Supplementary Information Figure Legends

Table S1. Overdispersion values based on dose distributions from the LLL OSL samples.

Table S2. Results from the Finite Mixture Modelling. The dominant age populations used for age calculation are highlighted in italics; the resulting ages for the dominant and second major age populations are also given for comparison.

Figure S1. Cumulative particle size curves for sediment samples from LL1 (orange), LL2 (blue), LL3 (green) and LL4 (purple). The second number gives sample depth. For location of cores see Figure 1.

Results of the preheat plateau test on single aliquots of the Lake Little Llangothlin sample L-EVA1231 (field code LL4). There does not appear to be a dependence of equivalent dose with preheat temperature, although more inter-aliquot scatter was observed for the preheat temperature of 280°C. Therefore a higher preheat temperature (260˚C) was chosen for subsequent SAR measurements. T~;~the cutheat temperature was 220˚C.

Figure S3~2~. Dose recovery test results for L-EVA1228, illustrated as a radial plot. The black line corresponds to the administered dose and the shaded line to 2σ on either side of the central age.

26 **Supporting Information Legends (File S1)**

27 **Table S1.** Overdispersion values based on dose distributions from the LLL OSL samples.

| Sample code	Overdispersion (%)
L-EVA1228 (LL1)	79.9
L-EVA1229 (LL2)	44.4
L-EVA1230 (LL3)	63.9
L-EVA123 (LL4)	61.4

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30 **Table S2.** Results from the Finite Mixture Modelling. The dominant age populations used for
31 age calculation are highlighted in italics; the resulting ages for the dominant and second major
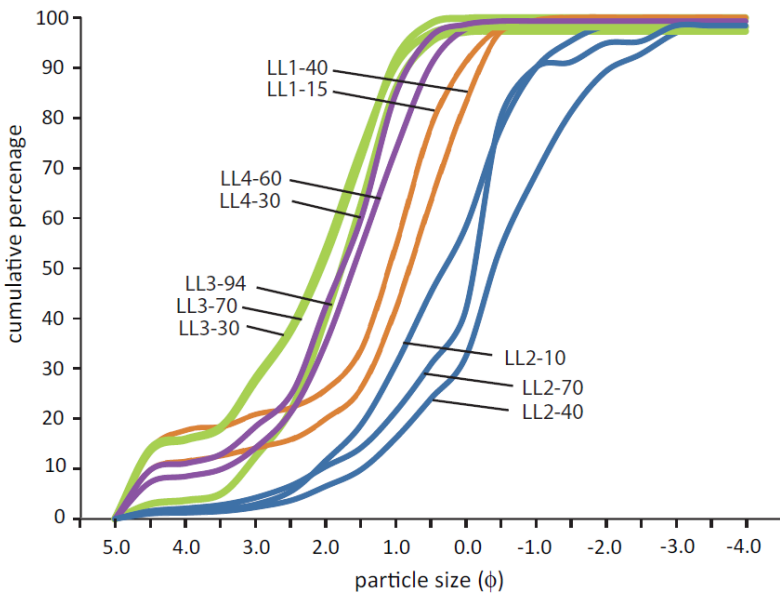32 age populations are also given for comparison.

| Sample code	Number of components	De (Gy)	% population	Age (ka)	BIC
L-EVA1228 (LL1)	4	1.4±0.1 2.8±0.3 *6.1±0.6* 13.4±1.6	22.4 28.7 *32.5* 16.5	1.2 ± 0.1 2.3 ± 0.3 *5.1 ± 0.5* 11.1 ± 1.6	155
L-EVA1229 (LL2)	2	5.7±0.3 *19.2±0.4*	12.8 *87.2*	5.6 ± 0.5 *18.9 ± 1.2*	101
L-EVA1230 (LL3)	3	4.5±0.3 11.8±0.5 *26.9±0.9*	12.2 39.0 *48.8*	 9.1 ± 0.7 *20.6 ± 1.4*	234
L-EVA1231 (LL4)	2	7.8±0.5 *22.9±1.2*	43.2 *56.8*	8.0 ± 0.7 *23.4 ± 1.8*	128

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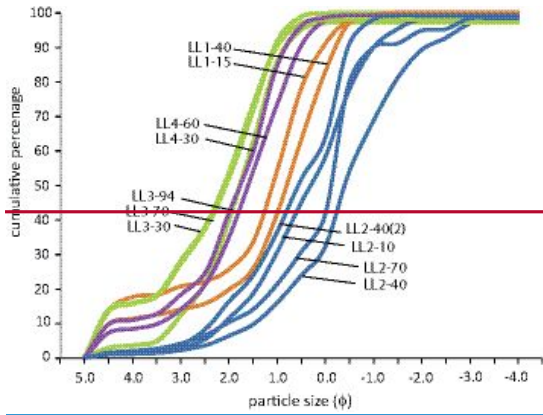
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Figure S1. Cumulative particle size curves for sediment samples from LL1 (orange), LL2 (blue), LL3 (green) and LL4 (purple). The second number gives sample depth. For location of cores see Figure 1.

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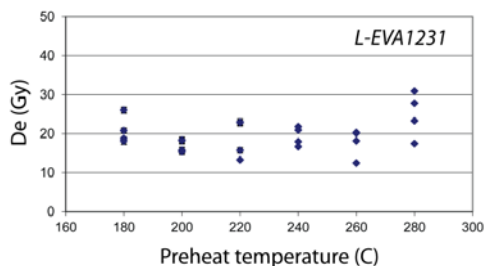
Figure S2~~1~~. Results of the preheat plateau test on single aliquots of the Lake Little Llangothlin sample L-EVA1231 (field code LL4). There does not appear to be a dependence of equivalent dose with preheat temperature, although more inter-aliquot scatter was observed for the preheat temperature of 280°C. Therefore a higher preheat temperature (260˚C) was chosen for subsequent SAR measurements; the cutheat temperature was 220˚C.
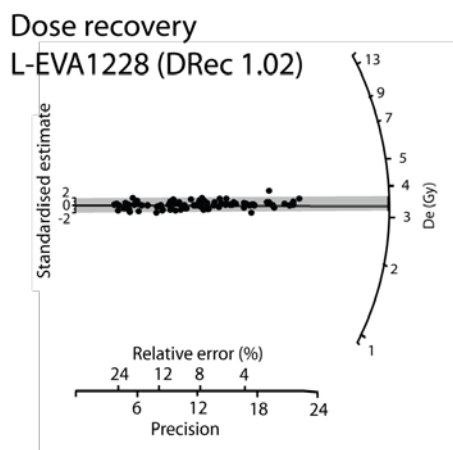
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Figure S3~~2~~. Dose recovery test results for L-EVA1228, illustrated as a radial plot. The black line corresponds to the administered dose and the shaded line to 2σ on either side of the central age.

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Supplementary Information - References

Botter-Jensen, L., Bulur, E., Duller, G.A.T., Murray, A.S., 2000. Advances in luminescence instrument systems. Radiation Measurements 32, 523-528.

Bowler, J.M., 1968. Australian landform example no.11: lunette. Australian Geographer 10, 402-404.

Bowler, J.M., 1973. Clay dunes: their occurrence, formation and environmental significance. Earth Science Reviews 9, 315-338.

Bowler, J.M., 1983. Lunettes as indices of hydrologic change: A review of the Australian evidence. Proceedings of the Royal Society of Victoria 95, 147-168.

Fitzsimmons, K.E., Stern, N., Murray-Wallace, C.V., 2014. Depositional history and archaeology of the central Lake Mungo lunette, Willandra Lakes, southeast Australia. Journal of Archaeological Science 41, 349-364.

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

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

Prescott, J.R., Hutton, J.T., 1994. Cosmic ray contributions to dose rates for luminescence and ESR dating: Large depths and long term variations. Radiation Measurements 23, 497-500.