

DR Table 1: Optically Stimulated Luminescence (OSL) Age Information

Sample number	USU number	Depth (m)	Num. of aliquots ¹	Dose Rate (Gy/ka) ²	Equivalent Dose, De (Gy) ³	Overdispersion (%) ⁴	OSL age (ka) ⁵
LS-TC-1	USU-425	1.9	24 (45)	1.92 ± 0.09	25.48 ± 2.56	17.7 ± 3.0	13.27 ± 1.59
LS-TK-1	USU-426	1.9	26 (71)	2.11 ± 0.09	11.18 ± 1.05	15.3 ± 2.7	5.30 ± 0.60
LS-TL-1	USU-427	1.1	24 (53)	2.25 ± 0.10	12.85 ± 1.10	16.5 ± 2.8	5.70 ± 0.61
LS-TR-1	USU-428	2.5	30 (45)	1.92 ± 0.09	14.76 ± 0.84	18.1 ± 2.7	7.68 ± 0.66
LS-TV-1	USU-429	1.5	28 (47)	1.71 ± 0.09	6.75 ± 0.66	32.8 ± 4.8	3.94 ± 0.47
LS-TW-1	USU-430	2.0	26 (55)	2.18 ± 0.10	5.43 ± 1.17	38.6 ± 5.7	2.49 ± 0.56
LS-TX-1	USU-431	0.7	23 (55)	2.07 ± 0.10	6.87 ± 0.60	14.9 ± 3.2	3.31 ± 0.36
LS-TY-1	USU-432	2.3	22 (63)	2.08 ± 0.09	4.55 ± 0.90	47.2 ± 7.5	2.19 ± 0.46
LS-TZ-1	USU-433	0.7	27 (52)	2.28 ± 0.10	2.77 ± 0.90	46.5 ± 8.2	1.21 ± 0.40
Paleo1	USU-590	2.3	31 (50)	1.66 ± 0.08	18.86 ± 2.14	20.5 ± 3.0	11.37 ± 1.51
Paleo2	USU-591	2.3	30 (45)	1.69 ± 0.08	18.08 ± 1.52	21.4 ± 3.0	10.73 ± 1.14
Paleo3	USU-592	2.3	34 (49)	1.69 ± 0.08	18.19 ± 1.60	20.5 ± 2.8	10.75 ± 1.20

OSL ages determined using the single-aliquot regenerative dose (SAR) technique (Murray and Wintle, 2000) and minimum age model (Galbraith et al 1999) on small aliquots of 90-150mm quartz sand.

¹ Number of accepted aliquots used in age calculation and number of aliquots analyzed in parentheses.

² Determined from ICP-MS and ICP-AES analysis and dose rate conversion by Guerin et al. (2011). See DR Table 2 for details.

³ De calculated using the three-parameter minimum age model of Galbraith et al. (1999) and reported at 2-sigma standard error.

⁴ Overdispersion represents the scatter in equivalent dose values beyond instrumental error, values > 20% in part suggest partial bleaching.

⁵ Error on OSL age incorporates all random and systematic errors summed in quadrature and is presented as 2-sigma standard error.

DR Table 2: Dose Rate Information for OSL samples

Sample number	USU number	<i>In-situ</i> H ₂ O ¹	U (ppm)	Th (ppm)	%K	Rb (ppm)	Cosmic ² (Gy/ka)	Dose Rate ³ (Gy/ka)
LS-TC-1	USU-425	2.7%	1.2 ± 0.1	4.9 ± 0.4	1.16 ± 0.03	42.7 ± 1.7	0.17 ± 0.02	1.92 ± 0.09
LS-TK-1	USU-426	7.4%	1.7 ± 0.1	5.3 ± 0.5	1.32 ± 0.03	57.5 ± 2.3	0.17 ± 0.02	2.11 ± 0.09
LS-TL-1	USU-427	6.7%	1.8 ± 0.1	5.5 ± 0.5	1.39 ± 0.03	60.7 ± 2.4	0.19 ± 0.02	2.25 ± 0.10
LS-TR-1	USU-428	3.2%	1.2 ± 0.1	4.6 ± 0.4	1.20 ± 0.03	47.0 ± 1.9	0.16 ± 0.02	1.92 ± 0.09
LS-TV-1	USU-429	15.0%	1.1 ± 0.1	4.8 ± 0.4	1.21 ± 0.03	45.9 ± 1.8	0.18 ± 0.02	1.71 ± 0.09
LS-TW-1	USU-430	7.2%	1.6 ± 0.1	5.4 ± 0.5	1.40 ± 0.04	55.1 ± 2.2	0.17 ± 0.02	2.18 ± 0.10
LS-TX-1	USU-431	12.2%	1.5 ± 0.1	6.1 ± 0.6	1.38 ± 0.03	64.9 ± 2.6	0.20 ± 0.02	2.07 ± 0.10
LS-TY-1	USU-432	9.2%	1.5 ± 0.1	5.9 ± 0.5	1.34 ± 0.03	51.0 ± 2.0	0.16 ± 0.02	2.08 ± 0.09
LS-TZ-1	USU-433	3.2%	1.6 ± 0.1	5.4 ± 0.5	1.37 ± 0.03	57.8 ± 2.3	0.20 ± 0.02	2.28 ± 0.10
Paleo1	USU-590	15.3%	1.3 ± 0.1	5.2 ± 0.5	1.10 ± 0.03	36.9 ± 1.5	0.16 ± 0.02	1.66 ± 0.08
Paleo2	USU-591	3.9%	1.0 ± 0.1	3.7 ± 0.3	1.08 ± 0.03	36.3 ± 1.5	0.16 ± 0.02	1.69 ± 0.08
Paleo3	USU-592	13.4%	1.3 ± 0.1	6.9 ± 0.6	0.98 ± 0.02	35.6 ± 1.4	0.16 ± 0.02	1.69 ± 0.08

Radioelemental concentrations determined by ICP-MS and ICP-AES techniques from ALS Chemex, Reno Nevada, USA

¹ Measured in the lab following field sampling. In samples were *in-situ* H₂O values were <3%, a representative of moisture content of 3±3% was assumed for burial history.

² Contribution of cosmic radiation to the dose rate was calculated by using sample depth (see Table DR 1), elevation (0.29 km asl), and longitude/latitude (44N/94W) following Prescott and Hutton (1994).

³ Dose rate was derived using conversion factors from Guerin et al. (2011) and includes cosmic contribution and attenuating affects of moisture.

DR Table 3. AMS Radiocarbon ages from terraces

Terrace name	Lab number	Distance Upstream (km)	Terrace Height (m)	Terrace Elevation (m)	$\delta^{13}\text{C}$	Radiocarbon Age (ka BP)	² Calibrated Age (cal ka BP ₂₀₁₀)
LS-16-00	Beta - 261877	9.74	9.10	256.9	-7.8	5.03±0.05	5.84 ± 0.12
LS-08-01	Beta - 261876	12.43	9.90	259.8	-8.5	6.51±0.05	7.50 ± 0.12
LS-TV-01 ³	Beta - 249184	15.42	7.7	261.5	-11.2	3.09±0.04	3.36 ± 0.09
LS-TV-02 ³	Beta - 249185	15.42	7.7	261.5	-8.8	6.48±0.05	7.41 ± 0.08
LS-TR-01	Beta - 249183	15.95	16.5	270.5	-9.5	7.63±0.05	8.51 ± 0.09
LS-22-06	Beta - 261879	16.00	2.30	256.4	-7.2	4.71±0.05	5.51 ± 0.13
LS-22-04	Beta - 261878	18.08	5.30	262.4	-6.3	4.58±0.05	5.31 ± 0.21
LS-90-05	Beta - 261883	20.73	24.06	283.8	-9.4	9.95±0.06	11.52 ± 0.23
LS-90-03 ¹	Beta - 260720	23.69	11.71	276.1	-7.9	6.58±0.07	7.52 ± 0.13
LS-90-01	Beta - 261882	23.92	3.89	268.6	-9.1	2.62±0.05	2.74 ± 0.17
LS-TW-01 ³	Beta - 249186	24.38	5.83	270.8	-8.1	2.33±0.04	2.38 ± 0.15
LS-TW-02 ³	Beta - 249185	24.38	5.83	270.8	-12.5	3.45±0.04	3.79 ± 0.11
LS-41-10	Beta - 261881	26.63	10.19	279.4	-6.7	4.57±0.05	5.31 ± 0.20
LS-TP-01	Beta - 255541	28.18	7.54	279.1	-9.6	4.33±0.04	4.99 ± 0.10
LS-41-01	Beta- 261880	30.10	15.21	290.3	-7.8	4.98±0.07	5.26 ± 0.07

Data modified from Johnson (2012). Material dated in all samples were freshwater mollusks and gastropods.

¹ Dated using radiometric technique, all others dated using AMS.

² Calibrated radiocarbon ages calculated as the median value using the IntCal09 calibration curve (Reimer et al. 2009), error based on 2-sigma calibrated age range. Calibrated ages were converted to BP₂₀₁₀ by addition of 60 years.

³ Terraces 'V' and 'W' had two units dated, one from basal sediments and one from the highest alluvial sediments. The results from the older strath sediments were used to assign a terrace age.

Data Repository - OSL sample processing and analysis

Sample collection and preparation

OSL samples were collected in opaque tubes pounded into sediment exposures. Samples were opened in the Utah State University Luminescence laboratory under dim amber light and wet sieved to separate the 90-150 μm fraction. Samples were treated with hydrochloric acid to remove carbonates, floated in 2.7 g/cm^3 sodium polytungstate to remove heavy minerals and exposed to three 30-minute treatments of concentrated hydrofluoric acid to remove feldspars and etch the quartz. Infra-red (IR) stimulation was used to detect the presence of feldspar and to assure the purity of the quartz separate, aliquots containing feldspars were removed from final equivalent-dose calculation.

Dosimetry

Representative samples for dose rate were collected from sediments surrounding the sample tube and analyzed for concentrations of U, Th, Rb, and K using ICP-MS and ICP-AES (performed by ALS CHEMEX Labs). Dose rate conversions followed Guerin et al. (2011). The contribution of cosmic radiation to the dose rate was calculated using sample depth, elevation, and latitude/longitude following Prescott and Hutton (1994). Final, dose rates were calculated based on water content, sediment chemistry, and cosmic contribution; errors were calculated in quadrature using the methods of Aitken and Alldred (1972) and Aitken (1976, 1985) (Table DR2).

Optical measurements

Optical measurements were performed on 1-mm aliquots of the quartz separates (~70 grains) using RISØ TL/OSL-DA-20 readers with blue-green LED stimulation ($470 \pm 30 \text{ nm}$, 36 mW/cm^2) and photon detection through 7-mm Hoya U340 filters ($330 \pm 50 \text{ nm}$). Preheat temperatures prior to measurement were 240°C for 10s for regenerative and natural doses and 160°C for 0s for test doses. Equivalent doses were determined using the single-aliquot regenerative-dose (SAR) technique of Murray and Wintle (2000). Equivalent doses (D_e) were calculated on a minimum of 22 aliquots using the three-parameter minimum age model of Galbraith et al. (1999) and reported at 2-sigma standard error.

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