus Copernicus University, Toruń, Poland.

** Corresponding author: pweck@umk.pl*

The main aim of this paper is to study the relation between sedimentary features of channel and overbank deposits of sand-bed braided rivers and the quality of the OSL dating results. The direct reason for undertaking these studies was the OSL age inversion discovered for the sequence of sandy fluvial series exposed at the Nowe Dąbie and Łochowo sites (the western part of the Toruń Basin). The fluvial series in the Toruń Basin fill up buried valleys and, In many cases, contact much younger river deposits building the terraces. No dating would mean difficulties with their identification. On the other hand, one of the main problems of the luminescence dating of geological deposits concerns the completeness of reset of accumulated luminescence signal at the moment which is subjected to the dating. However, the effectiveness of such optical bleaching is controlled by many conditions, which strongly depend on the environment of both transport and sedimentation.

Fluvial sand samples for the OSL dating were collected from the sites at Nowe Dąbie and Łochowo. The reconstruction of the fluvial processes included the genetic classification of the analysed deposits by delimiting sedimentological units which are characteristic for the environments of fluvial deposition. The OSL ages were evaluated for the sand samples representing various regimes of fluvial sedimentation. In the laboratory the coarse quartz grains were extracted from the sediment samples by sieving, flotation method and etching. The OSL measurements were carried out with the help of the Risø TL/OSL reader. Equivalent doses (*ED*) were estimated by the SAR OSL technique. The purity of samples (absence of feldspar contaminations) was checked for each aliquot by routine IR OSL tests at the end of the measurements. The annual dose rates (DR), comprised of beta and gamma radiation, were calculated on the base of gamma spectra measured in the laboratory with the help of Canberra System 100 spectrometer equipped with HPGe detector.

The results of the OSL dating are analysed with regard to sedimentary features of investigated sand samples and estimated conditions of optical bleaching taking place during transport and sedimentation. It was found out that some of the dated sediments were much older than expected. The *R* factor serves as a measurement of the *ED* overestimation. Moreover, it seems that using the *R* factor for correction of dating results almost abolishes the OSL age inversion.

It is commonly expected that ripple cross-laminated fine-grained sands (Sr) are of the best choice for the OSL dating. From the results of our investigation it infers however, that it may not be the general rule. Beside the structure of sediments, the type of fluvial subenvironment and the mode of transportation has to be taken into account.

Yet another factor which influences the possibility of the OSL age inversion is the overlapping of the fluvial erosive and accumulative processes being active at different times as a result of the younger river channel cutting into the older fluvial deposits (the Łochowo site). This refers to the situation when the redeposition process took place quickly in a deep (younger) river channel. As it was filled up with the deposits coming from the bottom erosion of the older river deposits there may be no clear lithological border and the OSL dating would show age inversion.

Keywords: OSL age inversion, Toruń Basin, sand-bed braided river

Investigating signal evolution: a comparison of red and blue signals emitted by the same quartz sample

K. Westaway[1*], J .Prescott[2]

[1]Department of Environment and Geography, Faculty of Science, Macquarie University, NSW 2109, Australia, (kira.westaway@mq.edu.au)
[2]School of Chemistry and Physics, University of Adelaide , SA 5005, Australia.

* *Corresponding author: kira.westaway@mq.edu.au*

Certain samples from specific geological settings emit strong blue and red luminescence signals. These samples are rare but provide a unique opportunity to investigate the evolution of luminescence emissions by comparing their origin, signal strength and the equivalent dose derived by certain techniques. Such unique samples have been collected from Puritjarra rockshelter, in the Northern Territory, Australia (PJ/ES/75), Atumbua basin, Northern Timor, Indonesia (TOSL1-4) and Tam Paling Cave in Luang Prabang, in Northern Laos (LS-TPL1-3).

In the last LED Proceedings, I compared the results of red vs blue emissions from a range of samples, which I then divided into 3 groupings. Group 1 quartz emitted only red emissions, Group 3 quartz emitted red and a thermally unstable blue, while Group 3 quartz emitted a strong blue and red signal. Therefore, in this talk I will be concentrating on Group 2 quartz as it displays characteritics that provide the most useful clues as to the mechanics of signal evolution.

The blue emissions are measured using a standard blue PM – while the red emissions are measured used a specialised red TL setup encorporating a Electron tubes LCT50 cooling tower (maintaining a standard -22°C) and red sensitive PM with an internal halogen bleaching system. The signals were compared according to the strength and shape of the emissions, their response to dose and recovered dose and the resulting palaeodose derived from SAR SG for the blue and DAP red TL for the red emissions. The potential of comparing blue and red palaeodeoses as an alternative measure of accuracy has also been explored. This is especially relevant for samples from certain depositional contexts where the use of independent age estimates is not possible. In addtion, SG red and blue measurements were conducted on the same grain of dosed quartz. The resulting comparisons have been used to address certain key issues relating to signal evolution, such as where do the signals come from? In what geological setting do dual signals of similar strength develop? Are dual signals common amongst geological samples? Are the different signals emitted by different or the same grains? This type of comparative analysis provides clues as to the source and evolution of the signals, a greater understanding of the complexities of the luminescence signal and a possible solution for accuracy testing in challenging depositional contexts.

Test of different protocols using the 210°C TL peak in quartz

C. Woda*, I. Fiedler

Helmholtz Zentrum München, Institute of Radiation Protection, Neuherberg, Germany,

** Corresponding author: clemens.woda@helmholtz-muenchen.de*

Quartz is an excellent natural dosemeter that has been extensively used in luminescence dating of sediments and retrospective dosimetry using building materials such as bricks and tiles. The successful development of the single-aliquot-regeneration (SAR) protocol in OSL has enabled a significant increase in robustness, precision and accuracy of the dose assessment in the last decade. In TL, it is well known that repeated heating to high temperature induces large and usually irreversible sensitivity changes, generally impeding the application of a SAR protocol. For the lower temperature 210°C TL peak in quartz however an equally powerful SAR protocol for TL could be developed by terminating the glow curve at 280°C and using only a limited amount of regeneration points, thus generally avoiding significant sensitivity changes. The 210°C TL peak has then successfully been used for dating 200–500 years old bricks and terrazzo from locations in England and Germany and for dose measurement in the contaminated areas of the Techa River valley, Southern Urals, Russia. As can be expected for a natural material like quartz, the degree of sensitization of the 210°C TL peak varies between samples and is generally dependent on dose. We have encountered a number of brick samples, where sensitization is no longer negligible and dose-recovery tests revealed a significant dose underestimation, when applying the SAR protocol in its simple, original form. It has been suggested to resort to the multiple aliquot additive dose protocol (MAAD) in such a case, but this would be at the expense of the achievable precision and robustness of the dose method. We thus investigated the applicability of two extensions of the SAR protocol for such kind of samples: SAR protocol with glow curve termination at 280°C and subsequent test dose normalization, analogue to OSL, and a SAR protocol using an isothermal readout of TL at 190°C, with and without test dose normalization. The accuracy and precision of the measurement protocols and the effect of the size of the test dose compared to the measured dose were evaluated using dose-recovery tests and comparative OSL measurements on the same samples. Results will be presented and implications for dating young bricks and for retrospective dosimetry will be discussed.

TL dating of ancient Chinese celadon porcelains of Yue Kiln

J. Xia*, J. Wu

Laboratory of Conservation and Science of Archaeology, Shanghai Museum, Jundingxia@hotmail.com, bluebaby1017@hotmail.com

** Corresponding author: Jundingxia@hotmail.com*

The Yue Kiln Sites produced celadon porcelain around the Shanglin Lake area during the Eastern Han, Tang, Five dynasties and Song dynasties. A variety of different Big textwares were manufactured during the kilns' history. Its production scale, technological level, product quality occupied first place in every large famous kiln. Yue kiln celadon not only tributed imperial court but also offered ordinary people. It was sold to more than 20 countries and regions. The production technology of Yue kiln celadon ware exerted an extensive and far-reaching influence to kilns in China, Korea, Japan, and even the whole world. Due to the high value of Yue celadons, more and more fake celadon porcelains appeared in the market. In order to date Yue porcelains more accurately by TL method, we collect over 200 samples from 6 sites and put TLD dosimeters in sites. TAC tests were run. Annual dose were measured. Two different pre-dose techniques were compared in dating Yue porcelains. Sixty porcelain samples from six sites of Cixi Shang Linhu Area, including Gou Jingshan, Di Lingtou,Kai Daoshan, Wa Pianya, Da Lukou and Si Longkou, whose history can be dated to Tang, Five Dynasties and Northern Song, have been tested their Thermal Activation Characteristic (TAC). The result shows the TL sensitivity of Yue Kiln porcelain is highly outstanding and their TAC and activation temperature present consistence. The highest thermal activation temperature is 700℃; the lowest is 640℃ and the average value is 658.3℃. In measuring the paleo-dose and age of Yue Kiln porcelains from Shang Linhu, Ci xi Area with Pre-dose Technique, adopting the proper and right activation temperature ensures the veracity and reliability of the estimated age. Then in order to choose the proper pre-dose technique for dating Yue kiln, the study dated 97 porcelain samples of the Tang Dynasty, Five dynasties,Song Dynasty, Yuan Dynasty, Ming Dynasty, Qing Dynasty, the Republic of China and Modern Age of different kilns including Yue with 2 different pre-dose techniques: quenching effect and activation effect. The result indicated that it is more accurate to date the porcelains of the late Qing Dynasty, the Republic of China and Modern Age with activation effect in pre-dose method than with the quenching effect. The ages of porcelains of Middle and Early Qing Dynasty and late Ming Dynast obtained by two methods are similar. However, it is more reliable to date the porcelains of Middle and Early Ming Dynasty, Yuan Dynasty, Song Dynasty, Five Dynasties, Tang Dynasty and earlier ages with the quenching effect in pre-dose method, as activation effect in pre-dose method is not suitable in dating those porcelains of rather early ages. Therefore, it is of crucial importance to date porcelains of Yue kiln with the quenching effect in pre-dose TL technique. Annual dose of 10 samples were measured and calculated of every sites, and the average annual dose were obtained. It is more accurate to use the average annual dose value than the typical annual dose value of porcelains of all ages and kilns when dating Yue porcelains which requires minimum sampling damage in the future. At the end of the research, to test how our TL dating method works for Yue kiln porcelains, 30 Yue kiln porcelains of Eastern Han, Tang, Five Dynasties and Northern Song with archaeological age already known were dated, and ideal result of application was gained.

An Approach to Luminescence Thermochrometer Applied on Quartz from Different Rock Types

T.-S. Wu[1*], J.-A. Kunz[1], J.. K. Manoj[2], Y.-G. Chen[1]

[1]. Dept. of Geosciences, National Taiwan Univ., Taiwan, R.O.C. (b90204026@ntu.edu.tw)
[2]. Dept. of Earth Sciences, Indian Institute of Science Education and Research-Kolkata, India.

** Corresponding author:* b90204026@ntu.edu.tw

Taiwan is an active and dynamic mountain belt providing a natural laboratory to understand the various mountain building activities. Thermal ages (e.g. Fission track and U-Th/He ages) are of great importance towards the understanding of the mountain building activities within the upper crust. In order to get the chronology of very recent events (as young as few thousand years), researchers explores the possibilities of having thermal ages of very low temperature resetting events in geological history, presumably could not be done using conventional methods of thermal ages. In order to understand the late quaternary uplift history of Taiwan, which involve the chronology of low temperature resetting events researchers have been looking for the applicability of luminescence dating methods from fairly low cooling temperature. Since the reliability of luminescence dating method is sample dependent, this study starts with checking signal intensity and relevant characteristics of luminescence from appropriate minerals (e.g. quartz). The samples for this study were collected from two rock types – (i) cherty-marble and (ii) meta-sandstone at various altitudes across the Central Range of Taiwan. This strategy is aimed to get the rock dependent variation since presumably the cherty-marble had not undergone the stress as high as the meta-sandstone. We analyze and compare luminescence behaviors of Quartz from these two rock types. The equivalent doses are determined by Single Aliquot Regenerative-dose (SAR) protocol and Iso-thermal Thermoluminescence (ITL) SAR protocol. Preheat plateau test for quartz from meta-sandstone does not show a plateau, suggesting varying stability of traps for studied temperature range; however, it does not rule out the applicability of applying ITL-SAR for a particular temperature. ITL SAR protocol is applied successfully on the samples for such an approach. Although our current results of ITL seem promising, further and detailed luminescence characteristics of ITL should be examined before the feasibility is finally proposed.

Keywords: Taiwan, quartz, thermochronology, ITL-SAR, luminescence dating.

OSL chronology of loess deposits of Tuoji Island in China and its palaeoclimatic implications

S. Xu*

Shandong Provincial Key Laboratory of Soil Conservation and Environmental Protection, Linyi University, Linyi, P. R. China.

** Corresponding author: xushujian1967@163.com*

The loess deposits in China are the most important terrestrial records of the Quaternary climate. Detailed analysis of the depositional characteristics of Chinese loess is required to determine the nature of the paleoclimate record preserved in these extensive sediments. Loess and paleosol sequences are well developed in the Miaodao Islands, in the eastern of Shandong Province, eastern China. Despite decades of research, the optically stimulated luminescence (OSL) chronology of the loess in Miaodao Islands is poorly constrained. In this study samples from the loess–paleosol sequence in the Houhou Section of Tuoji Island were dated by OSL of fine-grained quartz using a Simplified Multiple Aliquot Regenerative dose protocol (SMAR). The preliminary OSL dating results show that the equivalent doses (D_E) of the two samples from the depth 100 cm and 660 cm are 103±2 Gy and 299±10 Gy, and the dates are 20.7±0.3 ka and 64±2 ka, respectively. 220 grain-size samples were also analyzed by Malvern Mastersizer 2000. The grain size data show that average median grain size (Md) is 38.01 μm, and the percentage of sand, silt and clay are 28.30%, 61.19% and 10.51%. On the basis of the OSL dates and related stratigraphic evidence it is proposed that Houkou loess section recorded the variations of paleo-environmental evolution and sea level changes during the late Quaternary.

Keywords: OSL dating; Simplified Multiple Aliquot Regenerative dose protocol (SMAR); Chinese loess; Palaeolimatic change.

Temporal change of the sources of aeolian dust delivered to East Asia revealed by electron spin resonance signals in quartz

Y. Yamamoto[1*], S. Toyoda[1], K. Nagashima[2], Y. Isozaki[3], R. Tada[3], Y. Igarashi[4]

[1]Okayama University of Science(s10rd04yy@std.ous.ac.jp)
[2]JAMSTEC
[3] The University of Tokyo
[4]Metrological Research Institute Japan

** Corresponding author: s10rd04yy@std.ous.ac.jp*

Change of atmospheric circulation system in the past is an important issue for studies of paleoclimate. Aeolian dust, fine particle suspended in air and brought by wind, is a clue to know the wind direction and the strength in the past. Historical record of aeolian dust accumulation in Japan will give important information on this issue as well as on the climate change in the arid source regions in China. Various features, such as grain size distribution, mineral compositions, and isotope compositions, have been investigated for loess sequence for this purpose. In the present study, we would like to propose that ESR signals in quartz are other good proxies as well.

We observe the signals of the E_1' center, an unpaired electron trapped at an oxygen vacancy, the Al hole center, an electronic hole at aluminum impurity atom replacing a silicon, the Ti centers, and the Ge center. It was shown previously that, by measuring the number of oxygen vacancies, the precursor of the E_1' center, in loess sequence, the aeolian dust source in Holocene was different from that in LGM (Toyoda and Naruse, 2002). Later, the crystallinity index was found to be another proxy for such studies. Temporal change of the origins of the eolian dust accumulated in the Sea of Japan was found to be correlated with the climate change by using these proxies (Nagashima et al., 2007).

The dust samples taken at meteorological observatories in Japan since 1960's were examined by the same method. It was found that finer grain fractions contain more dust component of Chinese origin than coarser fractions and that the ratio of the Chinese component varies year to year.

The number tends to decrease with time (1964-1990) with some variation from 9 to 1.5 (1.3×10^{15} spins/g) in June and from 3 to 1.8 in March. The number in June is higher than the one in March in the 1960s while it is opposite in the 1970s. The decrease of the number of oxygen vacancies can be due to change in sources of dust in China.

Keyword Eolian Dust, Oxygen vacancies, Impurity Center in quartz

Optical dating of paleoearthquakes along the Ms7.3 1985 Wuqia earthquake surface ruptures at the northern margin of the Pamir syntaxis

H. Yang*, J. Chen, W. Li, W. Xiao

State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China, email:

* *Corresponding author: yanghuili07@mails.gucas.ac.cn*

The August 23, 1985 Wuqia Earthquake (Ms7.3) ruptured the east segment of the seismically active Pamir Front Thrust at the leading northern edge of the west syntaxis of the Tibetan Plateau, produced a 15-km-long surface rupture (Feng et al., 1988; 1994), and destroyed the old Wuqia town. Data on the recurrence period of such devastating earthquakes is a vital input for seismic hazard evaluation and risk assessment in this region.

Two trenches has been excavated for paleoseismologic study, across a 1.5 m high monocline scarp formed in 1985 mainshock but did not appeared at airphotos taken before the earthquake. The trenches exposed sediments are dominated by poorly sorted, sandy muddy matrix supported pebbles, interbedded with poorly sorted sandy clay or muddy sand bearing with gravels, which are interpreted as proximal alluvial fan deposits, with red clay, likely derived locally from the south limb of the Mingyaole anticline to the west of Kashgar, China. All the layers in the trenches are folded and faulted, and are north dipping with a tendency of steepening downward. Based on the onlapping structures, dip angle change, and fault cutting relation, we resolve 3 paleoearthquake events except the 1985 event. Optical dating samples collected from both sandy clay and muddy sand are being analyzed to better constrain when the these paleoearthquake events occurred and to check if the method can be applied independent of sediment type. Preliminary results of the fine-grained quartz show quite scatter and out of sequence, probably indicate insufficiently reset of OSL signal. Both dose distribution and‘signal analysis’ methods on different grain size fractions are being used to detect partial bleaching.

Luminescence dating of aeolian stratigraphy revealing historical desertification: A preliminary study of the Horqin dunefield, northern China

L.H. Yang [1,2,*] , T. Wang [1], Z.P. Lai [2]

[1]Key Laboratory of Desert and Desertification, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou 730000, China
[2] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China

** Corresponding author: ylh@ieecas.cn*

Desertification is the result of complex interactions among various factors, including climate change and human activity. The causes of the historical desertification of the Horqin dunefield in northern China are still being disputed. Through the analysis of stratigraphic evidences, climate change records and human activity records, this paper tries to explore the relative roles of climate change and human activity in the historical desertification of Horqin dunefield. According to 11 OSL ages determined by the SAR protocol and SGC method and the stratigraphy of two aeolian sand-sandy soil sections, two phases of desertification during the last two millennia were identified, one occurred during the Jin dynasty (around 1200 AD) and another during the Qing Dynasty (around1800 AD). This result is consistent with previous research of historical desertification in this region interpreted from historical documents. Further investigation of the cause of each phase of desertification demonstrates that the former one is the result of combined impact from extensive land reclamation started from Liao Dynasty and subsequent arid-warm climate in Jin Dynasty. However, the latter one, which occurred in the wet-cool Qing Dynasty, can be attributed solely to the second extensive land reclamation. Moreover, it is worth noting that the two phases of desertification all happened shortly after the main land use type in the Horqin dunefield has changed.

Keywords: OSL dating; desertification; Horqin dunefield; historical period

Exploration on provenance implication from TL glow curve of detrital zircon, related to U-Pb age

L. Yang[1*],L. Yue [1]

[1] State Key Laboratory of Continental Dynamics, Northwest University. Xi'an, 710069, China,

** Corresponding author: lryang@163.com*

Inspired by the age-dependence on luminescence signal of granite quartz worked by Han Zhiyong, et al. in 1997, who concluded that some characteristic luminescence signals showed relevance with crystallization age by U-Pb dating, it is inferred more forward in this study that if there are some possibility that provenance implication cound be found from luminescence signal of detrital minerals by means of relating to the their crystallization age. As is well known, detrital sediments derive from multi-sources,i.e. surrounding different tectonic block. So provenance study of a specific sediment provide significant clue for tectonic and environmental evolution. Traditionally, the chemical analysis have been widely applied to various minerals among it to trace the souces. In term of that zircon is highly refractory at Earth's surface, it occurs in virtually all sedimentary deposits. The acquirement of single grain U-Pb age has been revolutionized with the development of situ LA-ICPMS, which permit rapid analysis of many grains at specific circle so that large data sets useful in provenance analysis can be evaluated. If luminescence signal of single zircon grain can be related to U-Pb age successfully, it will be concuded that luminescence signal of zircon also include provenance information.

In this study, the age-dependence on luminescence signal of detrital zircon is explored. Three samples are from desert sand, gobi sand and river-bed sand respectively, in Mu Us Desert which is located at middle part of east-west desert belt in Northern China. About 100 grains from 50-300μm for each sample are mesured in the order of thermal luminescence(TL) and then LA-ICPMS one grain by one grain as group. The grains were annealed at ~500°C, then irradiated with β-rays from a ^{90}Sr-^{90}Y source irradiator with total dose of 60Gy. Glow curves were measured using 10mm stainless steel cup with one grain mounted on at a linear heating rate of 3°C /s to 500°C. Each grain was read out twice. The second readout was considered to be the background of the reader and sample.

The measured zircon TL glow curve (GC) can be divided into four types: one peak at low temperature(100-200°C), one peak at high temperature(300-400°C), two band at both low and high temperature, and no signal. Althought the result show that the ralation of TL glow curve with U-Pb age is not so linear that some of the young (hundreds of Ma.)and the old (thousands of Ma.) grains have similar GC, within an equivalent age span, some of the grains have similar GC, the others are different from them. In fact, the grains with same age may derive from either craton basement or ancient sandstone,or both, which cause these grains experienced different transportation processes. It is assumed that the same age grains with same GC have similar transportation history, which need more chemical data to prove. In terms of TL intensity, the grains with no signal of gobi, river-bed and desert sand amount to 92%, 44% and 35%, those with strong signal either at low and high temperature amount to 6%,33% and 60%. The transportation distance of gobi sand is relatively shorter compared to river-bed sand and desert sand. The latter experience much more sun light exposure. So more transportation distance and sun light exposure may activate luminescence center.

Keywords: zircon, TL glow curve, U-Pb age, provenance

Use the SAR TT-OSL method dating the Loess deposition in Horqin sand field (northeastern China)

S. Yi[1*], H. Lu[1,] T. Stevens[2]

[1] School of Geographical and Oceanographical Sciences, Nanjing University, Nanjing 210093, China;
[2] Centre for Quaternary Research, Department of Geography, Royal Holloway, University of London, Egham, Surrey, TW20 0EX, UK;

** Corresponding author: ysw7563@nju.edu.cn*

Horqin sand field, one of the most serious desertification areas in northern China. Paleoclimatic change in this region during the late Quaternary remains poorly understood, partly because of the scarcity of high quality age controls, especially lacking of an appropriate dating method for obtain age controls about the old loess depositions. In this work, a new SAR TT-OSL method, which is a promising method to dating old aeolian depositions (Stevens et al.,2009), has been used to obtain ages of the typical loess profiles (Kulungou and Pingancun). It showed that this method is suitable for dating our study sections and loess in Horqin sand field started to deposit at least since middle Pleistocene. During 300-230Ka, Sandy field maybe has undergone at least one process of desertification in geological period and this aridification event maybe is a common feature for the drylands in northern China.

Keywords: SAR TT-OSL method, the late Quaternary, Horqin sand field, loess disposition

The ESR signal characteristics of fault gouge from Wenchuan M_S 8.0 Earthquake

G. Yin[1*], C. Liu[1], Y. Zhou[1] , F. Han[1,2], L. Gao[1], J. Li[1]

[1] State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China (yingongming@sina.com)
[2] Departement de Prehistoire Muséum National d'Histoire Naturelle 1, rue René Panhard 75013, Paris, France

** Corresponding author: yingongming@sina.com*

On 12 May 2008, the devastating magnitude 8.0 (Wenchuan) earthquake struck the Longmen Shan mountain range, Sichuan Province in China. The earthquake co-seismic surface rupture extends about 300 km. The slip surfaces were observed and develop fault gouges in some locations. In this paper, we analyzed the mineral compositions and micro structural characteristics of the gouge from the co-seismic surface rupture zone. The study shows that the mineral compositions of the gouge are related to the mother rocks. The ESR signals of the gouge were not reset to zero, and still have a large residual value.

Keywords: Wenchuan Earthquake, fault gouge, ESR signal, co-seismic surface rupture

Coarse and Fine-Grained Quartz OSL Dating of Loess Deposit in Northern Tien Shan

J. Youn[1,2*], J.-H. Choi[1], Y.B. Seong[2]

[1] Division of Earth and Environmental Science, Korea Basic Science Institute, Ochang Centre, Chungbuk 363-883, South Korea (jhchoi@kbsi.re.kr)
[2] Department of Geography Education, Korea University, Seoul 136-701, South Korea (yjhee0218@kbsi.re.kr)

** Corresponding author: yjhee0218@kbsi.re.kr*

In the northern slope of Kyrgyz Range, the northernmost range of the Kyrgyz Tien Shan, a series of Neogene sediments, topped by the massive fine sediments with up to several tens of meters in thickness, are well observed. These sediments, being dominantly composed of fine-silt sized grains and with other field observations, have been identified as aeolian deposits, and interpreted as having formed by gravity wind descending from glaciated, high mountain during dry and windy glaciation period. For better understanding of the glaciation and deglaciation cycles and to reconstruct the history of palaeoclimate changes of this region during Late Pleistocene, it is essential to establish a chronological framework of these sediments. Thus, in this study, we perform OSL dating of sediments collected from a representative portion (~1500 m a.m.s.l) of the fine-silt sized loess profile capping fluvial deposit with cross-bedded sandy and imbricated conglomerate deposits in northern Kyrgyz Range. The loess profile, where the samples were taken, appears to preserve some well developed carbonate-rich palaeosol layers. Of a total of 24 samples collected, we selected 10 samples for detailed quartz luminescence investigation and dating. As was expected in the field, the samples are dominantly fine-silt sized (~ 98 % wt %), and the remaining ~ < 2 % fine sand sized. Thus, in this paper, OSL properties in both fine (4-11 μm) and coarse (90-250 μm) grained quartz and OSL ages of them are examined and compared with each other. Both fine and coarse quartz grains from the studied samples are all mainly composed of fast decaying OSL component, and based on several performance tests, both fine and coarse quartz grains are considered to be suitable for dating using usual single-aliquot regenerative-dose protocol. However, D_e values of fine quartz grains recovered from loess deposits (thus, the OSL age estimates) are observed to be, in most cases, at least twice as high as those of the coarse grain extracts. The difference in D_e values between fine and coarse quartz grains may help us distinguish the final depositional processes of the fine sediments initially drifted by wind in northern Kyrgyz Range.

Keywords: Kyrgyz Range, Tien Shan, Loess, OSL dating, palaeoclimate change

OSL dating of the Last Glacial sediments from Dangzi valley in the eastern Qinghai-Tibetan Plateau

B. Zhang[1,3], Z.P. Lai[1*], X.J. Ou[1,2]

[1.] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China (*Email: zplai@isl.ac.cn)
[2.] School of Geography and Tourism, Jiaying University, Meizhou 514015, China
[3]. Graduate School of Chinese Academy of Sciences, Beijing 100049, China

* *Corresponding author: zplai@isl.ac.cn*

Mountain glaciers are highly sensitive to temperature and precipitation fluctuations and, thus, the deposits of glacier growth and retreat constrain climatic variables. Dangzi valley, located on the northern slope of Queer Shan Mountain, eastern Qinghai-Tibetan Plateau, and influenced by Indian monsoon, has preserved four integrated sets of moraines and associated glacial sediments and one set of periglacial loess. The numerical ages are scarce in this area, even though the moraines have been investigated for decades. In this study, dating of the glacial tills, glaciofluvial deposits and periglacial loess was undertaken using quartz optically stimulated luminescence (OSL). The 38-63 μm grains were extracted and the equivalent dose (D_e) was measured using single aliquot regenerative-dose (SAR) protocol (OSL and Post-IR OSL). The effect of thermal transfer is small for all samples and the recycling ratio for each individual sample is close to unity. OSL ages show good agreement with previous studies of geomorphological and field investigations. Nevertheless, one of the moraine ages violates the stratigraphy, overestimated for several thousand years probably due to partial bleaching. It is suggested that glacial and associated sediments in this region are promising for OSL dating. The OSL results show that glacier advanced at MIS 3, LGM and Late Glacial, with decreasing extents. Multiple small moraines of the three LGM moraine sets indicate multiple rapid glacial fluctuations during this time interval. And Dangzi Cuo Lake was dammed by the terminal moraine, which was formed by glacial advance responding to Heinrich 1 cooling. We suggest that glaciers advances in this region were thermally controlled during the Last Glacial.

Keywords: OSL dating; Glacial sediments; Dangzi valley; Qinghai-Tibetan Plateau; Palaeoenvironmental change.

Optically stimulated luminescence and radiocarbon dating of sediments from Lop Nur (Lop Nor), China

J.-F. Zhang[1*], C.-L. Liu[2], X. Hong[3], K.-X. Liu[4], L.-P. Zhou[1]

[1]MOE Laboratory for Earth Surface Processes, College of Urban and Environmental Sciences, Peking University, Beijing 100871, China. (*Corresponding author: jfzhang@pku.edu.cn)
[2]Institute of Mineral Resources, Chinese Academy of Geological Sciences, 26 Baiwanzhuang Road, Beijing 100037, China
[3]School of Archaeology and Museology, Peking University, Beijing 100871, China
[4] School of Physics, Peking University, Beijing 100871, China

** Corresponding author: jfzhang@pku.edu.cn*

Lop Nur (Lop Nor) is a playa lake located on the eastern part of the Tarim Basin (filled with the Taklimakan Desert) to the north of the Tibetan Plateau in northwestern China. The Lop Nur is the lowest part of the basin and thus become the terminus of large rivers in the basin. The well-known ruins of Loulan, a vanished oasis town on the Silk Road connecting China to Europe, are located on the northwest edge of the Lop Nur. The environmental evolution of this region has attracted the attention of many geographers and geomorphologists. However, further investigation has been hampered by the absence of reliable terrestrial macrofossils from the lake sediments for radiocarbon dating. In this study, optically stimulated luminescence (OSL) and radiocarbon techniques were used to date the sediments from a pit section (~5.5 m depth) dug for the paleoenvironmental investigation of the lake. For OSL dating, fine-grained quartz extracted from lake sediment samples were used for equivalent dose measurement using the single-aliquot regenerative-doe (SAR) protocol. AMS radiocarbon dating of bulk sediment samples were performed on total organic matter extracted with the acid-alkali-acid method. The results show that the luminescence properties of the quartz extracts are suitable for dating using the SAR method. The OSL ages obtained for the ten samples range from ~0.4 ka at the depth of 0.35 m to ~10 ka at the depth of 5.68 m. These OSL ages are generally in stratigraphic order. It is noted that these samples are characterized by high dose rate up to 5 Gy/ka. The radiocarbon ages obtained for the 22 sediment samples range from 5.8±0.1 ka at the depth of 0.17 m to 30.0 ±0.3 Cal. ka BP at the depths of 3.16 m or 3.55 m. The bottom sample at the depth of 4.67 m was dated to 17.2±0.2 Cal. ka BP. These radiocarbon ages are not in strict stratigraphic order, especially for the ages of the four samples from the depths of 3.73-4.76 m. Comparison of the OSL and radiocarbon ages shows that the radiocarbon ages are much larger than the corresponding OSL ages. For example, the subsurface sample at the depth of 17 cm was radiocarbon dated to 5.8±0.1 Cal.ka BP, but the sample at the depth of 0.35 m was OSL dated to 0.4±0.1 ka. The oldest radiocarbon age of 30.0 ±0.3 Cal. ka BP is ~20 ka older than the oldest OSL age of ~10 ka. The radiocarbon ages may be overestimated due to radiocarbon reservoir effect in the lake. We argue that the OSL ages are more reliable than the radiocarbon age, and can be used to establish the chronology of the lake evolution.

Keywords: Lop Nur, Luminescence dating, Radiocarbon dating, Lake sediments.

Equivalent dose distribution of single grain quartz OSL in both a calibration quartz sample and well-bleached sedimentary samples

J.R. Zhang[1, 2], Z.P. Lai[1,*]

[1] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China (*Email: zplai@isl.ac.cn)
[2] Graduate School of Chinese Academy of Sciences, Beijing 100049, China

** Corresponding author: zplai@isl.ac.cn*

Luminescence dating is widely used to produce absolute ages for the time of deposition of a variety of types of sediments. The method relies upon the assumption that grains are well exposed to sufficient daylight prior to deposition. However, in many cases a sample could be poorly exposed. In these cases, single grain method, theoretically, has the potential to distinguish those well-bleached grains from poorly bleached ones, which is a significant advantage over the multi-grain method. However, recent published data show that there are a number of issues influencing the D_e distribution of single grain known as the intrinsic and extrinsic sources of scatter. Even for a well-bleached sedimentary sample, the single grain D_es show unexpectedly large scatter. A 'hotspot', where heterogeneously higher radioactivity exists, has been proposed to explain the data. In order to further examine the single grain D_e distribution and possible factors leading to large scatter, an ideal sample, in which all grains are completely zeroed and receive homogeneous dose, should be measured and analyzed. A calibration quartz has been annealed at >450^{o}C for >30 min and then irradiated by gamma ray for a known dose, so that all grains are homogeneous in both resetting and dosing. Thus, it can be treated as an ideal sample. In this study, three samples (collectively sand-sized quartz and with high OSL sensitivity) are measured using single grain method and SAR protocol to observe their D_e distributions. Single aliquot D_e, which is the average of all grains, was also determined for comparison. The first sample (#1) is the calibration quartz. The second (#2) was collected from sanddune sediments in Horqin Desert in northeastern China, which is completely bleached at deposition. The third (#3) was from a lake beach in Huangqihai Lake in northeastern China, and was also well-bleached. The distribution characteristics of their D_es were analyzed and compared. The primarily results suggest that even for the calibration quartz (#1), the D_es are widely distributed, though the average D_e is equal to the given dose, and that only about 20-30% of the grains have signals high enough for D_e calculation.

Keywords: Quartz OSL; Single grain; Equivalent dose distribution; Sources of scatter.

Equivalent dose determination for feldspar-contaminated quartz of moraine deposits from Daocheng Ice Cap in southeastern Tibetan Plateau

Z.G. Zhang[1], J.R. Zhang[2], X.J. Ou[3], J. Wang[1,4], Z.P. Lai[2,*]

[1]College of Geographical Sciences, Nanjing Normal University, Nanjing 210046, China
[2] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China (*Email: zplai@isl.ac.cn)
[3] School of Geography and Tourism, Jiaying University, Meizhou 514015, China
[4] College of Geographical Sciences, Key Laboratory of Virtual Geographical Environment (Ministry of Education), Nanjing Normal University, Nanjing 210046, China

* *Corresponding author*: zplai@isl.ac.cn

Chronology is critical for the reconstruction of palaeo-glacial development and climatic changes. OSL (optically stimulated luminescence) dating methods have been widely applied in dating glacial sediments from the Tibetan Plateau. Recently, ten samples were collected from seven moraines in Daocheng Ice cap in southeastern Tibetan Plateau. The ages for these moraines are assumed to fall into the last glaciation/interglaciation cycle (10-130 ka) based on the field geomorphologic observations. For these samples, it is difficult to isolate pure quartz, and the equivalent dose (D_e) determination has to use the feldspar-contaminated quartz. The SAR (single aliquot regenerative-doe) protocol was adopted for D_e determination. In this study, we try to investigate the difference between the D_es of OSL, IRSL and Post-IR OSL. For the majority of these samples, the D_es have the pattern of (post-IR OSL D_e) > (OSL D_e) > (IRSL D_e) and the discrepancy is larger for older samples, which could be explained by the increasing feldspar anomalous fading effect. However, for some other samples these D_es show just the opposite pattern. For two sample these D_es show good agreement.

Keywords: Moraine deposits; Tibetan Plateau; Luminescence dating; feldspar-contaminated quartz.

The fading factor of K-feldspar

H. Zhao*

Key Laboratory of Desert and Desertification, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Science, Lanzhou 730000, China (hzhao@lzb.ac.cn)

** Corresponding author: hzhao@lzb.ac.cn*

The fading factor of K-feldspar defined as the ratio (*f*1) of apparent K-feldspar IRSL age to the quartz OSL age was compared with which defined as the ratio (*f*2) between the intercepts of lines F, $D_f(0)$ and Q, $D_q(0)$ (Zhao and Li, 2002; Li et al., 2007). The latter (*f*2) was analyzed based on the β dose rate attenuation in sample grains, and then it could be shown as the former (*f*1) multiplier by a factor which correlates with internal and external dose rate. From this analysis, it could conclude that when only consider the β irradiation as the source of internal dose rate of K-feldspar, the both fading factors should be same. If consider extra α dose rate from U, Th concentration exist in K-feldspar gains (Zhao and Li, 2005), the *f*2 will larger than the *f*1. This analysis may give us another consideration of the assumption that the anomalous fading of IRSL does not occur when it created by the internal dose. This assumption is used to explain the experiments results of isochron age older than it should be (Li et al., 2007). This phenomenon now could be explained, at least partly, by the volume effect of α dose rate exist in K-feldspar grains. For different grain size grains, they have different U, Th content, and create different α dose rate because of different volume. These dose rate differences seems hardly to measured in laboratory, but could be estimated from the results of isochron measurements.

Newly developed type RGD-6 TL reader performance

J. Zhao*, F. Wang, Y. Wang, H. Li, H. Zhu, K. Tang, X. Ma ,D. Liu

Solid Dosimetric Detector and Method Laboratory, P.O.Box 1044 EXT. 204, Beijing 102205, PR. China.

** Corresponding author: Zhaojianxing@sohu.com*

To satisfy the increase of demand on dating the geological and the ancient ceramic artifacts, the recent development of the rotary type RGD-6 TL reader can automatically measure 60 samples at once. The main performances include:

1.The sample holding tray is made of ultra-thin stainless steel with 10 mm in diameter and 2 mm in depth. It is not only capable to directly measure the geological samples after being grinded and kept in the tray, but it can also measure other specification sheet or powder samples placed on the holding tray. RGD-6 is capable to measure many different types of TL samples with great versatility.

2.Considering that most samples are flake or granular with relatively lower thermal holding capacity, the heating plate is designed with 0.25 mm thick stainless steel (20% Ni-80% Cr) resistance band. The NiCr-NiAl (k type) thermocouple, which is spotted welding in the back of the geometric center of the heating plate, can quickly and accurately indicate the heating temperature of the sample. At the same time, it can minimize the delay of thermal transmission. The unique design of stainless steel heating plate with the shape of a finger can ensures that the samples can be quickly heated up through the sample holding tray equipped with a highly sensitive high-current controller. The heating plate temperature can be quickly increased to 700 degree C at the rate of 1 ~ 50 degree C/second with less than +/-0.5% tolerance. At the same time, it can minimize the temperature drop in other parts. It can also avoid the temperature in the operating room being gone up from continuous measurement operations. Thus, there is no temperature impact to the adjacent samples, which staying in the same room and to be measured.

3.In order to accurately measure the data from the sample with the very weak light emitted during measuring process, a sophisticated optical system is designed. To reduce the background noise, it is designed with semiconductor refrigeration technology. By using photon counting method, the effect of output signals generated from the high voltage power supply fluctuations on the photomultiplier tube can be ignored. The outcome data (especially the small doses) is much accurate and consistent. Through the successful design of a complete sealed optical measurement system, it can prevent various external light sources scattering into system through, such as, the entrance of placing the samples, the entrance of filter plate, the entering point for nitrogen, etc. With such design, the detection threshold and the whole system can achieve a high sensitivity on measurement with lower error.

4.By setting proper parameters (including the time of radiation and the number of irradiated samples) on the equipment and placing corresponding ^{90}Sr-^{90}Y â sources above the sample entrance, each sample can be irradiated with pre-dose. It is very convenient to calibrate the sensitivity and conduct repeated tests for dating the geological samples and other material. The results showed that the impact of irradiation to adjacent samples was only at 0.011% (the impacts to the samples located in other locations can be neglected.)

The conclusion is that RGD-6 type TL reader is not only equipped with the features of the precise temperature control of the Manual-type general instrument, but also designed with highly efficient and automatically continuous testing functions. It is a practical equipment to be used for dating the geological samples and the ancient ceramics.

Keywords: TL reader, Performance

Luminescence chronology of tills and its implications for glacial landform evolution in the Bogda Peak area, Tianshan range, China

J.D. Zhao[1], Z.P.Lai[2,*], S.Y. Liu[1], Z.Q. Li [1,3] , H.L. Jiang[3]

[1] State Key laboratory of Cryospheric Sciences, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, 730000, China
[2] Luminescence Dating Group, Key Laboratory of Salt Lake Resources and Chemistry, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining 810008, China
(*Email: zplai@isl.ac.cn)
[3] College of Geography and Environmental Science, Northwest Normal University, Lanzhou 730070, China

* *Corresponding author:* zplai@isl.ac.cn

The Bogda Peak area is one of the largest centers of modern glaciation in the eastern segment of the Tianshan ranges in the Xinjiang Uigur Autonomous Region. The glaciers are critical water resources for the development of the society and economy in this semi-arid and densely-populated area. The change of these glaciers has attracted the attention of both scientists and policy-makers. Projects have been established recently for these purposes. In the Bogda Peak area, the glacial landforms and associated sediments are well-preserved in the valleys, indicating multiple Quaternary glaciations in this region. Chronology of these landforms allows the temporal and spatial variations of the palaeoglaciers and glacial landform evolution to be understood. In this study, Optically stimulated luminescence (OSL) dating techniques was applied to determine the glacial tills and associated sediments using single aliquot regenerative-dose (SAR) protocol. A total of twelve samples were collected from moraines and two samples collected from glaciofluvial deposits. The dating results show good agreement with geological setting and field investigations. Based on the dates and the principles of geomorphology and stratigraphy, we proposed that the first, the second and the third sets of moraines were deposited during Little Ice Age (LIA), Neoglaciation and the late period of last glacial respectively. Furthermore, the fourth set of moraines could be assigned to penultimate glacaiton that are equivalent in age to marine oxygen isotope stages (MIS) 6 on the basis of the independent electron spin resonance (ESR) ages.
Keywords: OSL dating; Glacial landform; Bogda Peak area; Tianshan range

Luminescence ages for the onset of last glacial dust accumulation across loess regions in China

L. Zhou*, J. Qin

Laboratory for Earth Surface Processes, Department of Geography, Peking University, Beijing 100871, China (*lpzhou@pku.edu.cn*)

** Corresponding author: lpzhou@pku.edu.cn*

In order to improve our understanding on the role of mineral dust in past climate change, great effort has been made to determine the accurate timing of the loess accumulation during the glacial periods throughout the Quaternary. Luminescence dating method is one of the few methods that can be applied to date loess deposition directly, its applications can be traced back to early 1980s. Interestingly, despite of intensive investigation, there is still a lack of consensus on the age for the onset of last glacial dust accumulation across loess regions in China; the published luminescence dates vary widely depending on the methodology employed. In this study, we examine samples from the same stratigraphical position at the base of the Malan Loess at eight sites across China. These sites are located in the eastern, western, central and southern parts of the Loess Plateau, eastern Tibetan Plateau, south of the Yangtze River, and in the vicinity of Beijing. All the sites have a clear stratigraphy with a well-developed palaeosol recognized as S1 in Chinese loess sequence. Therefore, the depositional age of the sample for the basal loess above S1 is expected to represent the timing for the onset or the early stage of dust accumulation at the particular site. We determined the luminescence ages of the loess samples using fine-grained (4-11 μm) and medium-grained (45-63 μm) polymineralic mixture and quartz extracts. Three types of protocols, SAR and MAR using quartz and post-IRSL IRSL SAR using polyminerals, were employed. Given the difference in provenance and the sedimentary history of the dust grains, it was not surprising that optimal conditions leading to an acceptable dose recovery result vary among these samples. However, our results also reveal significant variations in the luminescence ages obtained, ranging from the youngest of ~50ka to the oldest of over 75ka. These variations were observed not only among different sites, but also among types of protocols for an individual sample. Further experiments suggest that such age differences cannot be used as evidence for an asynchronised onset of the dust accumulation in the last glacial period; rather it is due to the intrinsic property of the signals from quartz and feldspars of the loess samples. Therefore, palaeoclimatic interpretation of such methodology-related luminescence ages must be made with caution.

Keywords: loess, OSL dating, last glacial, dust accumulation

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Luminescence dating of aeolian sand and the implication for formative region of Otindag sand field in north China

Y. Zhou[1]* , H. Lu[2] , X. Zhang[1] , H.Gu[1] X. Zhang[1]

[1] College of Tourism and Environment, Shaanxi Normal University, 710062, China
[2] School of Geographic and Oceanographic Sciences, Nanjing University, 210093, China

** Corresponding author: ylzhou109@163.com*

Otindag sand field is an important source of dust which influences regional or even hemispheric climate change. However, it is not yet clear the formation age and the landform process history, just as which was formed as far as in the Later Tertiary at least according to the red sand layers. The single aliquot regeneration (SAR) optically stimulated luminescence (OSL) dating protocol, which has been successfully applied to aeolian deposits worldwide, is applied in this study. The OSL ages provide reliable constraints for the topographic proceeding since 20ka. During 13-10 ka, white aeolian sand was widespread overlying the alluvial sediment even bedrock of hillside which was the fundus of Otindag sand field. This result implicates that Otindag sand field probably formed at least before 13ka which is different from previous viewpoint. This aeolian sand bed recorded the climatic episode at about the same time as the Younger Dryas in the North Atlantic region, demonstrating the sand field region during this event.

Keywords: OSL dating, Formation age, Younger Dryas, Otindag sand field region

Study on the background stability of newly developed type RGD6 TL reader

H. Zhu*, Y. Wang, J. Zhao, K. Tang, C. Zhou, H. Li, T. Sun, X. Ma

Solid Dosimetric Detector and Method Laboratory, P.O.Box 1044 EXT.201,Beijing 102205,PR.China

* *Corresponding author: zhuhongying1008@163.com*

The background stability of a TL reader for dating is one of the most important characteristic to influence directly on the detection lower limit as well as the measurement sensitivity. The main factors of type RGD6 TL reader on the background stability were analyzed. The background stability not only originates from the intrinsic characteristic of TL reader, but also depends on the readout parameters. A high sensitivity and low dark current photomultiplier, an absolute stable high voltage module, and a good optical system were chosen to ensure the stability of RGD6 TL reader. The PMT is cooled for the reduction of dark current and for stabilizing the gain. Photon-counting enables the use of a pulse height analyzer with which thermal noise can be separated from the results.

The influences of metallic planchet, filter, environments and atmosphere on the background stability were investigated by experiments. The methods and measurements to improve effectively the background stability for type RGD6 TL reader were put forward. When the metallic planchet is contaminated, it influences significantly the background stability, so it should always be remain clean to reduce the background noise. It was suggested that the metallic planchet should be cleaned and annealed at over 400℃ regularly. The thermal radiation increases the noise significantly and can be avoided by a suitable optical filter. Nitrogen is imported during heating to reduce the possibility of unreliable results and lengthen the lifetime of the metallic planchet. The ambient temperature and relative humidity haven't significantly influenced on the background stability at indoor conditions, but the background noise increases significantly when the ambient temperature is more than 30℃ or the relative humidity is more than 80%.

Keywords: TL reader , the background stability

Absolute chronology of the Citadel of Nishapur (Khorasan, Iran). Contribution of luminescence dating

A. Zink[1,*], E. Porto[1], R. Rante[2]

[1]Centre de Recherche et de Restauration des Musées de France,UMR LC2RMF MCC-CNRS, Palais du Louvre, 14 quai F. Mitterrand, 75001 Paris, France (antoine.zink@culture.gouv.fr)

[2]Department of Islamic Art, Musée du Louvre, 75001 Paris, France

* *Corresponding author: antoine.zink@culture.gouv.fr*

The old city of Nishapur is situated in a fertile plain at the foot of the Binalud Mountains (northeastern Iran). It includes a lower city (Shahrestan) and a citadel (Qohandez). Despite the consensus of the written sources data and toponomy, all previous archaeological excavations (American excavations 1935-1940, Iranian excavations 1995-2002) have concluded that there is no trace of Sasanian occupation and pre-Islamic layers. To better understand the question of the Sasanian foundation of the city and the relation with later occupations, a joint research Irano-French Mission, involving the CNRS as well as the department of Islamic art from the Louvre Museum and the ICHHTO (Iran Cultural Heritage, Handicrafts, and Tourism Organization), began in 2004. Since the total absence of dating elements and therefore the impossibility to fix a chronology of the different occupation, a project of pottery analysis has been opened. In this context, 18 potsherds coming from various trenches and stratigraphic units of the citadel were dated by thermoluminescence and archaeomagnetism. From thermoluminescence dating, we inferred that the ages of potsherds can be divided into three groups (coverage interval of 95 percent): first group [485 BC - 415 AD]; second group [405 AD - 745 AD]; third group [745 AD - 1165 AD]. From the potsherds groups, we performed a seriation of our stratigraphic units and compared the results to the attribution of archaeological units to the different periods made by archaeologists. Some stratigraphic unit may have potsherds belonging to different groups. This result is not surprising if one accepts that potsherds can be found in over layer following a reworking of the building material (mud brick). Combining the various chronometric data (TL dating, archaeomagnetism, stratigraphy) gives a first chronology for the Qohandez (1) old settlement phase, ca. 450 BC - 150 BC; (2) Sasanian period and (3) Islamic period.

The central European hotspot and TL dating

L. Zoeller*, D. Richter

Chair of Geomorphology, University of Bayreuth, Germany

* *Corresponding author: Ludwig.zoeller@uni-bayreuth.de*

A modified theory of a Central European hotspot to explain the distribution of Quaternary volcanism in space and time has been proposed in the past decade. This theory assumes several pulsing "fingers" of magma rise originating from a common hot spot in the earth's mantle below Central Europe. So far there exist, however, few Ar/Ar datings from Middle to Upper Pleistocene eruptions. We are therefore exploring the use of TL dating to contribute to a more detailed chronology of the volcanic activity of the various "fingers". Due to well-known problems reported from volcanic minerals we prefer to date the last heating of crustal xenoliths during an eruption. In a pilot study the resetting of the geological TL of crustal xenoliths from the Eifel Volcanic Field (Germany) was investigated. Some xenoliths and maar tephra beds proved sufficiently zeroed at eruption, others yielded evidence of partial heating maintaining a residual TL signal at eruption. With the "Partial Heat – Longest Plateau" technique an intrinsic protocol was developed to detect partial resetting and to correct for it. Long-term instability of the blue TL emissions from polymineral fine-grained samples may, however, cause age-underestimates. We, therefore, focus on the orange-red TL (RTL) emissions from pure quartz separates extracted from crustal xenoliths. It is expected from this approach that, i), so-called "anomalous fading" can be circumvented, and, ii), the upper dating limit can be extended by an order of magnitude or more due to very high saturation doses of the RTL emissions from quartz. First results will be presented. Our study is sponsored by the German Research Foundation DFG, project numbers Zo 51/31-1 and Zo 51/32-1.

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