10th New World Luminescence Dating Workshop

June 18-20, 2015
Kansas State University, Manhattan, Kansas

Book of Abstracts

ORAL PRESENTATION

Comparison of single-grain Feldspar post-IR IRSL and cosmogenic ^{10}Be depth profile chronologies of the Providence Mountains alluvial fan chronosequence, Mojave Desert, California

Antinao, J.L.[1*], McDonald, E.[1], Baker, S.E.[1], Huenupi, E.[1], Gosse, J. C.,[2]
[1] Desert Research Institute, Reno, NV 89512 USA (jantinao@dri.edu)
[2] Dalhousie Geochronology Centre, Halifax, NS B3H3J4, Canada

We present here twelve new single-grain post-infrared high temperature (225 C) infrared stimulation (post-IR IRSL or PIRIR) ages on feldspars of the Providence Mountains alluvial fan chronosequence. Ages are compared to cosmogenic depth-profile dating performed on the same units. Testing the chronology of the different units of this sequence is an important step in deciphering potential linkages between regional and global climate variation and the geomorphic response of these arid catchments. Samples were taken from fan units Qt4, Qt3 and Qt2, derived from mixed plutonic (PM), quartz monzonite (QM) and mixed volcanic (VX) lithologies, in the sequence of McDonald et al. (2003). PIRIR ages cluster at 29-31 ka, 53-65 ka, and 70-83 ka. Central age model estimates were consistent with both cosmogenic profiles and soil development based on dated chronosequences in similar areas of the Mojave Desert, as opposed to Minimum Age Model determinations that yielded ages that are comparatively too young. The subset of grains that usually define Minimum Age populations in each analyzed distribution also displays high fading rates (g values 5-10%) compared to average fading rates of each sample (g values ~1%). This effect and potential variation in K content in the studied feldspars might account for the large dispersion (>20%) observed in some of the sample dose distributions. Observation of equivalent dose distributions in modern and Pleistocene samples suggests that the efficiency of hillslope and bedrock channel bleaching before flash floods can be as high as alluvial in-channel bleaching. The combined geochronology results indicate a strong precessional control on alluvial deposition over the Providence Mountains during the Late Pleistocene, similar to that documented for the southern regions of the Sonoran Desert in Mexico, almost 1,000 miles to the south.

Reference

McDonald, E.V., McFadden, L.D., Wells, S.G., 2003. Regional response of alluvial fans to the Pleistocene-Holocene climatic transition, Mojave Desert, California. In: Enzel, Y., Wells, S.G., Lancaster, N. (Eds.), Paleoenvironments and paleohydrology of the Mojave and southern Great Basin Deserts. Geological Society of America, Boulder, Colorado, pp. 189-205.

ORAL PRESENTATION

Unravelling the luminescence kinetics of K-feldspar during geologic cooling

Brown, Nathan D.[1], Rhodes, Edward J.[1,2], Harrison, T.M.[1]
[1]University of California, Los Angeles, CA 90095 USA (nathan.david.brown@ucla.edu)
[2]University of Sheffield, South Yorkshire S10 2TN, UK

Workers have recently made important advances on two fronts: a) reproducing the luminescence kinetics of feldspar during IRSL and isothermal decay (Jain et al., 2015), and b) extending the thermochronometric concept of 'closure temperature' to the first-order luminescence system of the quartz fast component (Guralnik et al., 2013). What remains elusive, however, is an understanding of how luminescence signals accumulate within K-feldspar during geologic cooling (e.g., tectonic uplift, fluvial downcutting, glacial erosion).

This study presents a kinetic model that reproduces the major detrapping pathways hypothesized for feldspar (ground- and excited-state tunneling, and phonon-assisted diffusion; Jain and Ankjaergaard, 2011). Controlling parameters (e.g., activation energy, recombination center density) are estimated experimentally. Charge accumulation is simulated at geologic timescales and dose rates, given various recombination distances within the crystal lattice. Model predictions are compared with field saturation measurements of natural K-feldspars sampled from a rapidly uplifting tectonic block within the Transverse Ranges of Southern California. We suggest ways in which K-feldspar luminescence signals may prove useful as low-temperature thermochronometers.

References

Guralnik, B., Jain, M., Herman, F., Paris, R., Harrison, T.M., Murray, A.S., Valla, P.G., Rhodes, E.J., 2013. Effective closure temperature in leaky and/or saturating thermochronometers. *Earth and Planetary Science Letters* 384, 208-218.

Jain, M., Ankjaergaard, C., 2011. Towards a non-fading signal in feldspar: Insight into charge transport and tunneling from time-resolved optically stimulated luminescence. *Radiation Measurements* 46, 292-309.

Jain, M., Sohbati, R., Guralnik, B., Murray, A.S., Kook, M., Lapp, T., Prasad, A.K., Thomsen, K.J., Buylaert, J.P., 2015. Kinetics of infrared stimulated luminescence from feldspars. *Radiation Measurements* In Press, 1-9.

POSTER PRESENTATION

Differentiating late Pleistocene and Holocene sediments in the Platte River Valley using optically stimulated luminescence dating

Bruihler, Jacob C., Hanson, Paul R.
School of Natural Resources, University of Nebraska-Lincoln, Lincoln, Nebraska, USA
jacob.bruihler@huskers.unl.edu, phanson2@unl.edu

This research investigates the evolution of the Platte River valley during the past ~ 100,000 years. Sediment cores were drilled into deposits underlying the Platte River floodplain near the towns of Hershey and Kearney, Nebraska. Platte River sediments recovered in drill cores ranged in depth from 12 to 20 meters in thickness and are directly underlain by sediments of the Neogene aged Ogallala Group. Sediments recovered from the alluvial fill generally consist of slightly calcareous (1-2% carbonate) tan-brown fine-grained silty sand that are locally dominated by gravel. Without datable carbon it has not been possible to date the alluvial fill. The most reliable method to date the fill and to differentiate the Late Pleistocene sediment from Holocene sediment is by using Optically Stimulated Luminescence (OSL) dating. OSL ages were calculated from 15 samples from Hershey and 11 samples from the Kearney study areas. The ages range from modern sediment younger than 1 ka to sediments that could not be dated with OSL and are older than approximately 121 ka. Interpretive geologic cross sections show the Holocene fill ranges in thickness from 2-4 m, while the underlying late Pleistocene fill ranges in thickness from 10-14 m. Using cross-sections, interpretations can be made about the evolution of the Platte River in the late Quaternary.

ORAL PRESENTATION

OSL dating of playa sediments from Laguna Salada, Texas

Regina DeWitt[1], Daniel Livsey[2], Alexander R. Simms[2]
[1]Department of Physics, East Carolina University, Greenville, NC, USA; dewittr@ecu.edu
[2]University of California at Santa Barbara, Department of Earth Science, 1006 Webb Hall - MC 9630, Santa Barbara, California 93106, USA

Recent droughts throughout the central United States highlight the need for a better understanding of the past frequency and severity of drought occurrence. Current records of past drought for the south Texas coast are derived from tree-ring data that span approximately the last 900 years before present (BP). The goal of this project was to extend this record by OSL dating of playa sediments from Laguna Salada, Texas.

Laguna Salada is a playa located 35 km inland from Baffin Bay along the semi-arid southern Texas coastal plain. Ten vibracores were collected to determine the thickest and least bioturbated section of playa sediment. Twenty-two OSL ages were obtained from quartz grains isolated from sand laminae within one core.

Challenges included very small sample volumes and the changing water content due to cycles of filling and desiccation. The results indicate that the Atlantic Multidecadal Oscillation was a dominant driver of drought frequency over southern Texas for the last 3,000 yr.

ORAL PRESENTATION

Dating K-feldspars from old contexts: Case study from Tanzania

James Feathers
University of Washington
jimf@uw.edu

Magubike Rockshelter in the southern highlands of Tanzania contains archaeological deposits that, from the artifacts, appear to span much of the Middle Stone Age. This includes occupation about 50,000 years ago, when cold, arid conditions limited population elsewhere in East Africa. The excavation work is being carried out by Pamela Willoughby, University of Alberta, who retained the University of Washington laboratory to date the deposits using luminescence. She collected six samples spanning the stratigraphy.

The granite rock outcrop that comprises the rockshelter is very high in radioactivity. Measured dose rates are 8 to 10 Gy/ka. Because of low sensitivity of quartz, IRSL of k-feldspars has been employed, although the sensitivity of the feldspars is not high either. Equivalent dose has been determined using both IRSL of single-grains and MET-pIRIR of multi-grain aliquots. Fading corrections have followed Huntley and Lamothe (2001), although this method does not appear applicable to the older samples. Both single-grains and MET-pIRIR signals seem to under-estimate the age, given the archaeology. Under-estimation is worse for the single-grains. Inadequate fading corrections or field saturation are possibly responsible. The samples appear to have dose-dependent signal sensitivity, so the approach of Li et al. (2014) using a "pre-dose" procedure, believed to have a higher saturation limit, is being explored.

References

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.

Li, B., Roberts, R. G., Jacobs, Z., and Li, S-H., 2014. A single-aliquot luminescence dating procedure for K-feldspar based on the dose-dependent MET-pIRIR signal sensitivity. *Quaternary Geochronology* 20:51-64.

ORAL PRESENTATION

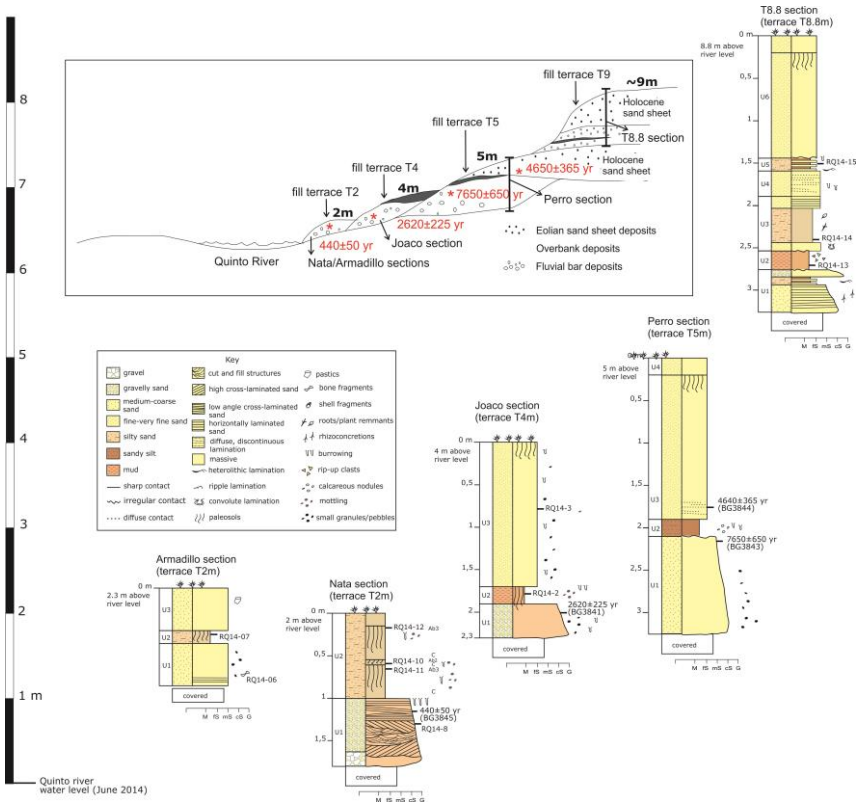
Removal of volcanic glass for improved dating of eolian and fluvial sand depositional records in San Luis Province, western Argentina

Steven L. Forman[a], Alfonsina Tripaldi[b] and Liliana C. Marin[a]

[a]Geoluminescence Dating Research Laboratory, Dept. of Geology, Baylor Univ., Waco, TX USA (Steven_Forman@Baylor.edu)

[b]University of Buenos Aries, IGEBA-CONICET, Buenos Aries, Argentina (alfo@gl.fcen.uba.ar)

Late Quaternary eolian sand depositional sequences are ubiquitous in w. Pampas of Argentina. These eolian deposits at the continental scale reflect precipitation variability during the late Quaternary with varying dominance of precipitation sources from the dry Westerly's and the southern expansion of South American Monsoon. Optical dating focused on the 100-150 or 63-100 micron quartz grains using SAR protocols. Unlike other Andean-sourced quartz, Pampean quartz shows a clear dominance of fast luminescence component with fast ratios > 10.



In contrast, distal eolian facies with an appreciable air-fall component can contain up to 40% of reworked volcanic glass, which is a challenge to separate from quartz grains and a source of appreciable IR emissions. Density separation at 2.4 g/cc is effective in eliminating up to 95% of volcanic glass, but with numerous iterations. Fluvial deposits are dominated by non-spheroid muscovite particles and volcanic glass particles and additional density separates at 2.4 g/cc is useful for separating both unwanted particles. Despite density separations, glass particles for some aliquots persist and with appreciable IR emissions. If the Blue/IR emission ratio from a known beta dose is <30% an IR wash prior to SAR protocols is applied and yields blue shine down curves with fast ratio of > 10.

Stratigraphic, geomorphic and OSL chronologic assessment identify four fluvial terrace levels at 9, 5, 4 and 2 m above the Quinto River, which bisects the sand sheet deposits (Fig 1). This nascent chronology of changing fluvial deposition and elevation indicates aggradation during the early Holocene ca. 10 to 7 ka, with sand sheet accretion on the adjacent landscape. Deep degradation occurred sometime between 2.6 and 0.4 ka and may be coincident with a wet interval post the Medieval Climate Anomaly.

POSTER PRESENTATION

What can computer simulations of sediment transport tell us about single grain distributions?

Gray, Harrison J. [1,2]
[1]U.S. Geological Survey, Luminescence Geochronology Laboratory, Denver Federal Center, Denver, CO
[2]Center for Research in Environmental Sciences (CIRES) and Department of Geology, University of Colorado, Boulder, Boulder, CO

Surface processes move sediment in various ways, for various distances, and by various means. Fluvial systems transport grains via water through turbulent motion, hillslopes advect sediment in a diffusive down-slope manner, and glaciers push and carry material to their eventual deposition. Because each surface process moves sediment differently, the sunlight exposure histories of individual grains will vary as well. This can lead to partial bleaching and dispersion in equivalent dose datasets. However, these processes often act on timescales longer than humans can feasibly observe. As such, computer based numerical modeling is often the only means to recreate their effects and predict their behavior.
I will present work using random-walk particle tracking (RWPT) simulations to recreate and predict the effects of fluvial sediment transport on partial bleaching and over-dispersion. I discuss how turbulent motions in turbid flood waters rapidly create large single grain over-dispersions in fluvial datasets. However, with increasing transport distance, these datasets collapse into distributions which display well-bleached behavior with few outliers. These numerical simulations compare favorably with field data [McGuire and Rhodes, 2015] and suggest the best places to sample for geochronology are upstream of tributary junctions. These results can be compared with field studies which suggest that sampling at elevations close to non-flooding river surface are preferable [Cunningham et al., 2015]. I also discuss how it is possible to extract sediment transport information using the inverse method [Gray et al., *submitted*] and by using two separate luminescence signal decays to solve for the transport time (with a handful of assumptions). Furthermore, I discuss the potential for signal regeneration during long sediment storage periods as the process that increases the dispersion seen in fluvial datasets.

Quantifying dispersion through numerical models and estimation of transport rates through equivalent dose datasets represent new uses for both computer simulations and luminescence dating. Both have the potential to reveal new and useful information for research into surface processes and effective luminescence sampling.

References

Cunningham, A. C., Evans, M., & Knight, J. (2015). Quantifying bleaching for zero-age fluvial sediment: A Bayesian approach. Radiation Measurements.

Gray, H.J., Tucker, G.E., Mahan, S.A., McGuire, C., & Rhodes, E.J. (Submitted) Estimation of sediment transport rate via luminescence equivalent doses in river sediment. *Submitted to Journal of Geophysical Research – Earth Surface*

McGuire, C., & Rhodes, E. J. (2015). Downstream MET-IRSL single-grain distributions in the Mojave River, southern California: Testing assumptions of a virtual velocity model. *Quaternary Geochronology*.

ORAL PRESENTATION

Single-grain OSL dating results from pre-colonial canal fills in Arizona

P.R. Hanson[1], J.B. Howard[2] and D.R. Abbott[3]
[1]School of Natural Resources, University of Nebraska-Lincoln, Lincoln, Nebraska, United States, phanson2@unl.edu
[2]Arizona Museum of Natural History, Mesa, Arizona, United States, Jerry.Howard@mesaaz.gov
[3]School of Human Evolution and Social Change, Arizona State University, Tempe, Arizona, United States, David.Abbott@asu.edu

Determining the ages of construction for Pre-Colonial irrigation canals found in and around Phoenix, Arizona has been problematic due to the lack of reliable datable materials within the canal fills. This study was undertaken to determine how precisely these canal fills could be dated with single-grain optically-stimulated luminescence. For this study we analyzed eight samples that were collected from three distinct canal fills at depths of 1.0 to 4.2 m. All analyses were conducted using the single-grain OSL dating technique and final age estimates were based on a minimum of 131 accepted grains. Our results show equivalent doses are predominantly normally distributed, but that both overdispersion (18-35) and skewness (0.5-4.4) values are higher than expected. Based on these findings we would typically employ a minimum age model to calculate the ages of the fills. However, these age estimates that ranged from 480 to 740 years ago, are younger than expected for the canal fills. Final age estimates were instead based on the central age model that dated the canals between 750 to 1360 years ago. These results are in correct stratigraphic order and are in better agreement with expected ages for the canals. Two samples collected from one of the older canals identified at the site were dated at 1230 to 1360 years ago, consistent with the dating of the earliest villages in the canal system. The two younger canal segments were dated between 750 to 970 (n = 3 ages) and 990 to 1040 (n = 3 ages) years ago. The former was consistent with age estimates based on ceramic materials incorporated in its fill. These findings indicate that single-grain OSL dating is useful for distinguishing between different aged canal fills in this setting.

ORAL PRESENTATION

Evidence of shallow TL peaks contributing to the infrared phosphorescence

Sébastien Huot[1], Marine Frouin[2] and Michel Lamothe[3]
1. Illinois State Geological Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. shuot@illinois.edu
2. Research Laboratory for Archaeology & the History of Art, University of Oxford (UK)
3. Département des sciences de la Terre et de l'atmosphère, Université du Québec à Montréal (Canada)

The notion of what is a 'zero age' is skewed when it comes to infrared radiofluorescence (IR-RF). Measured intensities are highest for bleached sediment samples and gradually fall to low intensities as it reaches dose saturation. It was shown that a sample emits phosphorescence immediately after optical bleaching, yet nothing is known about it. The solution that has been used was merely to wait for it to decay (Erfurt and Krbetschek, 2003). Recent work has been conducted to identify the source of these trapped electrons.

Experiments were carried out to determine the trap depth and frequency factor of any shallow trapping defects. We applied the initial rise and variable heating rate methods. Results will be discussed in light of its implications to dating with IR-RF.

Reference

Erfurt, G., Krbetschek, M., 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.

ORAL PRESENTATION

Latest Pleistocene/early Holocene dune activity in the Tanana Lowlands of Central Alaska

Johnson, William C.
Messner, Claire A.
University of Kansas, Lawrence, KS 66045, wcj@ku.edu & c.forgacs@ku.edu
Hanson, Paul R.
Young, Aaron R.
University of Nebraska-Lincoln
Rittenour, Tammy M.
Utah State University, Logan, UT
Gaines, Edward P.
AECOM, Fairbanks, AK

Sand dunes respond to environmental changes through activation and stabilization, and, accordingly, information about paleoenvironmental changes can be captured within the dune stratigraphy. Luminescence and to a lesser extent radiocarbon dating is being used to develop dune chronologies globally (http://inquadunesatlas.dri.edu/), and, while some North American high-latitude dune fields have been examined in past research (e.g., Wolfe et al., 2011), those in central Alaska have received little attention due at least in part to lack of a suitable dating technique. In most aeolian settings, organic material is scarce for radiocarbon dating, and quartz grains have proven largely unsuitable for optically stimulated luminescence (OSL) dating within this region. This research tested a recently developed luminescence protocol to date sand dunes located in the western Tanana River Lowlands of central Alaska. The research objectives were those of (1) determining if a post-IR IRSL protocol is suitable for dating feldspars contained within central Alaskan sand dunes, and (2) comparing resulting luminescence ages with regional proxies in order to gain further insight into past environmental conditions within interior Alaska. This post-IR IRSL protocol minimized the effects of anomalous fading, which characteristically occurs within feldspar grains.

Initially a pilot study was conducted in the Wood River dunes, a dune field within the western Tanana River Lowlands. The post-IR IRSL analysis, following Buylaert et al. (2009), indicated that the dunes formed no later than ~15-16 ka, and that the most recent reactivation occurred ~10-12 ka. Subsequently, the post-IR IRSL protocol was employed to extract the chronology of the Nenana dunes, situated ~35 km west/southwest of the Wood River dunes. The base of the thin (~ 1 m) loess mantle overlying the dunes dated to ~10.4 ka, the top of the dune sand to ~11.4-12 ka, and the basal dune sand to ~16 ka. The post-IR IRSL ages obtained from these two dune fields are consistent with calibrated radiocarbon ages obtained in the Kantishna Sand Sea to the west (Lea, 1996), the Upward Sun River Site to the east (Potter et al., 2011), and the Banjo Lake Site (Esdale et al., 2015), as well as to luminescence ages from multiple archaeological sites in the middle Tanana River valley (Reuther, 2013) and to the reconstructed paleoecological history of central Alaska (e.g., Anderson et al., 2004).

POSTER PRESENTATION

Luminescence-based investigations of dune activation in Kansas—Past, present and future

Johnson, William C. and Halfen, Alan F.
University of Kansas, Lawrence, KS 66045 wcj@ku.edu & afhalfen@ku.edu

In recent years, the Central Great Plains has been the focus of several luminescence-based reconstructions of dune-activation chronologies. Here in the State of Kansas, research into dune chronologies has expanded dramatically since the radiocarbon-based chronology from central Kansas reported by Arbogast and Johnson (1998). Published luminescence-based investigations and those in various stages of progress represent an array of age intervals and geomorphic environments. In northeastern Kansas, Halfen, Johnson and others (pre-submission) have identified what appears to be the oldest known dune-activation episode documented in North America (~45-30 ka), located along the north side of the Kansas River valley. In a related study, OSL ages indicate that the Kansas River initiated meandering about 3.5 ka, a time of activity documented in the regional aeolian and alluvial records. East-central and central Kansas has been the focus of extensive luminescence dating: Hanson et al. (2010) reported ages indicating that dunes mantling a 45 ka terrace of the Smoky Hill River valley near Abilene were last active ~ 1.1-0.5 ka. Halfen, Johnson, et al. (2012), in a high-temporal and spatial resolution study of the Reno County dune field along the Arkansas River of central Kansas, documented three major episodes of dune activation: ~2.1-1.8, ~1-0.9, and after ~0.6 ka. An ongoing study by Johnson and others in adjacent Rice County is expanding this chronology spatially, with ages likewise ranging from ~2.1-0.2 ka. In southwestern Kansas, the Arkansas River valley exhibits a low terrace with paleochannels and dunes, as well as multiple, dune-mantled high terraces. It was here that Forman et al. (2008) recognized aeolian erosion and deposition dating from ~16-12 ka, with activation occurring ~9.8-6.3 ka, ~1.5, 0.43, 0.38-0.32, 0.18, and 0.07 ka. In this southwestern Kansas reach of the Arkansas River valley, Halfen, Johnson et al. (pre-submission) have focused on a detailed dating of terrace systems and sequences of dune activation. The approach to dating dune stratigraphy has considered dune morphology (e.g., transverse, parabolic and dome) and has differentiated multiple terrace systems. In the Cimarron River valley of southwestern Kansas and adjacent Oklahoma, Werner et al. (2011) considered surface pedology as a factor controlling activation as part of their approach to the luminescence dating of dunes, i.e., older dunes being more resistant to destabilization due to a higher concentration of fine grains in the surface soils. In their study of playas on the High Plains of western Kansas, Bowen and Johnson (2012) reported latest-Pleistocene ages from a lunette (silt dune) formed on the down-wind side of a playa; this luminescence dating of lunette ages is currently being expanded. In canyons of the Breaks in the Republican River system of extreme northwestern Kansas, Koop, Johnson and others (in progress) are dating a stratigraphic sequence that contains intervals of aeolian sand deposition, dating to ~63-59 ka. In a review and compilation of reported Great Plains dune-field chronologies, Halfen and Johnson (2013) observed that, even with an abundance of reported chronologies, temporal correlation of dune activation periods among individual dune fields is difficult, which is at least in part due to factors such as unintentional sampling biases, the propensity for chronologies to represent only the most recent episodes of activation, and limited consideration of non-climatic factors controlling dune activity. Most recently, Halfen et al. (2015) examined aeolian records from North America from which they concluded that, in addition to sediment availability, sediment supply is a major factor in determining dune activity.

POSTER PRESENTATION

Thoughts on data processing and error estimation using the RF_{70} protocol

[1,*]Kreutzer, S., [2]Frouin, M., [1]Lahaye, C., [3]Lamothe, M. and [1]Mercier, N.
[1]IRAMAT-CRP2A, UMR 5060 – Université Bordeaux Montaigne - Pessac, France
[2] RLAHA, University of Oxford, Dyson Perrins Building, South Parks Road, Oxford OX1 3QY,
[3]Département des sciences de la Terre et de l'atmosphère, Université du Québec à Montréal, Canada
[*]corresponding author: sebastian.kreutzer@u-bordeaux-montaigne.fr

Despite considerable technical advances in commercially available luminescence dating equipment, serious challenges arise when the measured data need to be processed in a flexible and efficient way. The **R**-package 'Luminescence' [1] provides one solution for this challenge by taking advantage of a powerful statistical programming environment: **R**.

To analyse infrared radiofluorescence (IR-RF, throughout RF) measurements on K-enriched feldspars and to test the applicability of the RF_{70} protocol [2], we enhanced an existing software routine (analyse_IRSAR.RF()) that is already part of the **R**-package 'Luminescence'. This allows us to process the RF_{70} measurement data including D_e and D_e-error calculation in an efficient and transparent way.

Our contribution focuses on the details of this routine and its implementation in **R** and the package 'Luminescence'. Generally, for the D_e estimation we followed the approach implemented in the software *RLanalyse* [3], here enhanced using rejection criteria and error estimation. Applying the developed routine allows to directly analyse obtained RF_{70} measurement data without using other software. The chosen rejection criteria and the implemented error estimation are presented and discussed using simulated data and real examples.

References

[1] Kreutzer, S., Dietze, M., Burow, C., Fuchs, M. C., Schmidt, C., Fischer, M., Smedley R. K., (2015) Luminescence. R package. http://CRAN.R-project.org/package=Luminescence
[2] Frouin, M., Huot, S., Kreutzer, S., Lahaye, C., Lamothe, M., Mercier, N., (in preparation) Towards an optimised IR-RF dating protocol for K-feldspars.
[3] Lapp, T., Jain, M., Thomsen, K.J., Murray, A.S., Buylaert, J.P., (2012) New luminescence measurement facilities in retrospective dosimetry. Radiation Measurements 47, 803–808.

ORAL PRESENTATION

Sinusoidally modulated - Optically stimulated luminescence (SM-OSL): The quest for the medium component and a more rapid LM-OSL

Lawson [1], Michael J. and Rhodes [2], Edward J.
1. Earth, Planetary, and Space Sciences, University of California, Los Angeles (mlawson@igpp.ucla.edu)
2. Physical Geography, University of Sheffield (erhodes@epss.ucla.edu)

Sinusoidally Modulated- Optically Stimulated Luminescence (SM-OSL) is a more rapid method of Linearly Modulated- OSL (LM-OSL). In traditional LM-OSL, the light source intensity is increased linearly, ramping up stimulation so that the numerous components within the quartz signal can be observed. Due to long measurement times, LM-OSL is rarely used despite its versatility in analyzing the fast, medium, and numerous slow components. We present a modified version of LM-OSL, in which the stimulation intensity is not ramped linearly, but instead follows a sinusoidal function. SM-OSL offers the same potential for component analysis as LM-OSL, but far more rapidly. The initial stimulation is very low and is equivalent to a multi hour LM-OSL. As the stimulation time increases, the intensity grows following a sine curve which ramps up more quickly than traditional LM-OSL. SM-OSL allows for rapid assessment of the various quartz OSL components, with increased resolution of the fast and medium components.

ORAL PRESENTATION

Thermal transfer OSL and rodents: Running with the rats at Meade Basin, southwestern Kansas

Mahan, Shannon A., U.S. Geological Survey, Box 25046 Federal Center, Denver, CO 80225, smahan@usgs.gov
Robert A. Martin, Dept. of Biological Sciences, Murray State University, Murray KY 42071

The High Plains surface in southwestern Kansas is composed of a series of sedimentary levels indicating a complex history of deposition and erosion extending from at least the Late Miocene through modern time. A geological depression running about 48 km from northeastern Meade County south-west across the Cimarron River into the panhandle of Oklahoma containing this sedimentary sequence is often referred to as the Meade Basin. Reviews and revisions of regional stratigraphy can be found in various sources, with the latest work contained within Martin and Palaez-Campomanes (2014).

The Meade Basin contains a dense late Cenozoic rodent record through millions of years. This record will allow researchers to identify and clarify historical influences on species richness, determine the relative contribution of immigration, speciation and local extinction to species originations at the community level, and calculate background extinction rates to compare with modern species losses due to anthropogenic activities. The record also allows for recognition of rodent diversity vs. time, but a lack of absolute date chronology during extinction periods and subsequent replacement limits our ability to tell exactly how long the lag time is between extinction and replacement. Various models have been proposed (Alroy, 1998; Brett and Baird, 1995; Vrba, 1985) that predict turnover rates, but thus far imprecise chronology has been the limiting factor.

Seven samples for OSL dating were taken from various well-known fossil localities in spring 2007. Some of these samples were at or near the saturation for the fast component of quartz OSL (i.e. >150 Gy), although two samples were taken in conjunction with radiocarbon calibration sites. These samples closely matched the radiocarbon ages. With the advent of thermally-transferred OSL (TT-OSL), these samples were re-dated using protocol established in Brown (2009). Since the TT-OSL signal has been shown to grow with high (kGy) radiation doses, the TT-OSL dating technique was used on the fine-grained (250-180 μm) quartz fraction of these deposits.

Just as with Brown (2009), we found the TT-OSL signal continued to increase with radiation dose >800 Gy. Recycling ratios, zero-dose response values, and dose recovery tests all performed well for samples with burial doses >200 Gy but did not perform well for samples with burial doses <150 Gy. This made comparison of the OSL and TT-OSL on the same sample problematic. In fact, we were not able to replicate the lower doses with repeated measurements which calls into question results we obtained on the older samples.

We will show results on all the OSL and TT-OSL samples and look at them in the context of known chronology (i.e. tephras, radiocarbon, OSL) as well as examining the recycling ratio, the recuperation, and dose recovery tests. We will also interpret our sunlight exposure tests for efficacy in resetting the TT-OSL.

ORAL PRESENTATION

Hypothesis testing for equivalent dose distributions: Two case studies

McGuire, Chris P. [1*], Rhodes, Edward J. [1, 2]
[1] Earth, Planetary, and Space Sciences, University of California Los Angeles, United States
[2] Geography, Sheffield University, United Kingdom.
[*](cpmcguire@ucla.edu)

We present two case studies for which one might wish to test the null hypothesis that samples are drawn from the same population. The two questions posed are: (1) can a pair of samples be distinguished from each other in an age model? And, (2) can a pair of dose distributions inform whether the provenance of sediment is different? The first case study is from New Zealand, where offset geomorphic markers (Pleistocene-Holocene terraces) are used to obtain fault slip-rates. Field geologists are often concerned with the choice of sampling location relative to the intersection of the fault trace and the terrace riser edge. At issue is whether the fluvial process of aggradation will produce a spatial gradient in age (younging in the downriver direction) that is detectable. If the age of the sample is determined using the central age model (CAM), a likelihood-based test after Zhou et al. (1997) can determine whether log-normal means are equivalent. Terrace deposition ages in the mid-Holocene and older at this site will provide indistinguishable log-normal means in CAM.

The second case study is from the Mojave Desert, where we are interested in using equivalent dose distributions to determine provenance of modern sediments. At the Afton Canyon sample site, the Mojave River incises through Quaternary-Tertiary fanglomerate deposits. A sample from the modern Mojave River shows a small population of grains at significantly higher dose than grains from a sample at Barstow, upriver from the fan incision. We test whether these two samples are distinguishable from one another using the Mann-Whitney U-test. Although the Kolmogorov-Smirnov (K-S) test can provide a first assessment of sample equivalence, other tests, such as the Mann-Whitney U-test, are more powerful. We further explore the conditions under which it is possible to solve for the proportions of grains from multiple sources in a modern Mojave River deposit. Solving for the proportion of grains from each source (the Mojave River and the Quaternary fans) could allow for mass flux estimation, useful for quantitative modelling of the incision of Afton Canyon.

References:

Galbraith, R. & Roberts, B., 2012, Statistical aspects of equivalent dose and error calculation and display in OSL dating: An overview and some recommendations, Quaternary Geochronology, 11, 1-27.

Zhou, X., Gao, S., Hui, S., 1997, Methods for comparing the means of two independent log-normal samples, Biometrics, 53, 1129-1135.

POSTER PRESENTATION

A pre-Wisconsinan sedimentary record from a cave in central Vermont

Perzan, Zach[1], Amidon, William[2]
[1,2]Middlebury College Geology Dept., Middlebury, VT. 05753
[1]zperzan@middlebury.edu [2]wamidon@middlebury.edu

Understanding the timing and conditions of pre-Wisconsinan ice advances in New England has implications for landscape development and climatic reconstructions. Unfortunately, few surficial records exist of pre-Wisconsinan glaciations due to poor exposure and a paucity of chronologic control on older glacial deposits in New England. This study seeks to better understand the length and conditions of the last inter-glacial period in northern New England by studying a sequence of clastic sediments within Weybridge Cave in the Champlain Valley of central Vermont.

The main longitudinal passage of the cave (~35 m below surface) contains a coarse gravel conglomerate overlain by 2-5 m of fine laminated sediments. The majority of this sequence consists of silty clay (mean grain size of 10 μm) with mm-scale and sub-mm scale laminations. Several exposures contain local concentrations of rip-up clasts and a mélange containing intact blocks of finely laminated clays, indicating that deposition of this fine-grained unit was punctuated by higher-energy discharge events. These sediments are thought to record periodic infilling events under ice-free conditions in the Champlain Valley. Initial pollen analyses in nine samples have yielded little organic material or pollen to provide clues to the terrestrial environment.

Sand intervals were sampled for luminescence dating just above the basal gravel and near the top of the sequence. Samples were prepared at the Middlebury College Luminescence Lab and analyzed on a Daybreak 2200 reader equipped with a ^{90}Sr beta source and Blue/Infrared LED's. SAR OSL protocol was used to evaluate hundreds of large quartz aliquots (l = 260-390 nm), most of which were rejected due to dim shine-down signals and strong slow components. Improved results were obtained using a single grain $PIRIR_{225}$ protocol (l = 320-470 nm) on potassium feldspar following a filtering process to discard grains with a dim response to the initial test dose. Preliminary results suggest that the basal sand dates to late Marine Isotope Stage (MIS) 5 and that the overlying sand dates to late MIS 3 or earliest MIS 2. We thus conclude that the Weybridge Cave sediments bracket much of the last interglacial period in the Champlain Valley. Ongoing work is focused on constraining fading rates, unbleachable components, and additional pollen analysis to constrain climatic and biotic conditions during the last interglacial period.

POSTER PRESENTATION

Evaluating the potential of quartz ITL and TT-OSL signals for dating of fluvial sediments from Amazonia

Pupim, Fabiano N.[1]; Sawakuchi, André O.[1]; Mineli, Thays D.[1]
[1]Department of Sedimentary and Environmental Geology, Institute of Geosciences, University of São Paulo, São Paulo, SP, Brazil. (fabianopupim@usp.br; andreos@usp.br; thaysdesiree@gmail.com)

The modern Amazonia landscape and biodiversity are strongly related with the evolution of the Amazon River system during the Neogene and Quaternary. However, our understanding of the paleogeography of the Amazonia lowlands during the whole Quaternary remains hampered by the lack of reliable absolute ages to constrain sediment deposition in the hundred thousand to few million years timescales. Optically stimulated luminescence (OSL) technique applied to quartz has provided important chronological control for late Quaternary sediments, but the method is limited to the last ~150 ka due to saturation of the fast component of the OSL signal. In order to extend the age range of luminescence dating, new signals from quartz have been investigated. This study tested the potential of isothermal thermoluminescence (ITL) and thermally transferred optically stimulated luminescence (TT-OSL) signals of quartz for dating of Amazonian sediments. Coarse-grained (180-250 μm) quartz used for dose recovery experiments was taken at a modern fluvial bar (~200 years) from the lower Xingu river, eastern Amazonia. The OSL-SAR signal shows natural D*e* value of 0.31 ± 0.01 Gy. The maximun dose that can be estimated ($2D_0$) using the OSL signal is 100-150 Gy. Dose rate is 1.5 Gy/ka, limiting the quartz OSL dating to around 100 ka. Following, two ITL and two TT-OSL protocols were used for a dose recovery experiment which had been given a laboratory dose of 250 Gy and regeneration doses of 125, 250, 500, 1000 and 2000 Gy. Table 1 shows the calculated-to-given dose ratio and $2D_0$ from ITL and TT-OSL protocols. The $2D_0$ values are in agreement with the expected high saturation doses and confirm the potential of the ITL and TT-OSL signals to dating Amazonian sediments as old as 1 Ma. In addition, the results suggest that the protocols proposed by Jain et al. (2007) for ITL signal and Adamiec et al. (2010) for TT-OSL signal appears to be more suitable to date quartz from Amazonia, providing reliable dose response curves, accurate sensitivity correction (recycling ratio=0.90-1.10), low recuperation (<5%) and high saturation doses (>1 kGy). Ages for a sediment profile obtained using the ITL and TT-OSL protocols will be presented at the workshop. (FAPESP grant 14/23334-4)

Table 1. Summary data from dose recovery experiments.

Signal	Calculated/Given dose	$\bar{x}$ $2D_0$ (Gy)	$\bar{x}$ recycling ratio	$\bar{x}$ recuperation (%)
ITL310ºC[1]	1.084	1070	1.00	0.5
ITL280ºC[2]	0.914	646	1.07	2.8
TT-OSL[3]	1.099	1710	1.00	0.2
TT-OSL[4]	0.928	1039	0.97	29.9

1-Jain et al. (2007); 2-Vandenberghe et al. (2009); 3-Adamiec et al. (2010); 4-Duller et al. (2012)

Keywords: ITL signal; TT-OSL signal; Amazonia; landscape evolution

References

Adamiec, G., Duller, G.A.T., Roberts, H.M., Wintle, A.G. 2010. Improving the TT-OSL SAR protocol through source trap characterisation. *Radiation Measurements* 45, 768-777.

Duller, G.A.T., Wintle, A.G. 2012. A review of the thermally transferred optically stimulated luminescence signal from quartz for dating sediments. *Quaternary Geochronology* 7, 6-20.

Jain, M., Duller, G.A.T., Wintle, A.G. 2007. Dose response, thermal stability and optical bleaching of the 310ºC isothermal TL signal in quartz. *Radiation Measurements* 42, 1285-1293.

Vandenberghe, D.A.G., Jain, M., Murray, A.S. 2009. Equivalent dose determination using a quartz isothermal TL signal. *Radiation Measurements* 44(5), 439-444.

POSTER PRESENTATION

OSL dating of fine-grained quartz from carbonate lake sediments in central-western Brazil

Ribeiro, L. M. A. L.[1,2]; Sawakuchi, A. O.[2]; Sallun Filho, W.[2,3]
1 CPRM – Geological Survey of Brazil; 2 University of São Paulo, Institute of Geociences, 3 Instituto Geológico – Secretaria do Meio Ambiente do Estado de São Paulo. ligia.ribeiro@cprm.gov.br

The Serra da Bodoquena region comprises one of the largest sites of fluvial carbonate sediment (tufa) deposition from subtropical central-western Brazil. The tufa deposition occurs alongside the river channels, forming mainly barrage-type deposits over forested palustrine areas. Associated with the river channels it is usual to find micrite (carbonate mud) accumulations that form large floodplains and abandoned oxbow lakes associated with the drainage basins. The largest occurrence of these micrite accumulations has an area of 110,000 m^2 (approximately) and 6 meters depth. The micritic sediments are unconsolidated, range in color from beige to gray depending on organic matter content, contain more than 90% calcium carbonate as calcite, and a small volume of terrigenous sediments. The deposit has a large amount of bioclasts (mainly represented by gastropod shells) spread over the deposit. However, well-preserved shells without reworking and suitable for ^{14}C dating occur only in a few levels of the deposit. The main goal of this work is to apply OSL-SAR dating in a 6-meter sequence of micritic sediments by using detrital quartz in the fine silt fraction (4-11 μm). Well-preserved shells from four stratigraphic levels were dated using ^{14}C for comparison with OSL ages. Radionuclide concentrations for dose rate determination were measured by gamma spectrometry with a high-purity germanium detector (HPGe) encased in an ultralow background shield. The samples have dose-rates varying between 1 and 2 Gy/ka. A dose recovery test was performed with quartz in the fine silt fraction, using a pre-heat temperature of 200ºC and given doses of 5 and 30 Gy. The measured to given dose ratios were 0.96 and 1.00, respectively for 30 and 5 Gy, with recycling ratios between 0.9 and 1.1 and recuperation less than 5% for all measured aliquots. When compared to coarse-grained quartz (180-250 μm) from tufa barrage samples, the fine-grained quartz extracted from the micrite has higher sensitivity and equivalent dose distributions with very low overdispersion. This pattern permits to infer a different process of bleaching (eolian?) for the fine-grained quartz, compared to the coarse-grained quartz transported by fluvial processes in the tufa barrages alongside the rivers. The four levels dated by ^{14}C are located in the middle part of the deposit and have ages ranging from 2.5 to 5.6 ka. The equivalent doses obtained for OSL samples from the top and base of the profile were respectively 1.19±0.06 and 28.91±0.22 Gy. It is possible to estimate at least 14 ka for deposition of the studied micrite sequence. OSL ages from eight stratigraphical levels and their comparison with ^{14}C ages will be presented at the workshop.

ORAL PRESENTATION

Exploration and application of post-infrared high-temperature infrared stimulated luminescence dating techniques to investigate marine terrace deposits along the northern San Andreas Fault

Roozeboom, Jennifer E.[1*], Spencer, Joel Q.G.[1], Prentice, Carol S.[2], DeLong, Stephen B.[2]
[1]Department of Geology - Kansas State University, Manhattan, KS 66502, USA; joelspen@ksu.edu
[2]US Geological Survey - 345 Middlefield Rd MS 977, Menlo Park, CA 94025, USA; cprentice@usgs.gov, sdelong@usgs.gov
[*]Corresponding author: jboswell@ksu.edu

Late Quaternary slip rates for the northern San Andreas Fault (SAF) have been calculated, but are dependent upon the accuracy of the ages and the correlation of geomorphic features across the fault. U-series analyses of coral from two exposures of sediment mantling the lowest extensive marine terrace along the northern California coast – the Point Arena (PTA-) terrace – suggest an age of ~80 yr B.P., which is consistent with marine oxygen isotope substage 5a chronology. Earlier work using the single-aliquot regenerative-dose (SAR) approach with quartz suggest that either the Optically Stimulated Luminescence (OSL) may have reached dose-saturation levels, or was poorly bleached prior to deposition, giving discordant results compared to U-series ages. The post-infrared high-temperature infrared stimulated luminescence (pIRIR) technique for feldspars has been shown to produce accurate ages up to 600 ka and in suitable low-dose environments, up to ~1 Ma. We investigate an alternative luminescence dating approach, the pIRIR dating of potassium-rich feldspar minerals using SAR protocols, to correlate the PTA-terrace across the San Andreas Fault and test previously estimated Quaternary slip rates. Ratios from dose-recovery tests that are close to unity indicate a $pIRIR_{225}$ measurement, with 250°C 60-s preheat, is the most appropriate approach. Our luminescence data, including assessment of fading, residual dose levels and preliminary ages for marine terrace deposits may provide a technique for correlating marine terraces along the northern California coast.

ORAL PRESENTATION

Moving away from quartz and feldspar: evaluation of OSL dating of other silicate minerals and volcanic glasses

Sawakuchi[1], André O., Giordano[2], Daniele, Mineli[1], Thays D., Nogueira[1], L., Abede[3], T.A.
1- Luminescence and Gamma Spectrometry Laboratory – LEGaL, Institute of Geosciences, University of São Paulo, Rua do Lago, 562, 05508-080 São Paulo, Brazil (andreos@usp.br)
2-Earth Sciences Department, University of Torino, Via Valperga Caluso, 35, 10125 Torino, Italy (daniele.giordano@unito.it).
3- MASSA spin-off, CNR Pisa, via Moruzzi 1, 56124 Pisa, Italy

The luminescence geochronology research has focused on the development of dating protocols for quartz and feldspar. The determination of precise absolute ages of Quaternary volcanic rocks is still challenging. Well established protocols for sediment dating using quartz or feldspar are limited to ages up to few thousand years, despite promising possibilities to extend the age range using isothermal thermoluminescence and thermal transfer optically stimulated luminescence (OSL) of quartz. In this study, we investigated the OSL characteristics of volcanic glass (dacitic and basaltic) and other minerals (olivine, biotite, garnet and kyanite) commonly present in volcanic rocks and/or in the heavy mineral fraction of sediments. The employed glasses are constituted by a natural and a remelted and homogenized (via rotational rheometry) dacite from a Cretaceous volcanic sequence in the Rio Grande do Sul region (Brazil) and a remelted basaltic glass from the 1993 eruption of Mount Etna (Italy). The investigated crystals were separated from various peridotitic and metamorphic rocks. Luminescence measurements were carried out on multigrain aliquots (180-250 µm) using an automated Risø TL/OSL DA-20 system equipped with Hoya U-340 filters (290-370 nm) and built-in beta radiation source (dose rate=0.111±0.003 Gy/s). We investigated the presence of blue stimulated luminescence (BSL) and infrared stimulated luminescence (IRSL) signals in aliquots of the studied materials irradiated with 100 Gy of beta dose after bleaching. All materials present BSL signals, with dacitic glass, biotite and garnet showing higher BSL signals. Significant IRSL signals were observed in dacitic glass, biotite, garnet and kyanite. Dose response curves suggest that the BSL signals of all studied materials are suitable to recover equivalent doses ($2D_0$) from hundreds to few thousands of grays. Dose recovery tests using the BSL signal of the volcanic glass samples showed good recycling ratio (0.90-1.10), recuperation less than 10% and calculated-to-given dose ratios of 0.98±0.11 (basaltic glass) and 1.01±0.03 (dacitic glass), for a given dose of 100 Gy. The studied dacitic and basaltic glass are suitable to estimate equivalent doses up to 1300 and 900 Gy ($2D_0$), respectively. However, significant athermal fading was detected for the BSL signal of the studied volcanic glass samples. Biotite, garnet and kyanite stand out due to their higher saturation doses compared to the volcanic glass samples. Biotite, garnet and kyanite are common heavy minerals in sediments. These minerals can possibly extend the age limit of OSL dating of sediments beyond the Quaternary in low dose rate environments (0.5-1 Gy/ka) usually found in geological settings of Brazil. Measurements for evaluation of BSL signal stability of the mineral samples and for testing post-IRIR signals are being performed and will be presented in the workshop.

POSTER PRESENTATION

OSL chronology of marine terraces between Trabzon-Rize/Turkey: Initial findings

Mustafa Softa[a,b], Joel Spencer[b], Tahir Emre[a], Hasan Sözbilir[a], Mehmet Turan[c]
[a]Department of Geology, Dokuz Eylul University, TR 35397, Izmir
[b]Department of Geology, Kansas State University, USA 66506, Manhattan
[c]Department of Geology, Karadeniz Technical University, TR 61080, Trabzon
(mustafa.softa@deu.edu.tr)

Quaternary marine terraces in the coastal region of Pontides and northeastern Turkey are valuable archives of past sea level change. Therefore, it is important to find marine terrace levels and distinguish the key horizon. Also, stratigraphic-sedimentological analyses of these markers may provide information on the regions influenced by active tectonic deformation. The Quaternary marine terraces investigated in this study are located in the southeastern portion of the Black Sea basin in between the Trabzon-Rize regions. The terraces range in height from 1 to 17 m, and mainly comprise sand- and gravel-sized clasts of basalt, andesite and limestone, ranging in diameter from 0.5 to 40 cm. These clasts have elipsoidal, square or flat shapes. Initial field observations indicate that the marine terraces increase in height and thickness from west to east.

This research marks the first time OSL techniques have been used to date marine terraces in the Trabzon-Rize study area. Several OSL samples were collected from 3 marine terraces that extend between the Trabzon and Rize regions. In this study we are investigating 1-mm or 3-mm quartz aliquots. Our initial results indicate (i) nearly all samples so far analyzed show good luminescence characteristics, (ii) little evidence of signals with IR stimulation, but (iii) broad D_e distributions. These initial findings will be discussed at the workshop.

Keywords:
Quaternary Marine Terraces, OSL Dating, Northeastern Pontides, Black Sea Basin

ORAL PRESENTATION

Testing OSL approaches to constrain late Pleistocene lake fluctuations in the Sevier Desert, Utah

Joel Q. G. Spencer[1], Charles G. Oviatt[1], Yuxin Fan[1,2]
[1]Department of Geology, Kansas State University, Manhattan, KS 66506, USA, joelspen@ksu.edu
[2]School of Earth Sciences, Lanzhou University, Lanzhou, Gansu 730000, China

The chronology of lake-level changes during the late Pleistocene in the Lake Bonneville basin, Utah, is currently understood in a general way. Because the regressive phase of the lake occurred during a critical time in the history of the basin (climate was changing rapidly, humans were moving into suitable habitats that were being made available by the decline of the large lake), it is important to improve the dating of paleohydrologic and paleoclimatic events. The Sevier basin was integrated with the rest of Lake Bonneville during the time when its highest shorelines were being formed, including during the long period of development of the Provo shoreline (~17.6-14.6 cal ka). The lake regressed rapidly from the Provo shoreline (~1465 m) to the altitude of the divide between the Sevier basin and the Great Salt Lake (GSL) basin (~1390 m), then split into two lakes. In the GSL basin the lake continued to decline as a closed-basin lake, and the lake in the shallow Sevier basin overflowed into it along a large river (the ancestral Sevier River). An extensive wetland, fed by runoff from the Sevier and Beaver Rivers, and by groundwater discharge, developed over much of the Sevier Desert floor during the early Holocene.

This study applys optically stimulated luminescence (OSL) dating techniques to determine the age of deposits and landforms formed from the latest Pleistocene to early Holocene in the Sevier basin. Samples from two main geomorphological features associated with successively lower lake levels are the focus of this work: shorezone barriers related to the Provo shoreline and gravel barriers and spits marking the Gunnison shoreline. Radiocarbon has been used extensively to determine the chronology of these events but a record of precise timing is hampered by a combination of poor precision from conventional ^{14}C methods, errors from calibration, and overestimated ages thought to be due to a terrestrial reservoir effect from groundwater input. Despite the limitations in the radiocarbon dataset, many sites in the Sevier basin and numerous other Pleistocene Lake Bonneville localities are useful for testing OSL dating methods. Ultimately OSL may be utilized to reduce radiocarbon scatter and identify and correct for age overestimation. This presentation will evaluate the OSL data we have produced and compare it to the existing radiocarbon chronology.

POSTER PRESENTATION

Quaternary megaflood chronology from infrared stimulated luminescence dating of flood sands, eastern Himalaya

Turzewski, Michael D. (University of Washington, Earth and Space Sciences, zewski@uw.edu)
Feathers, James K. (University of Washington, Anthropology, jimf@uw.edu)
Huntington, Katharine (University of Washington, Earth and Space Sciences, kate1@uw.edu)

Sedimentary evidence suggests that high-magnitude glacial outburst floods occurred repeatedly throughout the Quaternary on the Yarlung-Siang-Brahmaputra River in the eastern Himalaya. Studies indicate that these megafloods were highly erosive, but there is still debate over the role of these extreme events in long-term river incision within the region. A chronology of megaflood events must be developed in order to constrain megaflood frequency and to better understand the long-term impact of these events. Although remnant glacial-lake terraces from the source of these floods have been well-dated using optically stimulated luminescence and radiocarbon methods, the ages of downstream flood deposits are still unknown.

Here we present results from dating downstream slackwater megaflood deposits using single-grain infrared stimulated luminescence (IRSL) dating of feldspar. We chose single-grain methods because of partial bleaching of the flood sediment during transport and apply a minimum age model to account for the youngest, fully bleached grains. An individual fading correction was applied to each grain because of anomalous fading issues present in feldspar. Using these methods, a modern test-sample was analyzed from a deposit sourced from a historic landslide-dam outburst flood that occurred in the region in the year 2000. This sample produced a non-zero minimum age component of 1300 ± 300 yr B.P, which is much older than expected. Samples from ancient megaflood deposits show various bleaching patterns; some are relatively well-bleached, whereas others are clearly partially bleached. Four megaflood deposits have minimum ages within error that range from ~20-25 ka, which may indicate deposition from the same megaflood event or a series of events over that time period. Four other megaflood deposits date >30 ka, potentially matching older glacial-lake terraces that are radiocarbon dead.

More grains will be analyzed for all samples to allow us to refine our interpretations. An additional sample from the historical flood will be dated and compared to the test sample described above. The ancient deposits will be sampled for radiocarbon dating during fieldwork next year and compared to results from IRSL methods. Results from this project will support the hypothesis that slackwater flood deposits were indeed sourced from dated glacially-dammed lakes during megafloods, and will offer us important insight about the timing of these events throughout the Holocene and late-Pleistocene.

ORAL PRESENTATION

Using AMS ^{14}C dating of short-lived fossil plants to constrain quartz OSL depositional ages of a glaciofluvial terrace

Hong Wang, Sebastien Huot
Illinois State Geological Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, Champaign, IL 62820
hongwang@illinois.edu; shuot@illinois.edu

Luminescence dating of glaciofluvial (outwash) terraces is challenging because its depositional environment does not usually allow sediments to be fully bleached. For example, high suspended sediment loads and rapid aggradation near ice margins reduce the opportunity for full bleaching before burial. We used the AMS ^{14}C dating method on short-lived fossil plants to constrain the quartz OSL dates for the depositional age of an outwash terrace in the Illinois River valley.

The outwash terraces were observed at four locations along the middle Illinois River valley and within the glaciated region of the Wisconsin Episode. Two till deposits, locally known as the older Tiskilwa and younger Batestown Formations, have been mapped in the valley walls, but till deposits are notably absent in the outwash terraces at the same elevations. This suggests the meltwater that deposited and shaped the terrace could have washed both till units away from the valley. Hence, this outwash terrace was formed after the till formation. A third re-advance of the ice margin of the Lake Michigan Lobe of the Laurentide Ice Sheet only reached to the northeast corner of Illinois and never reached to the Illinois River valley. The timing of the third re-advance is correlative to the period of the Heinrich Satdial 1 dune formation in the middle Illinois River valley. The outwash terrace is correlative to the glaciofluvial (outwash) deposits that underpins the Heinrich stadial 1 dune deposit in the upland bordering the Illinois River valley. Hence, the outwash terrace in the river valley was likely formed before the third re-advance of the ice margin of the Lake Michigan Lobe.

Recent mapping has shown that ice-walled lakes were common on top of end moraines, and AMS ^{14}C dating of short-lived fossil plants found within ice-walled lake deposits provides accurate and precise deglacial chronology for the history of ice margin fluctuations in Illinois. We compiled these AMS ^{14}C dates and with consideration of the stratigraphic relationships described, constrained the age of the outwash terrace between 21.2 and 17.6 calibrated ka (thousand years ago). With these boundary conditions, we examined the possibility of directly dating glaciofluvial deposits by luminescence dating on quartz. Promising results from quartz OSL dating on small aliquots (2 mm) will be discussed in this forum.

POSTER PRESENTATION

New OSL dating results from the Nussloch loess section near Heidelberg/Germany

Wolpert, U.[1], Fuchs, M.[1], Antoine, P.[2]

1. Department of Geography, Justus-Liebig-University Giessen, 35390 Giessen, Germany (e-mail: Urs.T.Wolpert@erziehung.uni-giessen.de)
2. Laboratoire de Géographie Physique (UMR 8591 CNRS-Univ. Paris I) Environnements quaternaires et géoarchéologie, 1 Place Aristide Briand, F-92195 Meudon Cedex, France

The Nussloch loess sequence marks one of the most complete loess profiles to reconstruct the palaeo-environmental conditions of Europe during the last Interglacial-Glacial cycle. The loess section is located in a Triassic limestone quarry ca 10 km south of Heidelberg in southern Germany. Distinguished by an exceptionally thick loess-paleosol sequence, the site spans from Weichselian Middle Pleniglacial (ca 55 ka) to Upper Pleniglacial deposits (ca 19 ka). Since the sequence was deposited with a very high sedimentation rate, high resolution studies of the last Interglacial-Glacial cycle are possible. Thus the Nussloch loess sequence serves as a connection for loess sections all over central Europe. Therefore a great amount of research on the stratigraphy, chronometry and palaeo-environmental reconstruction of Nussloch was done in the last 25 years. Antoine et al. (2001) differentiated the profile into 4 stratigraphic sequences: First a basal soil complex (MIS 5). A small sequence of loess and aeolian sands (MIS 4), followed by paleosols (Cambisols, Tundra Gleys) and also loess (MIS 3). The upper sequence is composed of thick loess and tundra gley soil layers (MIS 3, MIS 2). Also a lot of work has been put into building a high resolution chronostratigraphy at Nussloch. The dating work so far includes TL (Zöller et al. 1988), IRSL (Lang et al. 2003), OSL (Tissoux et al. 2010) and ^{14}C (Hattè et al. 2001) ages. Despite these efforts there are still uncertainties regarding the chronological position of several marker horizons of the Nussloch loess section. Our work aims to date samples from a new profile, sampled in 2012, using OSL. The samples are taken from certain points of the profile containing specific paleosols, as well as a tephra layer, which are all serving as important markers in the profile. With the new OSL ages we attempt to clear uncertainties about age and position concerning those markers, in respect of establishing a satisfactory chronology.

References:

Antoine, P., Rousseau, D.-D., Zöller, L., Lang, A., Munaut, A.V., Hatté, C., Fontugne, M., 2001. High resolution record of the Last Interglacial-Glacial cycle in the loess palaeosol sequences of Nussloch (Rhine Valley - Germany). Quaternary International 76/77, 211-229.

Hatté, C., Pessenda, L.C., Lang, A., Paterne, M., 2001. Development of accurate and reliable ^{14}C chronologies for loess deposits: application to the loess sequence of Nußloch (Rhine Valley, Germany). Radiocarbon 43, 611-618.

Lang, A., Hatté, C., Rousseau, D.-D., Antoine, P., Fontugne, M., Zöller, L., Hambach, U., 2003. High-resolution chronologies for loess: comparing AMS ^{14}C and optical dating results. Quaternary Science Reviews 22 (10-13), 953-959.

Tissoux, H., Valladas, H., Voinchet, P., Reyss, J.L., Mercier, N., Falguères, C., Bahain, J.J., Zöller, L., Antoine, P., 2010. OSL and ESR studies of aeolian quartz sediments from the upper Pleistocene loess sequence of Nussloch (Germany). Quaternary Geochronology 5 (1-2), 131-136. Special Issue LED 2008.

Zöller, L., Stremme, H., Wagner, G.A., 1988. Thermolumineszenz-Datierung an Löß-Paläoboden-Sequenzen von Nieder-, Mittel- und Oberrhein/Bundesrepublik Deutschland. Chemical Geology (Isotop Geoscience Section) 73, 39-62.