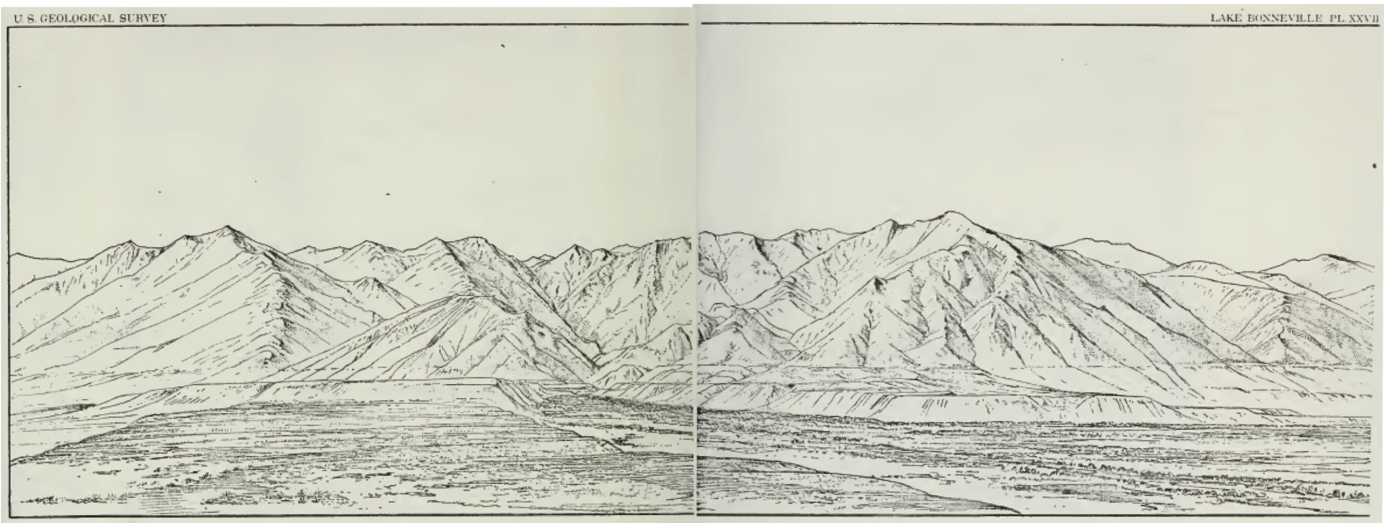
9th New World Luminescence Dating Workshop

August 15-18, 2013 Logan, Utah

Sponsored by: USU Luminescence Lab / USGS Luminescence Lab
Logan, Utah — Denver, Colorado

http://www.usu.edu/geo/luminlab/2013conference.html



THE ANCIENT DELTAS OF LOGAN RIVER, AS SEEN FROM THE TEMPLE.

On behalf of the Utah State University (USU) and the U.S. Geological Survey (USGS) Luminescence Labs, it is our distinct pleasure to welcome you to the Rocky Mountains of Utah and the 9th Annual New World Luminescence Dating Workshop.

Tammy, Michelle, and Shannon

Agenda, Maps of the USU Campus, Book of Abstracts, List of Participants, Information related to the Proceedings volume of Quaternary International and Special Appedices of citations

Ice Breaker 6:30 - 10 pm Thursday

Conference Dinner 6:30 - 10 pm Friday

Logan Golf Course both events

Ice breaker 6:30 pm Thursday August 15th, presentations on Friday August 16 – Saturday August 17th, Dinner 6:30 pm Friday, and all-day field trip to the Lake Bonneville Basin on Sunday August 18th, 2013

Co-Hosts: Tammy Rittenour, USU , Shannon Mahan, USGS, and Michelle Nelson, USU

REGISTRATION FEES:

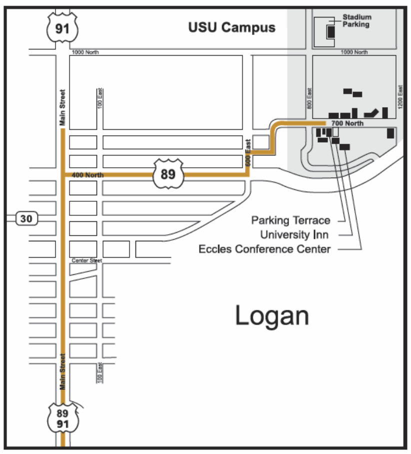
Professional Registration $180 Student Registration $80

Optional fees:

Field Trip Registration Sunday, August 18 $28 Conference Dinner Friday, August 16 $30

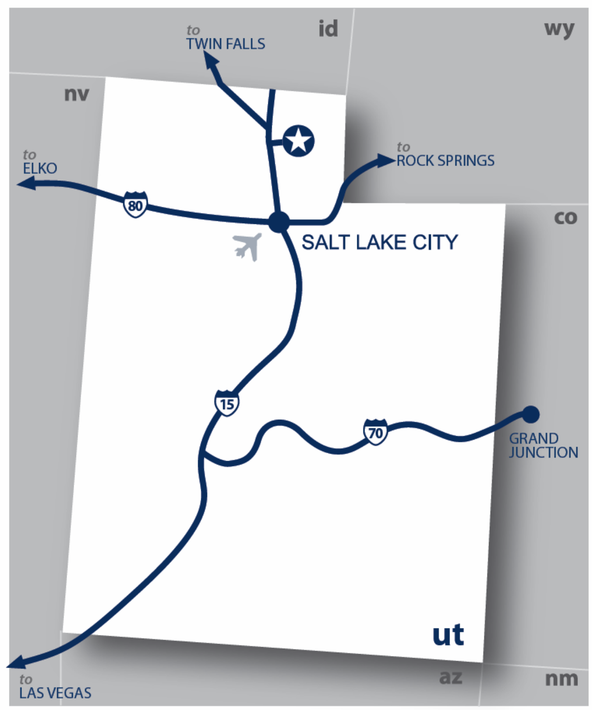
Dinner Companion $30

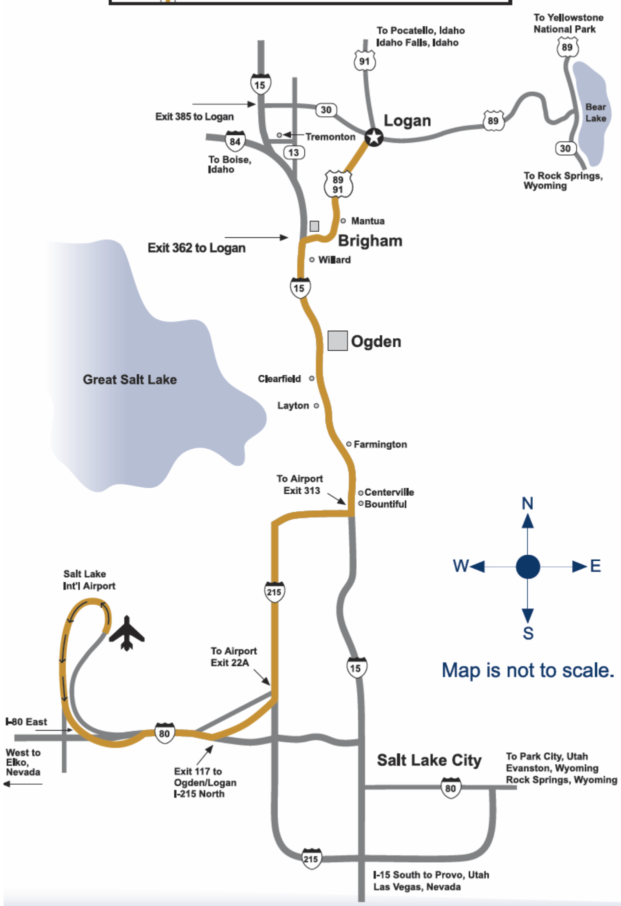
MAPS OF THE CAMPUS/CONFERENCE CENTER



university inn and conference center

MAPS & DIRECTIONS





DRIVING DIRECTIONS TO LOGAN

See back for detailed map

- 89 miles. Drive time = 1 hr. 20 min
- Leave airport taking I-80 East toward Salt Lake/Ogden
- Take Exit 117 to I-215 North toward Ogden/Logan
- I-215 will merge onto I-15 North
- Go North on I-15 approx. 55 miles
- Take first Brigham City exit, Exit 362 (1100 South St.)
- Continue through two stoplights, up the hill, going East on Hwy 89/91
- Go approx. 25 miles through the canyon
- Hwy 89/91 becomes Main Street in Logan
- Turn right onto 400 North, go six blocks (to third stoplight)
- Turn left onto 600 East, go one block
- Turn right onto 500 North, go one block
- Turn left onto 700 East, follow road uphill curving to the right
- Go through the stoplight
- Parking Terrace is 1/2 block on your right
- University Inn entrance is the next driveway on your right, go through parking lot to unload at front entrance
- Eccles Conference Center is a short walk from the Parking Terrace, just beyond the University Inn (refer to map)

UtahStateUniversity

ACCOMMODATIONS: OFF-CAMPUS

Best Western Inn-Complimentary Shuttle to USU Campus

$89.00 dbl occ/per night. 250 North Main Street, Logan, UT 84321

Phone: 435-752-5700

Days Inn and Suites Logan-Complimentary Shuttle to USU Campus

$89.00 dbl occ/per night. 447 N Main Street, Logan, UT 84321

Phone: 435-752-5700

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9th New World Luminescence Dating and Dosimetry Workshop

Geology Building Auditorium
Utah State University
Logan, Utah
August 15-18, 2013

Tammy M. Rittenour, USU	tammy.rittenour@usu.edu
Michelle Summa-Nelson, USU	michelle.summa@usu.edu
Shannon Mahan, USGS	smahan@usgs.gov

Oral Presentations—Geology Building Auditorium rm 105

Poster Presentations—Eccles Conference Center rm 201/203

Friday, August 16, 2013 ------------------------Presentations 8:45 am-12 pm, 1-6 pm

Saturday, August 17, 2013 ---------------------Presentations 8:00 am-12 pm, 1-6 pm

Sunday, August 18, 2013----Field Trip 8am-5 pm (drop-off at Salt Lake City airport possible)

Emergency Contact: Tammy Rittenour—435-213-5756

A BIG THANK YOU to Elizabeth Huss, USGS summer intern from the University of New Hampshire, for putting this booklet together, exhibiting grace under pressure, and being unfailing cheerful when faced with many changes!--The Organizing Committee

Dining guide on the USU Luminescence Lab website

Thursday, August 15, 2013

6:30-10:00 **Ice Breaker** (Logan Country Club, 710 North 1500 East, Sage Room, upstairs and on balcony)

Friday, August 16, 2013 (Breakfast on your own before meeting)

8:20-8:45 Name Tag and Workshop Booklet Pick-Up (Geology Building, inside main entrance)

8:45-9:00 Tammy Rittenour—*Welcome and Logistics*

SESSION A: Optically Stimulated Luminescence Using Feldspars—Session Chair: Ed Rhodes

9:00-9:30 C.P. McGuire: *A Post-IR IRSL procedure for K-Feldspar Grains in a Fluvial Setting to Estimate Transport Rate*

9:30-10:00 N.D. Brown: *Using single grain K-feldspar post IR_{50} $IRSL_{225}$ to constrain depositional dynamics of alluvial fan terraces in southern Baja California Sur, Mexico*

10:00-10:30 **Coffee Break** (Eccles Conference Center, Room 103)

10:30-11:00 E.J. Rhodes: *Single grain post-IR IRSL dating of K-feldspar: Practical and theoretical considerations*

11:00-12:00 INVITED KEYNOTE—M. Jain: *Feldspar Luminescence: A review and look forward*

12:00-1:00 **LUNCH ON YOUR OWN**

SESSION B: Luminescence Applications: Central Utah, Lake Bonneville and the Snake River Plain—Session Chair: Julie Rich

1:00-1:30 M.C. Summa-Nelson: *Optically Stimulated Luminescence characteristics and ages on quartz sand from Lake Bonneville sediments in Cache Valley, Utah*

1:30-2:00 J.Q.G. Spencer: *Testing and refining the timing of hydrologic evolution during the latest Pleistocene regressive phase of Lake Bonneville*

2:00-2:30 K. Nicoll: *Inadequate Luminescence Dates and Poorly Constrained Age Models Undermine the Younger Dryas Impact Hypothesis*

2:30-3:00 **Coffee Break** (Eccles Conference Center, Room 103)

3:00-3:30 T. Rittenour: *Application of Single-grain OSL dating to alluvial sediments in Range Creek, Utah*

3:30-4:00 R. Bell: *OSL dating of Aeolian sediments in the Bruneau Dunes complex on the western Snake River Plain, Idaho, USA*

4:00-4:30 J. Rich: *Holocene Aeolian sedimentation and climatic implications for the St. Anthony Dunes, Idaho USA*

4:30-6:00 **Poster Session I** (Eccles Conference Center, Room 201/203)

6:30-9:00 **Dinner** (Logan Country Club, 710 North 1500 East, Sage Room, upstairs and on balcony)

Saturday, August 17, 2013 (Breakfast on your own before meeting)

SESSION C: New Developments and Technical Challenges—Session Chair: Kathleen Nicoll

8:00-8:30 L.A. Gliganic: *All mixed up? Using single-grain equivalent dose distributions to shed light on post-depositional mixing*

8:30-9:00 H. Gray: *Towards constraining and quantifying the partial bleaching of Quartz OSL in turbid fluvial environments*

9:00-9:30 J.M. Pierson: *Using Luminescence Production per Unit Dose to Weight Experimental Data*

9:30-10:00 Z. Shen: *A simple mathematical approach toward routine use of fast component in quartz OSL dating*

10:00-10:30 **Coffee Break** (Eccles Conference Center, Room 201/203)

10:30-11:00 M.J. Lawson: *The Advancement of the Component Test for Assessing Signal Contamination within Small Aliquots and Single Grain Measurements*

11:00-11:30 S. Kreutzer: *The R package 'Luminescence': A comprehensive tool for luminescence data analysis*

11:30-12:00 S. Huot: *Looking for Albite in a Pile of Microcline*

12:00-1:00 **GROUP LUNCH** (lunch provided)

SESSION D: Archaeologic and Geologic Applications of Luminescence Dating—Chair: Tammy Rittenour

1:00-1:30 S. Sakai: *Explaining the Change in Production and Distribution Patterns of Olivine-Tempered Ceramics in the Arizona Strip and Adjacent Areas of the American Southwest using Optical Luminescence Dating: Part Two*

1:30-2:00 T. Capaldi: *IRSL thermochronology of the Yucaipa Ridge black, San Bernardino Mountains, southern California*

2:00-2:30 A.O. Sawakuchi: *OSL dating of marine sediments offshore the Amazon River and Congo River*

2:30-4:00 **Coffee Break and Poster Session II** (Eccles Conference Center, Room 201/203)

4:00-4:30 A. Zular: *Abrupt changes in the ITCZ position during the Late Pleistocene recorded by soil formation and dune building in NE Brazil*

4:30-5:00 S. Mahan: *Luminescence Dating of Anthropogenic Features of the San Luis Valley, Colorado: What to Know Before, During, and After Sampling*

5:30-7:00 **USU Luminescence Lab Tour and Reception** (1770 North Research Parkway, suite 123 - corner of 1800 North and 600 East)

Sunday, August 18, 2013

8:00-5:00 **Field trip** (meet in the University Inn Lobby at 8:00 am)

Preliminary observations of single-grain optically stimulated luminescence (OSL) of quartz and post-infrared high temperature infrared stimulation (post-IR IRSL) of feldspars on sand-size fractions of the Providence Mountains alluvial fan chronosequence, Mojave Desert, California

Antinao, J.L.[1*], Baker, S.E.[1], Huenupi, E.[1], McDonald, E.[1]

[1] Desert Research Institute, Reno, NV 89512 USA (jantinao@dri.edu)

{POSTER PRESENTATION}

The Providence Mountains alluvial fan chronosequence represents the response of a Mojave Desert alluvial fan setting to climate change during the Quaternary. Testing the age of the different units of this sequence is an important step is deciphering the potential linkages between climate change (regional and global) and the geomorphic response of these arid catchments. We present here results from tests on samples taken in 2013 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). Tests for single-grain optically stimulated luminescence (OSL) of quartz and post-infrared high temperature infrared stimulation (post-IR IRSL) of feldspars on sand-size fractions of the sediments were accomplished. The sedimentology of the deposits indicates that deposition was in ephemeral, flash-flood settings. Based on results from other settings where debris flows and flash floods are prevalent, we assume that bleaching was accomplished in the channels and hillslopes before the event, instead of taking place during transport. Single grain methods, along with minimum age model determinations, are preferred in this case because the assumed bleaching mechanisms likely yield a sizable population of poorly bleached grains.

Analysis of the first test samples has shown that the OSL-SAR protocol as applied to quartz might be difficult in these units. Quartz from units PM-Qt3 and -Qt4 appears to be dim, showing unstable slow and medium signals. To address the issue of low sensitivity of quartz grains in this region, we have also tested K-Feldspar grains with IRSL and post-IR IRSL protocols. Equivalent dose determinations on both quartz and feldspar of the PM Qt4 and Qt3 samples are of ~ 100 and 400 Gy, respectively, with stratigraphic consistency within units. Fading tests yield g values of 5-10% per decade on feldspar measurements, which could considerably impact the uncertainty determination of calculated ages. We performed EDX-SEM measurements on selected grains after IRSL measurements on feldspar grains. Results indicate highly variable K content, although no clear linkages have been observed between K content and equivalent dose or fading properties. A multiple-method investigation of dose rates is underway to determine ages. In a second stage of this investigation, these ages will be compared with depth-profile cosmogenic ^{10}Be chronology for the same units (McDonald and Gosse, unpublished), in a cross-check of these techniques.

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.

OSL dating of wave-generated sand bars in the lower Tapajós River, eastern Amazônia

L.A. Araki[1*], A.O. Sawakuchi[1], L. Nogueira[1], B.B. Turra[1]

[1]Universidade de São Paulo, Instituto de Geociências – Luminescence Geochronology Laboratory, São Paulo, SP, Brazil. (lina.araki@usp.br)

{POSTER PRESENTATION}

The confluence of Amazonas and Tapajós rivers in eastern Amazônia (-2.3°S, -54.8°W) comprise a stabilized sediment bar, which generates a natural dam in the Tapajós River. This bar is interpreted as an Amazon River levee that grows downstream. The dam effect provokes widening and constant wave action in the lower reach of the Tapajós River. Thus, this portion of the Tapajós River stands out as a "wave-dominated river" characterized by deposition of muddy sediments in deep water (up to 40 m water depth) and development of sand bars that grow upstream (i.e. the opposite direction of the river flow). The sand bars result from alongshore currents associated with waves generated by action of the northeast trade winds in the dam area. The age of the sedimentary features produced by these uncommon fluvial sedimentary dynamics is unknown. In this research, Optically Stimulated Luminescence (OSL) dating was used to determine deposition ages for wave-dominated sand bars and the Amazon River levee that blocks the Tapajós River mouth. We also describe the chronological and sedimentary evolution of this system, combining OSL dating with geomorphological, stratigraphical and facies analysis.

Samples for OSL dating were collected at trenches and bar outcrops using aluminum tubes. Around 200 g for each sample were dried and packed in sealed containers for gamma-spectrometry measurements (using a high-purity Germanium detector (HPGe) and dose-rate calculations. Quartz grain aliquots (180-250 µm) were prepared for OSL measurements in a Risø TL/OSL-DA 20 reader using blue LEDs stimulation (470 nm), Hoya U-340 filters (290-370 nm) and a built-in $^{90}Sr/^{90}Y$ beta radiation source delivering a dose rate of 0.084Gy/s. For each sample, 24 quartz aliquots were measured for equivalent dose estimation using a single aliquot regenerative dose protocol (SAR). The pre-heat temperature was 200 °C and natural doses were calculated using the Central Age Model. A dose recovery test was run with given doses of 84, 33.6 and 2.52 Gy (5 aliquots/given dose). The measured/given dose ratios were respectively 0.96, 0.97 and 1.13. As the values of measured/given dose ratios were close to unity, the samples are appropriate to be used as a natural dosimeter and the selected SAR protocol is adequate for dose measurement.

The minimum and maximum dose rates were, respectively, 0.256 and 1.878 Gy/ka. The OSL ages obtained for the upstream portion of the Amazon River levee were at least 6,743 ± 719 years. The wave-generated bars of the Tapajós River showed three intervals of genesis. The newer interval is around 252 ± 33 and 257 ± 40 years as represented by active bars from opposite channel margins. The older and middle interval comprises stabilized bars covered by vegetation, and the ages are respectively 10,704 ± 773 years and 6,488 ± 189 years.

Despite conditions for wave action, which have been present since at least the Early Holocene, alongshore bar growth does occur in short time periods. Thus, we hypothesize that the increase in local sediment supply, caused by vegetation cover loss, directly determined episodes of sand bar development in the lower Tapajós River. These periods where loss of vegetation occurs could be related to an Early-Mid Holocene drought during which Savanna-type vegetation expanded (Freitas et al., 2001) or related to deforestation and human settlement in the lower Tapajós river region during the last few centuries.

Freitas, H.A., Pessenda, L.C.R., Avarena, R., Gouveia, S.E.M, Ribeiro, A.S., Boulet, R., 2001. Late Quaternary Vegetation Dynamics in the Southern Amazon Basin Inferred from Carbon Isotopes in Soil Organic Matter. Quaternary research, v. 55, n. 1, 39-46.

OSL dating of aeolian sediments in the Bruneau Dunes complex on the western Snake River Plain, Idaho, USA

R. Bell*[1], J. Rich[1]

[1]Department of Geography, Weber State University, 1210 University Circle, Ogden, UT 84408, USA (richardbell1@mail.weber.edu)

{ORAL PRESENTATION}

This preliminary study provides the first age estimates on the Bruneau Dunes located in southwest Idaho, USA. These dunes are positioned in a depression, approximately 5.6 km in diameter, known as Eagle Cove located on the western Snake River Plain. Because of the geomorphic configuration of Eagle Cove, aeolian sediments carried by wind travel into this basin and become trapped; the wind energy decreases while moving out of the basin and the entrained sediment load is deposited creating one of the tallest dune structures in North America standing at >160 m (Greeley and Iverson, 1985). The accumulated aeolian sediments in the center of Eagle Cove create a chain of prominent star dunes that cover approximately 2.4 km^2 and are formed by prevailing bi-directional winds that blow from both the northwest and southeast during the year. Surrounding the cove are fixed linear dunes covered by sagebrush and wild grass. The entire active Bruneau Dune complex and the surrounding inactive dunes cover approximately 20 km^2.

The current climate in this region is classified as semi-arid receiving 200 mm of precipitation, mostly in the form of snow during the winter months. The average temperature is 19.5 °C and ranges from 3 °C in the winter to 33°C during summer months.

A total of six samples were taken from four geographically disparate sites. Two sample sites were located within the fixed dunes that surround Eagle Cove while a third location was a blowout area in the active sands. A fourth sample site was a lacustrine outcrop imbedded in the Bruneau Dune sands from what appeared to be a Pleistocene-aged lakebed. All samples were stratigraphically consistent and optically stimulated luminescence (OSL) provided age control. OSL measures the sample response to environmental ionizing radiation and provides a robust dating technique for aeolian material that determines when the sediments were last exposed to sunlight. OSL samples were processed and analyzed at the Utah State University Optically-Stimulated Luminescence Laboratory in Logan, Utah, USA.

The authors suggest that OSL age estimates of 9.9 ± 2 ka, 7.2 ± 2.2 ka, 3.2 ± 1.2 ka, 1.6 ± 1.2 ka, and 1.2 ± 0.6 ka from the Bruneau Dunes relate to past episodes of increased environmental aridity, which enhanced aeolian activity for the western Snake River Plain. Research by others (e.g., Smith and Betancourt, 2001; Beierle and Smith, 1998; Forman and Pierson, 2003) working in localities near the Bruneau Dunes have suggested a warmer drier climate during time intervals that coincide with the OSL dates determined by this study. The sample from the lacustrine outcrop has an optical age estimate of ~22 ka indicating an episode of increased moisture that most likely restricted dune mobility during that time. An understanding of the sedimentation history of aeolian sequences such as the Bruneau Dunes can assist in providing insight to climatic environmental change for the Snake River Plain.

Beierle, B., Smith, D., 1998. Severe drought in the early Holocene (10,000-6800 BP) interpreted from lake sediment cores, southwestern Alberta, Canada. Palaeo 140, 75-83.

Forman, S. L., Pierson, J., 2002. Formation of linear and parabolic dunes on the eastern Snake River Plain, Idaho in the nineteenth century. Geomorphology 56, 189-200.

Greeley, R. Iverson, J.D., 1985. Wind as a geological process on Earth, Mars, Venus and Titan. Cambridge University Press, Great Britain, 333 pgs.

Smith, F., Betancourt, J., 2001. The effect of Holocene temperature fluctuations on the evolution and ecology of Neotoma (woodrats) in Idaho and northwestern Utah. Quaternary Research 59, 160-171.

Using single grain K-feldspar post-IR_{50} $IRSL_{225}$ to constrain depositional dynamics of alluvial fan terraces in southern Baja California Sur, Mexico

N.D. Brown[1*], E.J. Rhodes[1], J.L. Antinao[2], E. McDonald[2], W.A. Barrera[1]

[1] University of California, Los Angeles, CA 90095 USA (nathan.david.brown@ucla.edu)
[2] Desert Research Institute, Reno, NV 89512 USA

{ORAL PRESENTATION}

Within the extensional basins of the southern tip of Baja California Sur, Mexico, are extensive alluvial fan terraces. The depositional dynamics of these units are largely unknown, because there are many challenges associated with dating the sediments therein: organic material suitable for radiocarbon dating is rare, bioturbation near the surface is common, and post-depositional reworking often precludes terrestrial cosmogenic nuclide dating. Luminescence dating stands as a strong alternative, but must overcome the obstacles associated with potentially rapid, subaqueous deposition (incomplete bleaching), bioturbation (foreign grains), and the typically low sensitivity of quartz grains in areas of active tectonics.

To overcome these difficulties we have chosen to use single grain post-IR IRSL K-feldspar dating (Buylaert et al., 2011). The theoretical advantages of this technique are discussed, with emphasis on the problem of anomalous (athermal) fading.

The issue of finding the true depositional age is considered, and recommendations are made for i) the omission of grains with outlying dose values, and ii) the selection of the burial dose value.

Buylaert, J.P., Thiel, C., Murray, A.S., Vandenberghe, D., Yi, S., Lu, H., 2011. IRSL and post-IR IRSL residual doses recorded in modern dust samples from the Chinese loess plateau. Geochronometria 38, 432-440.

IRSL thermochronology of the Yucaipa Ridge block, San Bernardino Mountains, southern California

Tomas N. Capaldi[1*], Natalia Solomatova[2], Edward J. Rhodes[1]

{ORAL PRESENTATION}

[1] Department of Earth and Space Sciences, University of California, Los Angeles, California, USA
[2] Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California, USA

New luminescence methods have the potential to provide low-temperature thermochronomerty for quartz and feldspar grains (Herman et al., 2010). The goal of the present study is to assess infra-red stimulated luminescence (IRSL) as a low-temperature thermochronometer to constrain the cooling history of uplifted crystalline basement. Yucaipa Ridge block of the San Bernardino Mountains, southern California, provides a suitable location for preliminary experimentation due to its rapid uplift rate of approximately 1.5 mm a^{-1} (Binnie et al., 2008). Luminescence measurements of feldspar grains, derived from a pair of ~300 m vertical transects of igneous and metamorphic rocks within the Yucaipa Ridge block near Forest Falls, California, provide encouraging preliminary results. These feldspar IRSL measurements yield a strong relationship between the fraction of saturation of the samples and elevation. The IRSL measured at 50°C displayed significant fraction of saturation (90-95%) for samples collected at higher elevations, corresponding to apparent ages in excess of ~150,000 years. Samples from lower elevations displayed a lower fraction of saturation and lower apparent age estimates, suggesting more recent exhumation and cooling.

Binnie, S.A., Phillips, W.M., Summerfield, M.A., Fifield, K.L., Spotila, J.A., 2008, Patterns of denudation through time in the San Bernardino Mountains, California: Implications for early-stage orogenesis, Earth and Planetary Science Letters, v.276, 62-72.

Herman, F., Rhodes, E.J., Jean, B.C. and Heiniger, L., 2010, Uniform erosion rates and relief amplitude during glacial cycles in the Southern Alps of New Zealand, as revealed from OSL-thermochronology: Earth and Planetary Science Letters, 297(1-2): 183-189.

Black Mesa revisited: Climate change impacts on sand supply and availability and the formation and stability of late Quaternary sand sheets and falling dunes, southern Colorado Plateau, USA

A. Ellwein[1], S. Mahan[2*], L. McFadden[3]

[1]Western State Colorado University, Dept. of Natural and Environmental Sciences, Gunnison, CO 81231 USA
[2]U.S. Geological Survey, MS 974, Denver Federal Center, Denver, CO 80225 USA
[3]University of New Mexico, Earth and Planetary Sciences, Albuquerque, NM 87131 USA

{POSTER PRESENTATION}

Stabilized sand dunes that exhibit incipient to well-developed soil profiles are common on the southern Colorado Plateau. Eolian sediments are often thought to be active during arid conditions and stabilized as effective precipitation increases. In this study, detailed geomorphic mapping, analysis of soil-stratigraphy, and 15 optically stimulated luminescence (OSL) ages from eolian sand dunes of the Black Mesa region of northeastern AZ, reveal a major period of eolian deposition from roughly 15-30 ka and sand sheet stabilization from 8-12 ka. Both periods are characterized by higher effective precipitation than the present throughout the region (e.g. Anderson, 2000).

The mid- to late Holocene eolian record indicates local linear dune construction resulting from small areal increases in sediment supply but very little localized reactivation of previously stabilized sand sheets. Cooler, wetter, and more variable climatic conditions during MIS 3 and 2 resulted in increased sediment supply from stream channels and floodplains, rapidly filling tributary canyons with eolian sediments up to 60 km downwind from their source and these deposits have remained largely stable since their deposition. This observation is corroborated by dispersion (or scatter) in the OSL radial plots of the measured equivalent doses. All of the younger dune reactivation samples show over-dispersion of 34-24% and two distinct populations with very little scatter other than within the population clusters, while the older topographically controlled samples show a dispersion of 4-18% and only one population with almost no scatter around the mean of the population.

Topographically controlled falling dunes and sand ramps on Black Mesa are preserved because of their geomorphic position and provide evidence of the paleoenvironmental state of the fluvial and eolian systems before, during, and immediately after the last glacial maximum on the southern Colorado Plateau. OSL ages allow us to extrapolate that while the stability and age of eolian deposits varies widely between landscape positions in the Colorado Plateau; these same eolian deposits in similar landscape positions have identical forms, stratigraphic characteristics, soil profile development, and ages of development.

SAR dating of the Holocene eolian sand depositional record San Luis Province, western Argentina

Steven L. Forman[a] and Alfonsina Tripaldi[b]

[a]Univ. of Illinois at Chicago, Chicago, Illinois 60607, USA (slf@uic.edu)
[b]University of Buenos Aries, IGEBA-CONICET, Buenos Aries, Argentina (alfo@gl.fcen.uba.ar)

Stabilized dune fields are common in western Argentina and reflect potentially drought variability in the late Quaternary. Geochronologic studies focused on the San Luis dune field on the western Pampas, with a mean annual precipitation of ~ 700 mm. Exposures through compound and digitate parabolic dune reveal a complex eolian history with multiple buried soils and intercalated eolian sand. Optical dating employed the 100-150 micron quartz grains using single aliquot regeneration (SAR) protocols. These eolian sands are immature mineralogically with quartz percentages between 40 and 50%. Unlike other Andean-sourced quartz, Pampean sediments show a clear dominance of fast luminescence component with medium and slow components near background levels. This quartz exhibits relatively small sensitivity changes (<10%) through the SAR protocols and with repeat doses yielding near identical luminescence response. Further, a known dose given in the laboratory was recovered by the SAR protocols. Geochronometric sensitivity of Pampean quartz reflects full solar resetting, the dominance of fast luminescence components and high light output, possibly reflecting multiple dose and solar reset cycles for this quartz.

There are thick sequences (5-7 m) of eolian cover sands on upland surfaces within the Rio Quinto watershed. These near continuous sequences of eolian sand initially deposited ca. 11.6 to 10 ka ago and continuing to at least 1 ka reflects deposition of a sand sheet, probably with sand sourced from an adjacent aggraded fluvial systems. Post ca. 1 ka the Rio Quinto degraded by 30 m, isolating many upland surface from further eolian additions. Sand sheet accretion is associated with drier conditions than today with predominance of grassland versus savannah-type environments (Espinal) that were common prior to European settlement. This dry condition is associated with a weakened South American Monsoon and less import of Amazon-sourced moisture from orographic jets that are confined to the Andean Front.

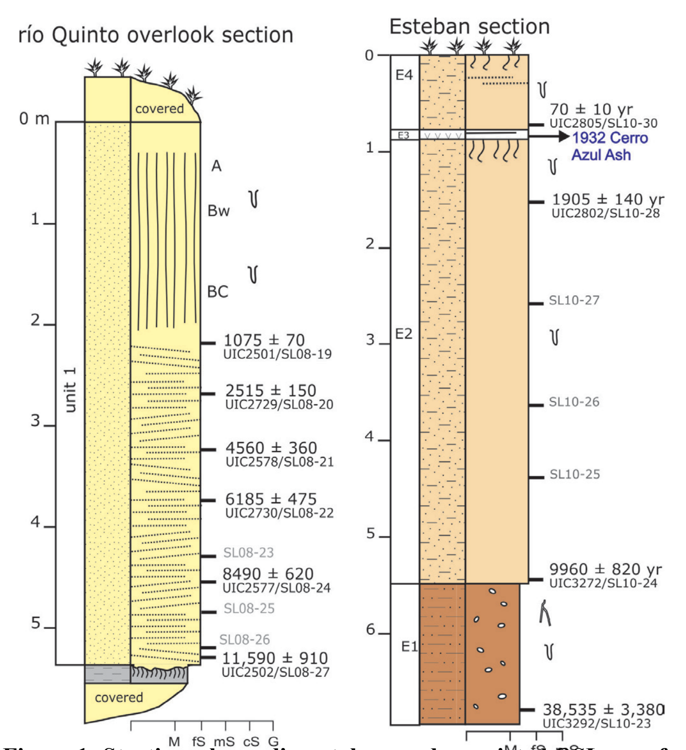

Figure 1: Stratigraphy, sedimentology and associated OSL ages for sections on upland surfaces in the Rio Quinto watershed, San Luis Province, western Argentina

Near the top of many sections is a distinct ash that is probably associated with the 1932 Cerro Azul phreatic eruption, which in many places is immediately covered by eolian sand. The ash may have increased land surface hydrophobicity during a mulit-year, particularly dry period, enhancing sediment availability. In turn over grazing and expansion of acreage to wheat, like the 1930's Dust Bowl on the Great Plains, expanded the footprint of eolian activity.

All mixed up? Using single-grain equivalent dose distributions to shed light on post-depositional mixing

L.A. Gliganic[1*], J.-H. May[1], T.J. Cohen[1]

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{ORAL PRESENTATION}

The optically stimulated luminescence (OSL) signal from quartz grains can be used to estimate the depositional age of sediments that were fully bleached during transport and have not been mixed after deposition. However, sediment that is transported fluvially may not have been exposed to sufficient sunlight to bleach the latent OSL signal, while stable land surfaces on which soils are developing will likely be subject to mixing processes such as bio- and pedoturbation. In these cases, large equivalent dose (D_e) datasets derived from individual sand-sized quartz grains can often shed light on the depositional and post-depositional histories of sedimentary deposits.

Here, we report the results of geochronological investigations of Mt Chambers Creek alluvial fan, on the eastern footslopes of the Flinders Ranges, South Australia. We collected 13 OSL samples from bank exposures and pits excavated into relict floodouts to reconstruct late Quaternary alluvial dynamics. The D_e values from individual quartz grains were measured using the single-aliquot regenerative-dose procedure. Over-dispersion values of between 26 and 68% were obtained during measurement of the natural signal. These values are significantly higher than the <10% over-dispersion values obtained during dose-recovery experiments, suggesting that most of the deposits were poorly bleached, mixed, and/or experienced significant dose rate heterogeneity. A suite of models, including the central and minimum age models and the finite mixture model (FMM) were used to elucidate these issues. The FMM was applied with a range of input parameters and the results were compared to ensure the identified components were not artifacts of the model.

Despite the alluvial nature of the sediment, the D_e data is not consistent with a scenario involving partial bleaching during transport. While dose rate heterogeneity almost certainly increases the over-dispersion of D_e data, the generally homogeneous nature of the deposits suggest that it is unlikely to cause all of the observed variability. Given the context and D_e data, post-depositional mixing by bio- and pedoturbation is inferred to be the major process increasing over-dispersion. We infer that depositional ages for each sample are reflected by the major FMM component and that the secondary components represent intrusive younger grains. The fan-wide presence of contemporaneous intrusive grain-populations suggests that post-depositional mixing occurred in phases, possibly associated with intervals of increased bio- and pedoturbation related to enhanced magnitude and/or frequency of precipitation.

Towards constraining and quantifying the partial bleaching of Quartz OSL in turbid fluvial environments using fluid dynamics

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{ORAL PRESENTATION}

Fluvial sediments are the frequent target of optically stimulated luminescence (OSL) based geochronology because of their importance in deciphering climatic and tectonic change. However, a more complete understanding of partial bleaching as it occurs in this environment can improve the utility of OSL in fluvial environments. Attenuation of solar energy through the water column, flocculation of the particles, reworking of sediments during high water, and randomization of the particles in turbulent systems (i.e. turbidity) have all been cited as factors in partial bleaching (Lepper 1995, written communication) . In particular, river turbidity is often alluded to as the main source of partial bleaching, yet this relationship has not been explored in detail within the published OSL literature. The apparently better bleaching of an OSL signal in fluvial sand grains compared to silt is also not fully understood (Olley *et al.*, 1998; Colls *et al.*, 2001; Wallinga, 2002b), although Truelsen and Wallinga (2003) looked at thermal transfer effects on grain size as a way to understand the phenomenon. Since a more complete comprehension of partial bleaching allows for improvements in technique applicability, we propose to explore the implications of fluid dynamics on the resetting of the OSL signal. We will employ both empirical and theoretical-based approaches to accomplish this.

First, we will quantify the independent variables of water opacity on OSL signal bleaching by using an experimental apparatus composed of a light-tight, two-meter-long graduated cylinder, fitted with sunlight-simulating LEDs. This apparatus will be mounted above a water column of controllable depth that will be diluted or concentrated by varying the percent mass of suspended sediment in the water column. Below the apparatus and the water column will sit a pre-dosed OSL discs. After various experimental parameters have been achieved, the pre-dosed OSL discs will then be analyzed to ascertain the extent of partial bleaching based on the percent of aliquots statistically indistinguishable from an equivalent dose of zero. A water depth versus opacity relationship for one and two-sigma populations of completely bleached aliquots will then be used to quantify the zone of bleaching in a turbid water column based on light penetrative depth. This zone can subsequently act as an empirical constraint for numerically-based fluid dynamic models, which will enable an estimate of the time necessary for sediment to persist in this zone for complete bleaching. By constraining the zone of bleaching of the OSL signal, we hope to contribute to future numerical modeling studies of OSL bleaching in fluvial environments.

Evidence for Post-Burial Re-Setting of Luminescence Signals in Eolian Sand on Upland Ridges in Southeastern Minnesota

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{POSTER PRESENTATION}

This study was initiated to identify the age of eolian sand found on narrow ridges in the Root River valley of southeastern Minnesota. The ridges in the region are cored by Ordovician Dolomite and Cambrian Sandstone, but the ridge tops are typically covered with Peoria and older loess units. However, in some locations the Peoria loess is absent and instead the ridge tops are covered with up to 3 meters of eolian sand which was likely sourced from local river valleys and transported to the uplands by sand ramps.

We studied nine ridge top soil profiles and collected 17 OSL samples from eolian sand at depths ranging from 0.3 to 2.6 m below the present ground surface. All OSL analyses were conducted using small aliquots where 90-150 µm quartz grains were applied to the inner 2 mm of 10 mm aluminum disks. The OSL ages ranged from 12.7 to 1.5 ka indicating a significant amount of variability between the ages, and potentially suggesting nearly continual eolian deposition throughout the Holocene. Upon further investigation, several key differences were identified between those samples taken from within 1 m of the ground surface when compared with samples that were more deeply buried. Those samples collected from depths of greater than one meter yielded ages that were tightly clustered between 12.7 to 10.3 ka, while samples taken from depths of less than 1 m showed ages with much higher spread that ranged from 1.5 to 9.9 ka. In addition, the samples collected from within 1 m of the present ground surface also commonly showed higher spread in their equivalent dose distributions and higher overdispersion values relative to the samples that were more deeply buried.

These lines of evidence suggest the luminescence signals from the upper portions of these profiles were reset by bioturbation, and therefore do not represent true burial ages. This interpretation is supported by evidence from a core sample collected from one of our sites that shows primary eolian laminations are preserved below 1.2 m depth but not above this depth. Presumably, the bioturbation agents were effective at both resetting the luminescence signal and disturbing the primary bedding to depths of at least 1 m. If bioturbation was active below this threshold it apparently did not impact either of these indicators. Our findings suggest the upper 1 m of these profiles were impacted by bioturbation and that the eolian sand was most likely deposited between 12.7 to 10.3 ka.

Looking for Albite in a Pile of Microcline

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{ORAL PRESENTATION}

Understanding the source of luminescence is important when dealing with single grain feldspar dating (or with any very small aliquot). Although the calculated dose rate is very different for a grain of microcline (an all potassium feldspar) compared to a grain of albite (an all sodium feldspar), during analysis their signal can look very similar and pinpointing the exact feldspar source can be difficult. Is there a more accurate, convenient, and efficient way to identify the specific type of alkali potassium feldspar or plagioclase found in our aliquot after analysis other than taking it to an electron microscope?

We will present current work at the University of Quebec luminescence lab exploring the feasibility of FTIR (Fourier transform infrared) spectroscopy and Raman spectroscopy, as well recent data obtained from a modified Raman spectrometer coupled with a defocussed laser. These tools allow us to perform a quick survey over the small area of our aliquot. We will conclude with preliminary applications and investigations on the properties of albite as it relates to luminescence.

Feldspar luminescence: A review and look forward

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{INVITED ABTRACT/KEYNOTE SPEAKER/ORAL PRESENTATION}

There are several promising signals from feldspars that show low or no fading: for example a) an elevated temperature infrared stimulated luminescence (IRSL) signal measured after a prior infrared bleach at or above room temperature (pIR-IRSL; Thomsen et al., 2008; Buylaert et al., 2012), and b) the signal obtained from a combination of detection between the pulses (>5 µs) and selection of data only from the later part of the pulsed IRSL measurement (Jain and Ankjærgaard, 2011). Based on detailed study of transport routes using time-resolved OSL (TR-OSL), it has been shown that these signals arise from recombination via the band tail states (~0.05 eV phonon assisted diffusion and quantum mechanical tunnelling; Jain and Ankjærgaard, 2011).

Despite significant developments in theoretical understanding, there is still debate in the literature regarding the trap(s) responsible for IRSL. A first-order based interpretation of thermal annealing data suggests the presence of more than one IR-sensitive trap (Li and Li, 2011), but a consideration of the more likely complex charge transport suggests that a single trap could give rise to the observed range of TL and OSL processes (Jain and Ankjærgaard, 2011; Thomsen et al., 2011; Jain et al., 2012). Recently, Andersen et al. (2012) used red-IR excitation spectroscopy to demonstrate decisively that there is only one IR-sensitive trap in feldspar, responsible for both IR and post-IR IRSL signals.

In this presentation we give an overview of the performance of the different feldspar signals in obtaining accurate ages, and review the success of the feldspar model (Jain and Ankjærgaard, 2011) in explaining the origins of these stable signals and related luminescence phenomena. Finally we suggest directions for future research aimed at both understanding the physics of feldspar luminescence and its use in dosimetry and dating.

Andersen, M.T., Jain, M., Tidemand-Lichtenberg, P., 2012. Red-IR stimulated luminescence in K-feldspar: Single or multiple trap origin? Journal of Applied Physics 112, 043507.

Buylaert, J.-P., Jain, M., Murray, A.S., Thomsen, K.J., Thiel, C., Sohbati, R., 2012. A robust feldspar luminescence dating method for Middle and Late Pleistocene sediments. Boreas 41, 435-451.

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

Jain, M., Guralnik, B., Andersen, M. T., 2012. Stimulated luminescence emission from localized recombination in randomly distributed defects. Journal of physics: Condensed matter 24, 385402.

Li, B., Li, S.-H., 2011. Thermal stability of infrared stimulated luminescence of sedimentary K-feldspar. Radiation Measurements 46, 29–36.

Thomsen K.J., Murray A.S., Jain, M., 2011. Stability of IRSL signals from sedimentary feldspars. Geochronometria, 38(1), 1–13.

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.

Radiofluorescence of quartz: Challenges towards a dating application: a project description

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{POSTER PRESENTATION}

In contrast to OSL, IRSL and TL dating, where the latent luminescence signal is stimulated by the absorption of optical or thermal energy, radiofluorescence (RF) is specified as luminescence induced by ionizing radiation.

RF in combination with OSL using Al_2O_3:C dosimeters is already routinely used for real-time dosimetry in medical applications. The potential of RF emitted by potassium-rich feldspars and its applicability to sediment dating has been shown e.g. by Trautmann et al. (1999) and Erfurt and Krbetschek (2003). For RF of quartz, on the other hand, so far only a few preliminary but promising studies exist for the present time. Some of these investigations suggest a dose-dependency of the RF signal, making it attractive for dosimetric applications. Our project aims at investigating the basic RF characteristics (spectrum, signal evolution, dose-response, bleaching, heating effects, sensitivity change) of different quartz separates with varying origin (hydrothermal, volcanic, sedimentary) using conventional detection equipment (e.g. different filter combinations, photomultiplier tube) and a CCD/EMCCD detector for spectroscopy.

The obtained RF data are thought to contribute to a better understanding of charge movements in quartz minerals. Furthermore, in the case of predictable RF signal change during heating, bleaching and irradiation, a dosimetric application might be considered. With this contribution, the scope of the project is given and the conventional luminescence characteristics, as well as the chemical data of the chosen quartz samples, are presented and discussed.

Trautmann, T., Krbetschek, M.R., Dietrich, A., Stolz, W., 1999. Feldspar radioluminescence: a new dating method and its physical background. *Journal of Luminescence* 85, 45–58, doi:10.1016/S0022-2313(99)00152-0.

Erfurt, G., Krbetschek, 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.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

The R package ‘Luminescence’: A comprehensive tool for luminescence data analysis

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{ORAL PRESENTATION}

Luminescence dating has become one the most important tools in Quaternary research to establish high-resolution and robust chronostratigraphies. Benefitting tremendously from the development of luminescence dating equipment during the last decade and accompanied by improved measurement protocols, nowadays luminescence data is produced more and more rapidly. However, the produced data has to be analyzed and this time-consuming part of the dating process is often underestimated, especially for non-standard dating routines where proprietary software solutions are limited. Taking into account the increased complexity due to newly introduced measurement protocols and coping along with the needs of flexible data handling, Kreutzer et al. (2012) introduced an R package for luminescence dating data analysis called ‘Luminescence’. The package provides a set of tools for the purpose of luminescence data analysis and is continuously under development. Since the first release, a year ago, the package has been considerably enhanced, not least due to constructive input from package users.

Using these contributions, we present the general scope of R and the package ‘Luminescence’ for luminescence dating data analysis. Our contribution focuses on new concepts introduced with the latest package version. Based on examples, we illustrate how the package can be used in the dating process. Our presentation may stimulate further discussions on how luminescence data is best analyzed and on what might be needed to further improve the software program.

Kreutzer, S., Schmidt, C., Fuchs, M.C., Dietze, M., Fischer, M., Fuchs, M., 2012. Introducing an R package for luminescence dating analysis. *Ancient TL* 30, 1–8.

The Advancement of the Component Test for Assessing Signal Contamination within Small Aliquots and Single Grain Measurements

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{ORAL PRESENTATION}

Quartz in tectonically active regions can suffer from OSL signal contamination. Given that feldspar often has an inherently brighter signal, environments with dim quartz can be difficult to date due to the possibility of mineral inclusions within quartz grains; OSL contributions from these inclusions may dominate the measured signal. Previously, we presented a signal composition test (Lawson et al., 2012) which utilizes thermal quenching and susceptibility to IR bleaching of the OSL signal to assess the purity of quartz contribution. Additional measurements have been made by looking at the systematics of how small volumes of feldspar can affect the results of aliquots tested with this composition test. Further, different feldspar samples have been assessed for their response to the composition test. The chemical compositions of these feldspar samples were then determined using energy-dispersive X-ray (EDAX) spectroscopy with a scanning electron microscope (SEM). Finally, we will present a single grain protocol for the component test.

Lawson, M., Roder, B., Stang, D., & Rhodes, E., 2012. OSL and IRSL characteristics of quartz and feldspar from southern California, USA. *Radiation Measurements* 47, 830-836.

An evaluation of SAR data-collection variations and data-analysis approaches for dating modern sediments with OSL

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{POSTER PRESENTATION}

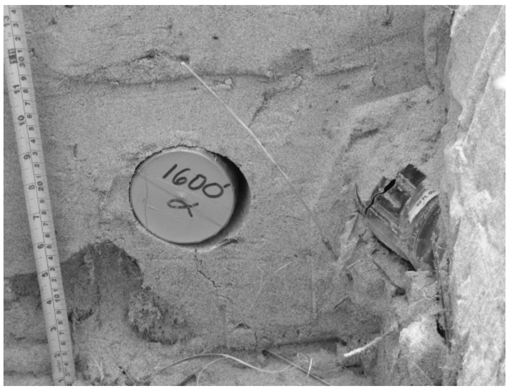

Figure 1. OSL sample adjacent to the buried beverage bottle. Intact bedding structures can be seem just above the sample 1600□ and on the right hand wall of the pit above the bottle.

During fieldwork for a larger project to establish a chronology for beach ridge formation in ridge and swale topography along the shores of Lake Huron, we excavated a soil profile in the lakeward face of a large beach ridge in Albert Sleeper State Park, approximately 6.6 km NE of Caseville, Michigan. During excavation we encountered a buried beverage bottle that was enclosed in eolian sands that exhibited undisturbed bedding structures (Fig. 1). The bottle retained its label, which had a copyright date of 1998. A sediment sample was collected for OSL dating adjacent to the bottle (Fig. 1). The Great Lakes experienced relatively high lake levels in the late 1990's and exceptionally strong storms in the winter of 1998-99. Lake level fell to low levels in 1999 and 2000 where it has remained. Due to the condition of the plastic bottle and its delicate printed plastic label, we infer that the bottle was encased in sand shortly after it was discarded. Therefore, this artifact provides a robust anthrochron for constraining the deposition date of the sand sample to 1998 or shortly thereafter.

Although recent efforts to date modern sediments with OSL have favored and focused on single-grain analyses, this sample afforded us an opportunity to test SAR-based data collection variations and data analysis approaches for contemporary sediments. Experimental variations focused on the magnitude of the test dose. Four data filtering strategies, ranging from no culling to aggressive data disqualification were applied. And, three paleodose (D_P) selection strategies we used: Mean D_e, fitted mode D_e and "leading edge" dose or D_{LE}. Combination of these treatments yielded 21 D_e data sets for evaluation against the D_e corresponding to the sample's anthrochronological depositional age.

Our analysis indicates that only three of the resultant D_e data sets had symmetry values consistent with eolian deposition, supporting our interpretation that the sediments were likely deposited in a storm event. Six of the treatment combination data sets yielded D_P's that were within ± 35% of the control value. However, all of these had poor precision (more than ±100%). One treatment combination did result in a D_P value that we deem appropriately accurate and precise, corresponding to an age of 27 ± 21 yrs, which is non-zero and statistically consistent with the sample's constrained depositional age of 14 yrs. This treatment combination used large test-dose SAR data-collection methods with conservative data filtering (minimal data rejection) and the "leading edge" D_P selection approach.

We conclude that single aliquot OSL measurements can be used to determine modern/contemporary depositional ages from low signal intensity and low dose rate environments such as sand deposits on the shores of the Great Lakes. However, careful consideration must be given to data retention and paleodose selection; aspects of OSL dating that are frequently under-appreciated.

Luminescence Dating of Anthropogenic Features of the San Luis Valley, Colorado: What to Know Before, During, and After Sampling

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{ORAL PRESENTATION}

Humans have hunted, gathered, and left signs of their presence in the San Luis Valley of Colorado for well over 11,000 years ago. Many of the features that remain are intriguing and include cairns, effigies, stone circles and walls, and rock art. Modern human curiosity over the age of these structures has brought about increased study and dating of the objects using the well-established methods of radiocarbon, dendrochronology, and relative dating.

Optically stimulated luminescence (OSL) dating has been used in the San Luis Valley for dating of the Great Sand Dunes (Forman et al 2006, Madole et al 2008), lunettes around the dunes (Brunhart-Lupo et al 2012), past earthquake reoccurrence at fault scarps (Crone et al 2006), and will include future work on fluvial terraces of the Rio Grande. Although OSL is commonly used at other archeological sites throughout the country (e.g. Topper, Buttermilk Creek, Cactus Hill, etc.) with varying degrees of success, within the San Luis Valley it has not been applied because of the abundance of organic remains for radiocarbon or lack of experienced investigations using luminescence dating. Traditionally in the luminescence dating literature, the bulk of the OSL ages have been obtained from surrounding sediment or ceramics, with the occasional stone tool (if heated at some point); however, if one thinks “outside of the box” then endless possibilities become available. OSL has been used to date the time of emplacement for teepee rings, stone walls, stone huts, earthen mounds, liquefaction features within archeological sites, and creation of cairns (see Appendix III this volume).

What should archeologists or Quaternary geologists know about the luminescence technique before determining whether the site they have found would be suitable for OSL dating? What would be important to have at the site and what could be unimportant or missing and still guarantee an effective outcome? At what level does the complexity in calculating a dose rate preclude meaningful ages for young structures? What does over-dispersion in the equivalent doses of a modern vs. the desired archeological structure really mean if you have eliminated the obvious choices of bioturbation and partial bleaching? Using two case histories of structures that were dated in 2011 and 2012, the appropriate steps and procedures will be explained and a template will be given for the successful dating paradigm.

A Post-IR IRSL procedure for K-Feldspar Grains in a Fluvial Setting to Estimate Transport Rate

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{ORAL PRESENTATION}

The Mojave River and Santa Clara River of Southern California were chosen as field sites to investigate the applicability of luminescence dating to sediment transport mechanics problems. Both rivers are ephemeral, but the Mojave River is much drier: continuous flow from the headwaters in the San Bernardino Mountains to the terminus at Silver Lake (~200km) occurs only once each decade and is closely correlated with El Nino events (Enzel & Wells, 1997). The Santa Clara River typically flows continuously from the San Bernardino Mountains to the Ventura coast (~150km) on an annual basis (Critelli et al., 1997). Grains in the active channel of these rivers are expected to show signs of partial bleaching and this makes it difficult to accurately determine time since deposition.

A modification of the Post-IR IRSL procedure, (Buylaert et al., 2009), was used for K-Feldspar grains (175-200 microns) at temperature increments of 50, 95, 140, 185, 230 °C over multiple cycles in order to provide more information about relative signal bleaching and growth among samples. The measurements show an exponential decrease in equivalent dose with distance down the Mojave River, with slower bleaching downriver for higher temperature measurements. The equivalent dose for samples at 50 °C is roughly constant along the river. These results suggest cyclical bleaching and burial as grains are transported downriver and higher energy (deeper) traps are vacated. Results from the Santa Clara River were inconclusive: a pattern of equivalent dose values with respect to sample location was not observed.

The pattern of equivalent dose values for the Mojave River can be used to constrain the sediment transport rate for this river by building a model of growth and bleach for each temperature increment. A bleaching experiment was run with multiple aliquot samples for direct sunlight exposure times of 0, 10, 30, 300, 1000, 3000, 10000, 30000 seconds. The Post-IR IRSL procedure was applied at each temperature increment for each exposure time aliquot and the results for all exposure times were fit to the general order kinetics equation using a non-linear regression. The bleaching parameters were used in conjunction with the growth curves to build a model of partial bleaching of grains during transport. This model is not a unique solution, but can be used to assess the likelihood of various sediment transport regimes.

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

Critelli, Salvatore, Emilia le Pera and Raymond V. Ingersoll. "The effects of source lithology, transport, deposition and sampling scale on the composition of southern California sand." *Sedimentology*, 44 (1997), 653-671.

Enzel, Y. and S.G. Wells. "Extracting Holocene Paleohyrology and Paleoclimatology from modern extreme flood events: an example from Southern California." *Geomorphology*. 19 (1997), 203-226

Inadequate Luminescence Dates and Poorly Constrained Age Models Undermine the Younger Dryas Impact Hypothesis

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{ORAL PRESENTATION}

Luminescence dates are used to develop age-depth models and resolve the YDB (Younger Dryas Boundary) in archaeological sequences (e.g., Wittke et al, 2013 and references therein). However, these geochronological data are problematic and lack the accuracy and precision required to support the Younger Dryas Impact Hypothesis (YDIH), a paradigm-changing theory linking extraterrestrial impacts with massive wildfires, megafaunal extinction, and cultural catastrophe. Luminescence dating generally yields age calculations with errors ± ≥ 10%. For the base of the Younger Dryas Chronozone (and YDB) at ~12.8k cal BP, a 10% error is >1200 cal years, with a 66% chance the date is within a range of 2400 cal years. Only a few luminescence dates with large errors are used in the age-depth models: 3 for Barber Creek, 2 for Blackville, and 1 date at Melrose. However, the calculated YDB "dates" have 0.1 ka standard deviations. Such results are nothing but simple arithmetic exercises. Age-depth models at Abu Hureya and Blackville sites include significant reversals. At Blackville, an older OSL date is rejected in favor of one that approximates the general YD timeframe, without any sound *a priori* rationale. Clearly, the YD age was selected because it fits the YDIH.

The Gainey age-depth model relies solely on thermoluminescence (TL) dates on burned flints, which are essentially meaningless: the analyses reported in Simons (1997) did not employ modern methodologies, and yielded imprecise age determinations (12,360 ± 1240) that lack C-14 validation. The viability of TL dating of burned chert has not been demonstrated, nor does the community consider it a reliable geochronological method. Furthermore, there is no obvious YDB layer at Gainey and the original investigator described the site as "plowed and disturbed." Sediment mixing is also documented for Blackville and Topper, but effects on site preservation and OSL dating are ignored. At Blackville, the YDB spike is within a 15 cm zone above an ancient soil. Topper has been intensely bioturbated, and the YDB is at a stratigraphic break only 60 cm below the surface buried by sands of unknown age. There is no way to resolve when or how carbon spherules and Scoria-Like Objects (SLOs) accumulated where they are found at or above documented stratigraphic disconformities at Topper, Blackville, Barber Creek, Big Eddy, Blackwater Draw, Chobot, Gainey, Lingen, Lommel, Murray Springs, Ommen, and Talega. All these sites are probably different ages. Accumulation of indicators near disconformities can be explained via (1) depositional changes from high to low energy; (2) lag from wind erosion; (3) pedogenic processes; and/or (4) prolonged accretion of normal cosmic outfall on stable surfaces (Brownlee, 1985). Dates on carbon spherules from Gainey, including those dated by Wittke et al (2013) and Firestone (2009), are all very young to "future" (Boslough et al., 2012). The Melrose age-depth model is based on only one optically-stimulated luminescence (OSL) age; interpolation places the YDB within a 38 cm zone, yet indicators are present in an 8 cm zone. At Big Eddy, only one C-14 age is within the layer that yielded spherules; other C-14 dates are ignored (Lopinot et al., 1998). A clear implication of these issues of geochronology is that spherules are not discrete accumulations unique to ~12.8k cal yr BP, and therefore do not indicate an YDB impact.

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Using Luminescence Production per Unit Dose to Weight Experimental Data

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{ORAL PRESENTATION}

In any experimental science, it is common practice to repeat an experiment many times over and combine the results in order to develop a robust estimate of its expected value. The apparent dose determination is an example of this from luminescence dating studies, which can either combine the results into one data set to be analyzed in bulk (e.g. Galbraith et.al. 1999) or with moment-matching algorithms (e.g. Lepper et.al. 2000), or sort the results into two or more data sets to be analyzed separately (e.g. Galbraith and Green 1990). Each result then contributes to the expected value for its data set, weighted by the probability of that particular result occurring. Ideally, this probability can be estimated using a relevant metric common to each experimental result.

When no common metric exists between experimental results, the inverse variance is traditionally used to weight contributions, giving credence to well-determined results (e.g. Thomsen et.al. 2003). This strategy relies on a proper assessment of random error, a requirement difficult to meet in complex experiments. However, in recent years the inverse square of the relative error has gained favour to weight contributions from each result, supplanting use of an arithmetic mean to estimate the expected value with a geometric mean (e.g. Galbraith et.al. 1999). This change lessens the effect of random errors but negates the inclusion of non-positive results, biasing any estimated values derived from data sets with such members. The limitations of both choices could be averted if a common metric exists between experimental results. Fortunately, such a metric exists in many experimental data sets, including those commonly produced during luminescence studies.

We propose using luminescence production per unit dose as the common metric to weight contributions from each result. This choice gives credence to results generated from more luminous sample portions, producing expected value estimates from an arithmetic mean that closely match its conventionally weighted geometric mean counterpart. We will present the justification for this choice and examples supporting its use.

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Single grain post-IR IRSL dating of K-feldspar: Practical and theoretical considerations

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{ORAL PRESENTATION}

Many sedimentary contexts are characterized by rapid deposition after short grain transport distances. In these cases, the risk of incomplete zeroing of luminescence signals is clearly high, and considerable effort has been expended in identifying these contexts and mitigating the negative effects for sediment dating. While multiple grain single aliquot approaches may be able to identify the presence of partial bleaching (depending on the sensitivity distribution of the constituent grains), single grain measurements offer the potential to isolate a population with equivalent dose values corresponding to the depositional event.

In locations where quartz OSL sensitivity is low or quartz grains show other negative attributes such as high thermal transfer or unstable signal components, K-feldspar IRSL offers a potential alternative. At UCLA, we have now dated around 120 K-spar samples using a post-IR IRSL approach, using several different measurement conditions. Important to the selection of preheat and measurement temperatures is the desire to balance the bleachability and thermal stability of the post-IR IRSL signal. Samples from different locations display variations in IRSL response and some interesting systematic patterns are observed, including relationships between IRSL sensitivity and measured equivalent dose, grain size and equivalent dose, sensitivity and grain density. Different approaches to isolating a reliable subset of grains will be examined, including comparisons with independent age estimates.

OSL dating of Brazilian continental carbonates (tufas) using their terrigenous content

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{ORAL PRESENTATION}

Quaternary tufas are potential paleoclimatic archives. Their use, however, for such reconstruction is often limited by difficulties associated with their absolute age control. Ancient tufa deposits are rare and understudied in Brazil with a poor or inexistent geochronology, in most cases, consisting of few ages obtained by radiocarbon or uranium series methods on thin stratigraphic horizons making for difficult robust age control for paleoclimate proxies. Moreover, tufas are problematic to obtain reliable ages by both these methodologies because of their open behaviour system and contamination effects. Despite the very low content of terrigenous sediments in tufa deposits, they may represent an alternative in obtaining a reliable chronology of these deposits by optically stimulated luminescence dating (OSL).

This study evaluates the potential of OSL dating for geochronology of the Brazilian tufas. We used two samples (MR-304 and MR-192) from the Serra da Bodoquena Formation (SW Brazil) and a sample (F4-40) from the Ribeira River Valley (SE Brazil). Under subdued red light conditions in the laboratory, the exposed outer rim (2 cm) was trimmed from the samples manually. The sample core was crushed into smaller fragments then it was concentrated by sieving to get the 180-250 µm grain size fractions. The residual outer material trimmed from the tufa was powdered (<2mm) for gamma ray spectrometry measurements and dose rate calculation. The 180-250 µm fractions from the core of the samples was pre-treated with 10% HCl solution for several times to remove the carbonates, then washed repeatedly in distilled water, and treated with 30% of H_2O_2 for several times to remove organic material, followed by further washings. The treatment of the remaining material was accomplished by a 40 min with HF solution to etch the alpha-exposed outer rim of the quartz grains and remove occasional feldspar grains. It was then sieved again to remove grains whose diameter was significantly reduced by the etching. The quartz grains aliquots were mounted on steel cups for OSL measurements in a Risø DA-20 OSL/TL systems equipped with a built-in beta source (0.084 Gy/s), Hoya U-340 filters (290-370 nm) and blue LEDs (470 nm) for optical stimulation. Observation of grains aliquots under an optical microscope and tests with IR stimulation was carried out to evaluate feldspar contamination. A dose recovery test was performed for sample MR-304 using a SAR protocol with pre-heat temperature of 200 ^{o}C and given doses of 2.5, 33.6 and 84.0 Gy. The recycling ratios are consistent, ranging from 0.94 to 0.99. The recuperation test shows negligible values, displaying absence of significant thermal transfer. The reliability of these measuring parameters was confirmed by a dose-recovery test exhibiting measured/given dose ratios of 1.13 ± 0.05 (given dose = 2.5 Gy), 1.02 ± 0.09 (given dose = 33.6 Gy) and 0.90 ± 0.11 given dose= (84 Gy). A SAR sequence was run for 24 aliquots for each sample. All samples presented OSL decay curves dominated by a fast component. Table 1 shows data summary and ages obtained for the studied tufa samples. The OSL dating of Brazilian tufa deposits was successfully performed for all the three studied samples. Reliable OSL geochronology for Brazilian tufa deposits makes them potential paleoclimatic and paleoenvironmental archives for further studies.

Sample	Aliquots	Average ED(Gy)	Dose Rate(Gy/ka)	Age (ka)
MR-304	10	42.62 ± 1.38	0.500 ± 0.027	85.24 ± 5.38
MR-192	17	72.99 ± 2.47	0.591 ± 0.035	123.43 ± 8.34
F4-40	5	79.27 ± 8.80	0.355 ± 0.021	223.49 ± 27.75

Table 1. Data summary and obtained ages of Brazilian tufa deposits.

Holocene aeolian sedimentation and climatic implications for the St. Anthony Dunes, Idaho USA

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{ORAL PRESENTATION}

Late Quaternary aeolian dune systems occur across portions of the Great Plains and western U.S. and provide insight into past climate variability for these regions. In southeastern Idaho an active dune area designated by the Bureau of Land Management as the St. Anthony Dunes Special Recreation Management Area (SRMA) is located in the northeastern portion of the Snake River Plain. Aeolian systems in the intermountain west such as the St. Anthony Dunes are impacted by moisture flux from the Pacific and may provide insight into how Pacific Decadal Oscillation (PDO) and El Niño Southern Oscillation (ENSO) may have impacted environmental conditions for the intermountain region.

The climate for the St. Anthony Dune region is semi-arid with precipitation occurring during late fall and winter, then again during early spring. This present climate regime allows an active core to exist within the St. Anthony Dunes that encompass approximately 450 km^2. The geomorphic character of the active dunes include compound crescentic, blowout, falling, and climbing dunes that range in height from 15 to 121 m in elevation. The surrounding region is characterized by ~20,000 km^2 of stable dunes that are fixed by vegetation.

This study analyzed nine samples collected from the fixed dunes that surround the active core of the St. Anthony complex. Sediments were manually collected from road-cut sections and excavated trenches at depths ranging from 8.5-1.04 m. Optically stimulated luminescence (OSL) provided age control with measurements and analyses completed at Utah State University Optically-Stimulated Luminescence (OSL) Laboratory in Logan, Utah, USA. Results indicate that during the middle Holocene (5.13 ± 0.61 ka), late Holocene (1.47 ± 0.22 and 1.17 ± 0.30 ka), and Medieval Warm Period (MWP), the present-day fixed dunes were mobile and actively accreting (Figure 1). This suggests a hydrologic deficit and/or warmer climate for the area than currently exists. This research provides new information regarding the depositional timing of the St. Anthony Dunes and assists in providing evidence of paleoclimatic conditions for the northeastern Snake River Plain during the middle to later Holocene.

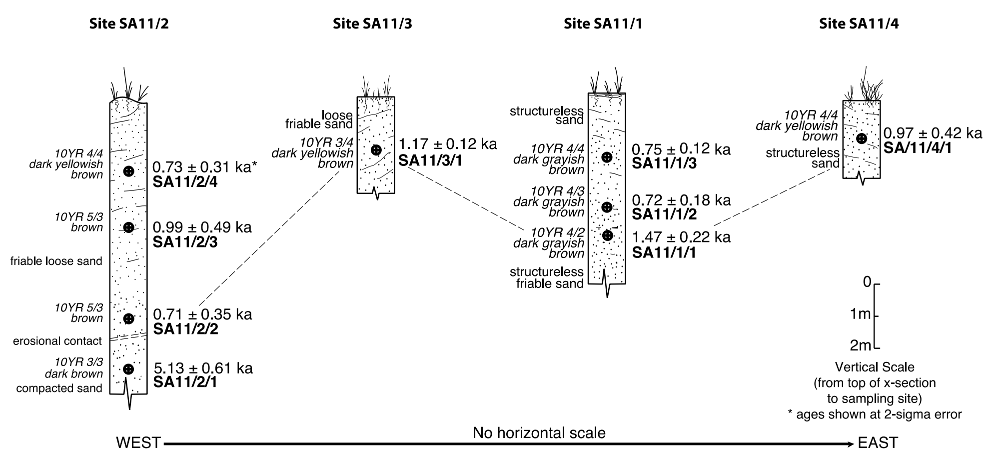

Figure 1. Stratigraphic cross-sections of St. Anthony Dunes sample sites.

lexsygSmart-A New Basic Luminescence Reader for Dosimetry and Dating Application

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{POSTER PRESENTATION}

A new luminescence reader - *lexsygSmart* - was designed for standard routine measurements in dosimetry and dating application, based on the *lexsygResearch* instruments (Richter et al., 2013). It provides access to the basic and most frequent routines of luminescence measurement by thermal as well as optical stimulation within a single reader, which is very compact in its design, even though sample reservoir and measurement chamber are separated. All operations are software controlled from an external PC and several failure protection features are incorporated, which makes the *lexsygSmart* easy to maintain.

Sample carriers of $10^{+0.0}_{-0.1}$ mm diameter can hold sample material in various geometries and forms in grain or solid form. The sample carriers are conveniently externally loaded into a 40 position sample wheel, which is easily placed in the loading drawer of the *lexsygSmart* (Figure 1). Samples are lifted inside the *lexsygSmart* by a piston into the measurement chamber and transferred to and between the measurement and the irradiation position by precision sliding. The presence of a sample carrier is monitored during processing.

Luminescence optical stimulation (OSL) is achieved with diodes for 2 different wavelengths with blue and IR modules (further wavelengths on request), which homogeneously illuminate the sample area for the stimulation of quartz, feldspar and other dosimetric materials. OSL modules are suited for continuous wave as well as linear modulated OSL. Thermoluminescence can be measured by linear heating of samples up to 500 °C, at ramping rates between 1 K s^{-1} and 10 K s^{-1}, with an option for automated background measurement and subtraction. Preheats within the given temperature range of the heater plate and gas purging of the very small measurement chamber volume of approximately 10 ml is possible.

The *lexsygSmart* is equipped with a standard bi-alkaline photomultiplier tube (300–650 nm). It is mechanically protected by a shutter during non-detection times, which also provides electronically controlled overexposure protection during measurement. A filter quick change module allows easy manual change of detection filters between measurements. The detection wavelength band can be more conveniently changed between up to 6 windows with a software driven optional automated filter changing wheel, which allows the setting of detection windows for individual samples.

For internal irradiation an optional well shielded Beta (^{90}Sr, <2 GBq) source is available, delivering approximately 0.12 Gy s^{-1} to quartz coarse grain, with variation in deposited dose similar to the respectively reported 15% variation at the plane of a flat sample disc (central 8 mm diameter) of the one of the sources available for the *lexsygResearch* system (Richter et al., 2012). Because the sample reservoir and measurement chamber are separated, cross-irradiation is minimized, as samples are transported underneath the source only for irradiation purposes.

The *lexsygSmart* luminescence reader allows most standard operations in luminescence detection such as the reading of TLDs, OSLDs or the application of multiple or the single aliquot regeneration (SAR) dose protocols.
Picture—Page 47

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Preliminary chronology of Holocene alluviation and arroyo dynamics in Johnson Wash, southern Utah

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{POSTER PRESENTATION}

In the late 1800's to early 1900's, ephemeral streams throughout the semi-arid southwestern US underwent dramatic geomorphic change; channels became rapidly entrenched, generated high sediment yields, and were transformed into the characteristic arroyo landforms observed across the region today. Arroyos are an end-member, vertical-walled channel form produced due to river entrenchment into cohesive, fine-grained, valley-fill sediment. Stratigraphic records indicate during the mid-late Holocene these modern entrenched streams were primarily characterized by shallow channels dominated by floodplain accretion. Previous age control suggests that aggradation occurred over centennial to millennial timescales while episodic entrenchment occurred on decadal timescales. This research utilizes detailed sedimentologic and stratigraphic descriptions coupled with AMS radiocarbon and optically stimulated luminescence (OSL) dating to investigate arroyo cut-fill sequences in Johnson Wash, southern Utah.

OSL dating provides an age estimate for the timing of deposition/burial of sediment. Previous work identified partial bleaching to be a significant problem with OSL dating in arroyo settings. Ephemeral streams in the Grand Staircase region of the Colorado Plateau are characterized by flashy discharge and high sediment supply resulting in low bleaching efficiency. To minimize problems with partial bleaching, thin (~30 cm), well-sorted, sand lenses with sedimentary structures representative of less turbid, low-flow regimes were selected when possible. Poorly sorted deposits or those with evidence of bioturbation and soil development were avoided. Importantly, samples were analyzed using single-grain dating and statistical models, such as the minimum age model (MAM) in order to isolate populations of grains that were bleached at deposition.

Chronostratigraphic results are presented for six stratigraphic sections along the ~10 m tall and ~25 km long arroyo in Johnson Wash. Detailed descriptions of sediments, bounding unconformities, and paleosols are presented along with ~13 radiocarbon and ~8 preliminary OSL ages. Preliminary OSL ages will be discussed in the context of AMS radiocarbon ages, De distribution statistics, sediment transport processes, and spatial relations within the catchment. Ultimately, the chronostratigraphy will be used to reconstruct periods of aggradation and constrain periods of incision. Sediment archives from Johnson Wash valley-fill will be compared to adjacent Kanab Creek and Kitchen Corral Wash to provide insight into the application of OSL dating to arroyo settings and spatial context of the timing of alluviation and arroyo cut-fill dynamics.

Application of Single-grain OSL dating to alluvial sediments in Range Creek, Utah

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Range Creek is occupies a bedrock canyon between the Book Cliffs and Roan Cliffs of the Tavaputs Plateau in east-central Utah. Unique preservation of numerous archaeological sites and artefacts indicates that Range Creek hosted a high-density, yet relatively short-duration Fremont occupation 0.8-1.0 ka. While dating of cliff-top ruins and granaries with radiocarbon has been highly successful, obtaining age control for alluvial and peat sequences along the valley floor have proven difficult. For example radiocarbon dating of alluvial sequences containing abundant charcoal and burned horizons exposed in arroyo walls along Range Creek has produced age reversals and generally unreliable results, possibly due to contamination by hydrocarbons and coal from the surrounding bedrock. However age control for these alluvial and peat deposits is important because they contain valuable archives of environmental conditions leading up to and following Fremont occupation of Range Creek.

In order to test an alternative to radiocarbon dating, samples for optically stimulated luminescence (OSL) dating were collected from an alluvial sequence containing evidence of arroyo entrenchment interrupting >4m of vertical floodplain accretion and previously dated with multiple charcoal and pollen radiocarbon samples. Equivalent dose (De) results from quartz single-grain analyses suggest the samples were partial bleached as indicated by large De distributions and positive skew in results. Partial bleaching was expected in this small fluvial system due to flashy discharge and abundant sediment supply from easily erodible sandstone bedrock. Ages were calculated using a minimum age model (Galbraith et al. 1999).

Single-grain OSL ages provide stratigraphically consistent results that suggest aggradation began prior to 1.3 ka, was interrupted by entrenchment by 0.6 ka and was followed by continual aggradation until historical entrenchment in the late 1800's. OSL results confirm contamination of some radiocarbon results and suggests caution when selecting material for radiocarbon dating from alluvial deposits in catchments with coal deposits within the catchment.

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Explaining the Change in Production and Distribution Patterns of Olivine-Tempered Ceramics in the Arizona Strip and Adjacent Areas of the American Southwest using Optical Luminescence Dating: Part Two

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{ORAL PRESENTATION}

The ceramic assemblages found within the Arizona Strip and adjacent areas of Utah and Nevada are characterized by being widely-distributed, uniquely tempered with olivine, a volcanic mineral, and thought to have been created between A.D. 100 and 1300. The source of this olivine is thought to be Mt. Trumbull or Mt. Tuweep; both are located near the northwest rim of the Grand Canyon (*Billingsley and Wellmeyer, 2006*). Olivine-tempered ceramics are distributed westward from these olivine source areas over a distance of more than 100 km.

The ultimate goal of this study is to understand the evolution of production and consumption patterns of olivine-tempered ceramics within a small-scale society situated in an unstable agricultural environment. To investigate the source of olivine-tempered ceramics, detailed and on-going chemical analyses on ceramic samples and clay were obtained by using laser ablation inductively couples mass spectrometry (LA-ICP-MS) (*Sakai in progress*). Eight compositional groups were found in the chemical compositional data of 1069 sherds from Mt. Trumbull and the lowland Virgin River area, which is one of the destinations of the olivine-tempered ceramic trading. In this study, I will examine how the use of each clay group changed over time by combining the data sets of the optical luminescence dating on the sherds as well as the elemental compositional analyses. These analyses reveal that use of some of the clay groups increased over time.

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Sakai, S. In progress Explaining Change in Production and Distribution Pattern of Olivine-Tempered Ceramics in the Arizona Strip and Adjacent Areas in the American Southwest. A dissertation which will be submitted to the department of Anthropology, University of California, Santa Barbara.

OSL dating of marine sediments offshore the Amazon River and Congo River

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{ORAL PRESENTATION}

The Amazon and Congo rivers deliver huge amounts of terrigenous sediments to the ocean. The flux and origin of these sediments are sensitive to climate changes on the continental areas drained by these rivers. Sediments deposited offshore the mouth of the Amazon and Congo rivers are important archives for paleohydrological and paleovegetation reconstructions. Late Pleistocene and Holocene paleoenvironmental reconstructions based on proxies measured in marine sediment cores depend on reliable age models, which are usually established using radiocarbon dating. The absence of organic material for radiocarbon dating and its age limit make it difficult to build robust age models for some marine sediment cores. The extended age range ($10\text{-}10^5$ years) and suitability for dating terrigenous sediments make OSL dating a promising geochronological method to improve age models for marine sediment cores.

In this study, twelve samples from three marine sediment cores collected offshore from the Amazon (GeoB16211-water depth = 56m; GeoB16218-water depth = 41m) and Congo (GeoB6518-water depth = 962m) rivers were used for OSL dating. Cores GeoB16211 and GeoB16218 have low content of organic material suitable for radiocarbon dating and frequent sandy intervals. Core GeoB6518 is dominated by mud and has significant age differences between radiocarbon ages obtained for distinct organic materials. OSL ages were determined for coarse-grained quartz aliquots (180-250 μm) of cores GeoB16211 and GeoB16218. OSL ages for core GeoB6518 were determined using fine-grained polymineral aliquots (4-11μm). The quartz aliquots as well as the polymineral fine-grained aliquots used for OSL dating show recycling ratios close to unit, negligible zero-dose signal and good performance under dose recovery tests (measured/given dose = 0.9-1.1). The calculated ages show normal stratigraphy for the three dated cores (Table 1). Core GeoB16211 shows a middle interval with age superpositions, indicating high sedimentation rates. We will discuss the measured OSL ages vs. the radiocarbon ages, dose distributions, age models, luminescence properties of the samples and these significances within the sedimentary system.

Table 1 – OSL ages obtained for marine sediments offshore Amazon and Congo rivers.

Core	Sample	Depth (cm)	Dose (Gy)	Dose rate (Gy/ka)	Age (ka)
GeoB16218	16218-3	306	1.19 ± 0.11	0.93 ± 0.06	1276 ± 146
	16218-2	361	6.41 ± 0.26	1.53 ± 0.10	4184 ± 332
	16218-1	399	7.37 ± 0.15	1.42 ± 0.10	5183 ± 378
GeoB16211	16211-5	10	0.22 ± 0.06	1.63 ± 0.12	135 ± 38
	16211-4	90	0.50 ± 0.04	1.53 ± 0.11	326 ± 35
	16211-3	238	0.47 ± 0.03	1.56 ± 0.11	301 ± 29
	16211-2	289	0.46 ± 0.21	1.60 ± 0.11	287 ± 133
	16211-1	359	0.71 ± 0.05	1.68 ± 0.12	422 ± 42
GeoB6518	OSL-2	147	7.66 ± 0.42	1.98 ± 0.09	3867 ± 280
	OSL-1	167	10.09 ± 0.63	1.87 ± 0.17	5392 ± 583

Radiofluorescence dose-response of various quartz samples: First results

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{POSTER PRESENTATION}

While thermoluminescence (TL) and optically stimulated luminescence (OSL) of natural quartz are well-established dating methods and routinely applied in environmental dosimetry, only few studies have focused on radiofluorescence (RF, luminescence emitted during sample irradiation) of quartz (e.g. Krbetschek and Trautmann 2000; Poolton et al. 2001; Shimizu et al. 2006). In addition to the dosimetric information that could be retrieved, intensity and temperature-dependence of the RF signal are expected to contribute to a better understanding of quartz luminescence origin.

For this purpose, four quartz reference samples (sedimentary, volcanic, hydrothermal; see companion contribution by Kreutzer et al.) were investigated in detail with regard to their TL and OSL properties. Moreover, first RF dose-response curves are presented here, recorded in the determined main emission windows (UV ≈ 340/380 nm, violet/blue ≈ 410/470 nm, red ≈ 630 nm; Poolton et al. 2001; Martini et al. 2012). The partly contrasting behavior of various quartz samples is discussed with respect to their TL and OSL characteristics.

It is shown that at least part of the investigated quartz samples exhibit a time-/dose-dependent RF signal with the potential of various dosimetric applications. In accordance with previous investigations concerning high saturation dose levels of specific TL emissions (e.g. red TL; Fattahi and Stokes 2000), the use of distinct RF emissions may have the capability to enhance the upper dating limit. At the same time, RF might circumvent difficulties with the measurement setup compared to red TL, due to a better signal-to-noise ratio. However, important investigations – such as the bleachability of quartz RF and its sensitivity changes during illumination and irradiation – are still pending.

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A simple mathematic approach toward routine use of fast component in quartz OSL dating

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{ORAL PRESENTATION}

It has been well known that quartz OSL consists of multiple components characterized by distinct photon-ionization cross section, dose response and thermal stability. The common practice in OSL age determination uses a signal integrated over the initial part of decay curves that contains all these components. Although the fast component is characterized by great thermal stability and sensitive to light stimulation, the medium and slow components can lead to inaccurate age estimate either due to their thermal instability or insufficient bleaching, with the latter being a concern particularly for sediments transported by turbid water. However, there has been no routinely adopted approach to isolate the fast component in quartz OSL dating.

The key challenge facing mathematic fast component isolation is that it is difficult to find a unique solution in deconvolution analysis of OSL decay curves while experimenting with fast component isolation because one is limited by their relatively poor dating precision. This presentation demonstrates a simple mathematic solution for the quartz OSL fast component isolation. This solution does not rely on deconvolution analysis so it can be easily adopted into routine dating practices using predefined quartz OSL components. By using selected data points from smoothed OSL decay curves, the precision of the calculated equivalent dose using the fast component can even be improved when compared to equivalent dose calculations using bulk OSL.

When the fast component is isolated using this method, is can be used to date a group of samples containing both insufficiently bleached and sufficiently bleached deposits if they have independent age constraints for a majority of the deposits. Fast component OSL ages are just as accurate as bulk OSL ages for sufficiently bleached deposits, but are more accurate for the grains or samples affected by insufficient bleaching, demonstrating the potential of using the isolated fast component to improve dating accuracy of insufficiently bleached deposits.

Evaluation of the Thermoluminescence (TL) sensitivity for facies correlations in oil wells

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{POSTER PRESENTATION}

In the petroleum systems of Brazilian coastal basins, studies are restricted to geophysical methods and drill core samples are rare due to the great depth at which the rocks are found. Therefore facies correlation is the main task that combines seismic sections and well sampling. Within this context, our experiment aims to evaluate the use of thermoluminescence (TL) properties in polymineralic samples as a tool for stratigraphic correlation.

For this task, we have chosen the Teresina Formation outcrop at the Irmãos Gobbo Limestone Mine (inland of São Paulo State). The Teresina Formation consists of dark shales, siltstones with light gray sandstone in thin discontinuous layers, limestones, and silexites. In the literature, most of the studies that use TL are focused on the dating of sediments of the Quaternary period. Few studies attempted to apply TL for stratigraphic correlation on sedimentary rocks of any age.

Data from three facies columns were obtained in the field, using standard systematic sampling collection, focusing on the lateral continuity of the layers for further comparison with TL data. In the laboratory, the samples were heated into 420 °C (788 °F) and crushed and sieved into the 0.125-0.250 mm fraction (fine sand); the main objective was to eliminate the natural TL signal of the samples. The TL analyses of the samples were carried out at a heating rate of 5 °C/s, after a gamma radiation dose of 0.7 Gy. We also made an additional analysis of natural gamma rays through a high purity germanium detector, aiming to simulate the natural gamma ray response of the studied facies. Samples without the radiation dose were also analyzed. The final resultant curve was the difference between the analytical curve obtained from irradiated samples and the curve obtained from empty samples. The peaks were obtained with the TL tools software.

It was observed that there were four main sedimentary facies in the outcrops: oolitic limestones, siltstones, sandstones, and nodular silexites. The TL analysis had three main patterns: oolitic limestone (figures 1A), nodular silexites (figure 1B), and fine sandstone/siltstone. The analysis was thus useful for distinguishing between these facies. The analysis of gamma rays generated similar overall results for nodular silexites and oolitic limestones. Oolitic limestone facies shows a stable peak at 246 °C (474.8 °F) that does not occur in sandstones and silexites. This peak was associated to the calcite TL peak. The results indicate that the TL method can discriminate calcareous facies more efficiently than the gamma analysis, which is a known method of geophysical analysis, widely applied in oil industry.

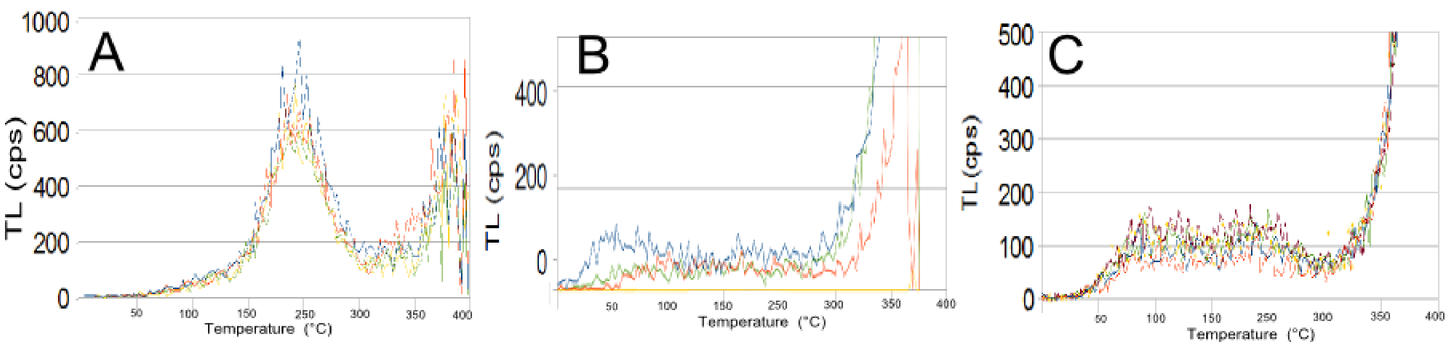

Figure 1. Thermoluminescence results for different sedimentary facies.

Testing and refining the timing of hydrologic evolution during the latest Pleistocene regressive phase of Lake Bonneville

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{ORAL PRESENTATION}

Lacustrine, fluvial, and wetland landforms present in the now desertified regions of Dugway Proving Ground (DPG) and the Sevier Desert (SD) in western Utah, record a fascinating history of falling lake level, river development, and establishment of wetland habitats in the Lake Bonneville basin between ~14-8 ka ago. This was not only a time of rapid climate change but also of human occupation into suitable habitats made available by decline of the large lake. Using optically stimulated luminescence (OSL) dating methods, we are determining depositional ages for sediment samples from bar features (reworked deltaic sands), braided fluvial channels, and topographically inverted fluvial channels collected from DPG during prior fieldwork. These data will be compared to existing chronological evidence from DPG and SD to test and refine the timing of changes in the geologic environment during this stage of Lake Bonneville regression. Accurate assessment of the timing of the hydrological and geomorphological changes taking place during the late regressive phase of Lake Bonneville will help determine the relative importance of environmental change compared with groundwater discharge thought to accompany falling lake levels. This presentation will discuss preliminary OSL results from DPG.

Optically Stimulated Luminescence characteristics and ages on quartz sand from Lake Bonneville sediments in Cache Valley, Utah

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{ORAL PRESENTATION}

Lake Bonneville was the largest late Pleistocene pluvial lake in the western US and covered most of Utah, eastern Nevada, and southern Idaho. Observations of the formation and timing of key lake levels in the Bonneville Basin (BB) began with G.K. Gilbert's seminal USGS publication in 1890 and have continued today with 100's of published radiocarbon ages (e.g. Oviatt et al., 1992; Godsey et al., 2005; Benson et al. 2011) and a few cosmogenic surface exposure (e.g. Goehring et al. 2010) and OSL ages (e.g. Oviatt et al. 2005).

Geomorphic and stratigraphic evidence indicate large lakes in the BB during marine isotope stage (MIS) 6 (~130-160 ka) and MIS 3/4 (~30-60 ka), known as the Little Valley and Cutler Dam cycles, respectively (e.g. Oviatt et al. 1987). The timing of events surrounding the highest lake-level during the Bonneville cycle, include the Standsbury oscillation (26-23 ka), Bonneville highstand then flood (18-17.4 ka), Provo shoreline (17.4-14.0 ka), followed by the much lower Gilbert shoreline (13.1-11.6 ka) during the period of lake-level fall towards the level of the modern Great Salt Lake (e.g. Oviatt et al., 1992; Godsey et al. 2005; Benson et al, 2011).

OSL samples were collected from three sites in Cache Valley in the north-easternmost part of the BB. These include samples from the Provo-level delta at the mouth of the Logan River, pro-delta deposits associated with the Bonneville highstand at the mouth of Green Canyon just north of Logan, and deposits associated with multiple lake cycles at gravel pit exposures near Newton in northern Cache County, Utah. Quartz sand was analyzed using the single-aliquot regenerative-dose method (Murray and Wintle, 2000). Luminescence properties are dominated by the fast component and displayed minimal evidence for recuperation and sensitivity change. Natural signals were well below saturating, excluding some aliquots from one sample collected from sediments interpreted to have been deposited during the Little Valley paleolake cycle (~160 ka).

Preliminary results suggest Logan River delta deposits are 21-14.7 ka and Green Canyon pro-delta sediments are ~22-17.5 ka. Overdispersion values for the Logan delta samples are generally between 0-10%, whereas all of the Green Canyon samples have values >20%, suggesting they are less well-bleached. Sediments at the mouth of the Green Canyon may have been influenced by higher energy and more ephemeral transport regimes than those of the larger Logan River catchment. In addition, rapid re-deposition and deformation of pro-delta deposits by seismic activity could have accentuated partial bleaching at the Green Canyon site (Janecke and Oaks, 2012). Stratigraphic relationships and preliminary age results from the Little Mountain site indicate the presence of three lake cycles; Little Valley (~160 ka), Cutler Dam (67-45 ka), transgressive-phase of Bonneville (31 ka), and an extended Provo level (14.2ka). The presence of MIS 3 sediments above 1330 m asl is significant because they suggest a higher lake-level during the Cutler Dam cycle than previously known (Hart et al., 2004).

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Constraining abandonment ages and primary controls on hillslope evolution for Quaternary fluvial terraces in the Nenana River Valley, Alaska Range

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{POSTER PRESENTATION}

Slope diffusion processes on fluvial terrace risers have been studied extensively in arid, mid-latitude environments. However, less work has been done on such landforms in high latitude, subarctic environments. Preliminary observations in this environment suggest that diffusion occurs at a slower rate, when compared to arid, semi-latitude regions, because landforms appear younger than they are. This phenomenon could be due to factors such as standing dead trees, soil moisture content, loess coverage, and presence of permafrost. This research focuses on developing a better understanding of the primary controls on hillslope evolution in the boreal forest environment, and the ties between vegetation and geomorphic processes to aid in the prediction of future landscape response to global climate change.

Optically stimulated luminescence (OSL) and radiocarbon dating are used to constrain abandonment ages for the sequence of Quaternary fluvial terraces in the Nenana River Valley of Alaska. Recent age constraints and observations reveal that soil moisture plays a large role in hillslope evolution and only partially support our preliminary observations. These age constraints will be incorporated into future research to develop a sediment flux equation for this region. This work not only provides a more complete picture of landscape evolution rates in this region but also has significant broader impacts on on-going regional neotectonic research, because the age constraints will be pertinent to active faults which cross the terraces.

Late Glacial-Holocene stratigraphy: dune-paleosol records in the Illinois River Valley

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{POSTER PRESENTATION}

Two dune-paleosol successions were recently reported in the Illinois River Valley (Wang et al., 2012), which documents the stratigraphy of the Late Glacial to Holocene period. At the first site near Manito, Illinois (40° 22’ N, 89° 54’ W), eight distinctive lithostratigraphic units are identified. The units can be defined from the base to the surface as: 1) glaciofluvial sand and gravel, 2) first episodic dune sand, 3) wetland paleosol, 4) lacustrine deposit, 5) second episodic dune sand, 6) sandy paleosol, 7) third episodic dune sand, and 8) modern soil. At the second site near Arenzville, Illinois (39° 52’ N, 90° 22’ W), six lithostratigraphic units are identified because the basal glaciofluvial unit is not exposed and the wetland paleosol and lacustrine deposit appear to be one unit.

The single aliquot regenerative protocol (Murray and Wintle, 2000; Wintle and Murray, 2006) was employed for optically stimulated luminescence (OSL) dating of dune and fluvial sand, and the high temperature pyrolysis-combustion technique (Wang et al., 2003) was employed to partition total soil organic carbon into high and low molecular weight organic compound groups for ^{14}C dating of paleosol and lake deposits. To date, 23 OSL and five ^{14}C dates have been obtained at the Manito site. The dating results and age-depth relations indicate: 1) the basal glaciofluvial sand and gravel accumulated until 19.5 thousand years ago (ka), 2) the first episodic dune sand formed from 17.7 to 14.7 ka, 3) the wetland paleosol formed from 14.7 to 13.5 ka, 4) the lacustrine deposit formed between 13.5 ka and 12.8 ka, 5) the second episodic dune sand formed from 12.8 to 11.8 ka, 6) the sandy paleosol formed before 6.1 ka, 7) third episodic dune sand formed between 6.1 and 4.0 ka, and 8) the modern soil formed after 4.0 ka.

The OSL and ^{14}C chronology, lithological characterization, grain sizes, trace elements, rare earth elements, and stratigraphic contacts suggest that these lithological units from the base to the surface are: 1) the Last Glacial Maximum glaciofluvial sand and gravel unit; 2) Heinrich 1 dune sand; 3) Bølling wetland soil; 4) Allerød lacustrine deposit; 5) Younger Dryas dune sand; 6) Holocene paleosol; 7) Holocene dune sand; and 8) modern soil. Moreover, dating results and stratigraphic changes also suggest that the Heinrich 1 dune sand unit contains three facies: an unweathered dune sand with characteristics of cross bedding and lamination at the bottom; a weathered zone of dune sand with characteristics of bioturbation and leaching in the middle; and the less weathered dune sand at the top of the unit.

These dune-paleosol successions may provide the most complete stratigraphic record currently available in the Midwest from the Late Glacial to Holocene periods.

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Limits of Luminescence Dating: an update regarding quartz of the Southern Alps of New Zealand and the Olympic Mountains, Washington, USA

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{POSTER PRESENTATION}

Late Pleistocene glacial sediments from the South Fork Hoh River valley in the Olympic Mountains, Washington, USA and the Lake Hawea valley in the Southern Alps, New Zealand were dated using optically stimulated luminescence (OSL) on quartz and infrared stimulated luminescence (IRSL) on feldspar sand during 2012 and 2013. High sediment supply (typical of glacial environments), short transport distances, and sediment newly eroded from bedrock sources were expected to pose problems for luminescence dating in these locations. Samples were collected from a variety of depositional environments and inferred distances from the ice-front to assess how luminescence signals may vary due to these factors and to determine which samples produce the most reliable age estimates.

Although initial results looked promising for single-aliquot regenerative protocol on single quartz grains, further work supports previous research that discusses limitations of quartz OSL dating of sediments from the Southern Alps, New Zealand and advocates for feldspar IRSL dating in the Hawea drainage. In contrast, results from the South Fork Hoh, Olympic Mountains of Washington, showed good quartz sensitivity and amenable mineralogical parameters that were used to highlight the importance of transport environment and sedimentary facies on solar resetting. Samples from these two glacial settings were collected as a part of more relevant and larger scale research goals towards improving the understanding and age resolution of the glacial history of coastal alpine areas.

Abrupt changes in the ITCZ position during the Late Pleistocene recorded by soil formation and dune building in NE Brazil

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{ORAL PRESENTATION}

Active and stabilized eolian dunefields generated by NE trade winds related to the Intertropical Convergence Zone (ITCZ) are common landforms along the NE Brazilian coast. This relationship makes stabilized dune successions as potential paleoclimate archives for studying changes in the ITCZ. High-resolution sampling for sedimentological and geochronological analyses were carried out in a 15m thick stabilized dune succession, adjacent to the active dune field of Lencois Maranhenses (NE Brazil).

Samples for OSL-SAR dating were collected at intervals of 1 m (14 samples). Samples for particle size, magnetic susceptibility, heavy minerals and reflectance analyses were collected at 5 cm intervals (268 samples). OSL quartz grain samples showed good dose recovery results for calculated/given doses of 1.13, 1.01 and 0.97 for lab doses of 30, 400 and 1000 seconds, respectively, with a preheat treatment at 200 ^{o}C. All samples comprise bright quartz grains with an OSL signal dominated by fast component and recycling ratio from 0.97 to 1.04. Radionuclides activities were determined using a high-purity Germanium (HPGe) detector in an ultralow background shield. Dose rate calculations for all samples show predominantly low values between 0.287 and 0.632 Gy/ka. The OSL ages show a time span of ~113,000 years from 126.7 ± 9.7 ka to 13.8 ± 0.9 ka at 14 m and 1 m depths, respectively, indicating that this dune succession records sediment deposition from the Last Interglacial to about the Bølling/Allerød transition. Intervals with age superpositions ranging from 23.3 ± 1.6 ka to 24.9 ± 1.7 ka occur between the depths of 2 m to 6 m. This indicates a peak of dune building just before the Last Glacial Maximum (21 ka). Despite the low analytical errors (~7%), standard OSL dating was not able to present a definite age model for the 2 m to 6 m interval.

Mean sedimentation rates were assessed based upon the calculated OSL age differences. Sedimentation rates less than 0.35 ± 0.02 mm/yr are representative of the basal dune bed up to 30 ka, when it starts to increase until a peak of 0.75 ± 0.06 mm/yr at around 28 ka. High-resolution reflectance and magnetic susceptibility analyses indicate changes in the rate of pedogenic processes during dune building with the formation of goethite and hematite as the main iron oxides. Abundance of goethite and hematite can be estimated by the reflectance parameters of a* (redness-greenness) and b* (yellowness-blueness), respectively. Humid periods favoring soil formation may be indicated by the relative abundance of goethite (a*/(a* + b*); Abrajevitch *et al*., 2009). Also, magnetic susceptibility can be a proxy for coating of grains by iron oxide and it is considerably sensitive to reflect weathering and soil formation. Abrupt changes of relative abundance of goethite and magnetic susceptibility values intensify since 40 ka, attesting that deposition and pedogenesis were competing and alternating processes throughout this period, neither of them extensively predominant. This would indicate a shift in the dynamics of the ITCZ, with abrupt southward (wet) and northward (dry) displacements. In addition, during this period there is a conspicuous downward shift on the value of L* (grayscale density) coupled wth increased magnetic susceptibility. This may indicate the contribution of detrital or authigenic magnetite.

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APPENDIX I: WORKSHOP PARTICIPANTS

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APPENDIX II: QUATERNARY INTERNATIONAL WORKSHOP PROCEEDINGS DEADLINES

Paper submission guidelines

9th New World Luminescence Dating Workshop – Quaternary International

These guidelines are based on the general instructions for preparation of papers that can be found at: http://www.elsevier.com/journals/quaternary-international/1040-6182/guide-for-authors

HOWEVER, please note that to enable the completion of the reviewing process within a short period (see Key Deadlines below), you should follow **this** set of instructions which have been produced specifically for the NWLD Workshop proceedings. If you are in doubt, please contact one of the Proceedings Editors (tammy.rittenour@usu.edu and smahan@usgu.gov).

Preparation	There is a limit of **6 printed journal pages** (~6000 words with 4-6 figures/tables) for all accepted contributions. Abstract are limited are 400 words in length. There is no difference between oral and poster presentations when it comes to publication in the Proceedings volume.
Submission	Submission for all manuscripts to *Quaternary International* must be made on-line via the Elsevier Editorial System (EES) website at http://ees.elsevier.com/quatint/ you will need to log-on as an "Author" and get a user name and password. After selecting "submit new manuscript" you be guided through the creation and uploading of the various files. After entering your title you will be asked to 'Select Article Type' and 'chose the volume you are submitting to' with a pop-up menu from which you select: *9th New World Luminescence*. Please indicate in the cover letter that you are submitting to this volume. Please consult recent articles published in *Quaternary International* for details concerning reference format and journal style. SI (Metric) units must be used. Figures (diagrams, photographs etc.) should be submitted with lettering large enough to permit 20% reduction. The maximum size of the final printed version is 249 x 172 mm. All scales should be in metric units. All photographs should be numbered as figures. All tables, page numbers, and figure numbers should use Arabic numerals. Digital photographs submitted must be at a minimum resolution of 300 dpi. Digital photographs that include annotated text must be submitted at a minimum resolution of 500 dpi. For digital figures, please ensure that colour fills will be distinctive and contrasting if printed in black-and-white. Reproduction costs for colour photographs will be determined by the Publisher, in consultation with the Editor-in-Chief.
Reviewing process	Submitted manuscripts may be rejected and/or amended in the reviewing process and acceptance of the manuscripts is based on reviewer and editor suggestions (one lead authorship per participant). Once the uploading is completed, the system automatically generates an electronic (PDF) proof, which is then used for reviewing. All correspondence, including notification of the Editor's decision and requests for revisions, will be notified by e-mail.
Key Deadlines	**15 November 2013**. Submission of papers to *Quaternary International* via on-line system **15 January 2013**. Papers returned to Editor by Reviewers via on-line system **30 February 2014**. Corrected papers due back to Editor by authors via on-line system **30 April 2014**. Final paper acceptance Late entries/returns may lead to the exclusion of a paper from publication in the Special Issue.

Guest Editors:
Shannon Mahan*, Tammy Rittenour*, Michelle Summa-Nelson, Ken Lepper and Paul Hanson,
***First Responders**

APPENDIX III: HANDY REFERENCE FOR LUMINESCENCE DATING APPLICATIONS

***Amorphous Quartz**

Schmidt, C., and Kreutzer, S. (**2013**). Optically stimulated luminescence of amorphous/microcrystalline SiO_2 (silex): Basic investigations and potential in archeological dosimetry. *Quaternary Geochronology 15*, 1-10.

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***Basalt Flows**

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Morthekai, P., Jain, Maynak, J., Cunha, P.P., Azevedo, J.M., and Singhvi, A.S. (**2011**). An attempt to correct for the fading in million year old basaltic rocks. *Geochronometria 38 (3*), 223-230.

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***Bioturbation**

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Bateman, M.D., Frederick, C.D., Jaiswal, M.K. and Singhvi, A.K. (**2003**). Investigations into the potential effects of pedoturbation on luminescence dating. *Quaternary Science Reviews 22*, 1169-1176.

***Bleaching rates of quartz and feldspar**

Murray, A.S., Thomsen, K.J., Masuda, N., Buylaert, J.P., and Jain, M. (**2012**). Identifying well-bleached quartz using the different bleaching rates of quartz and feldspar luminescence signals. *Radiation Measurements 47*, 688-695**.**

***Bricks, Castle Stones, or Mortar**

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APPENDIX III: HANDY REFERENCE FOR LUMINESCENCE DATING APPLICATIONS (continued)

***Thermal Transfer OSL (TT-OSL)**
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Note: We welcome improvements or suggestions to this list. We realize it is not exhaustive or comprehensive. SAM and EGH
Final Note: Daniel Richter included a picture of the new lexsygSmart Luminescence Reader that could not be included on his abstract page. It is included here. We are sorry it could not be included on the abstract page-SAM.

Figure 2: lexsygSmart luminescence reader

Graphs generated from Web of Science on 08/05/13

Studies Published Using OSL Dating

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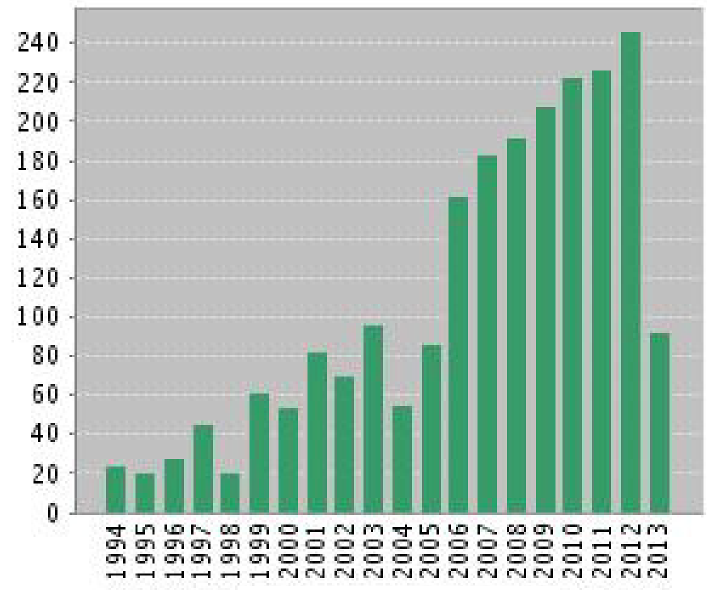

Year From 1994

Citations of Studies Using OSL Dating

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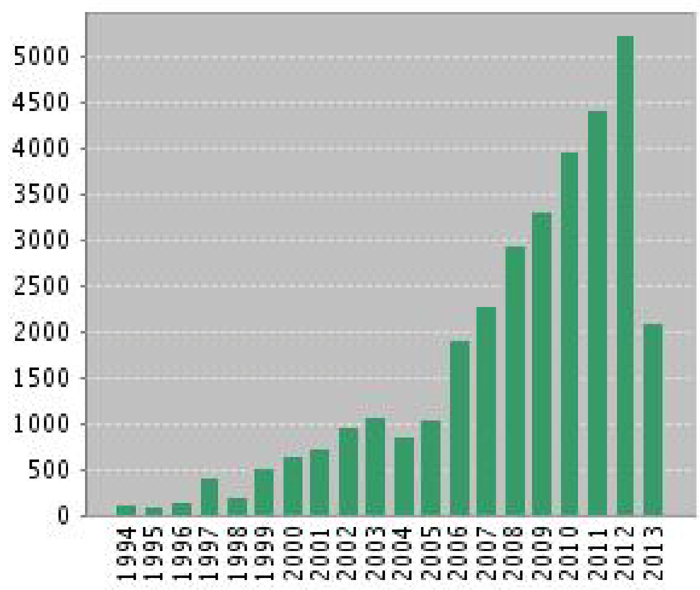

Year From 1994