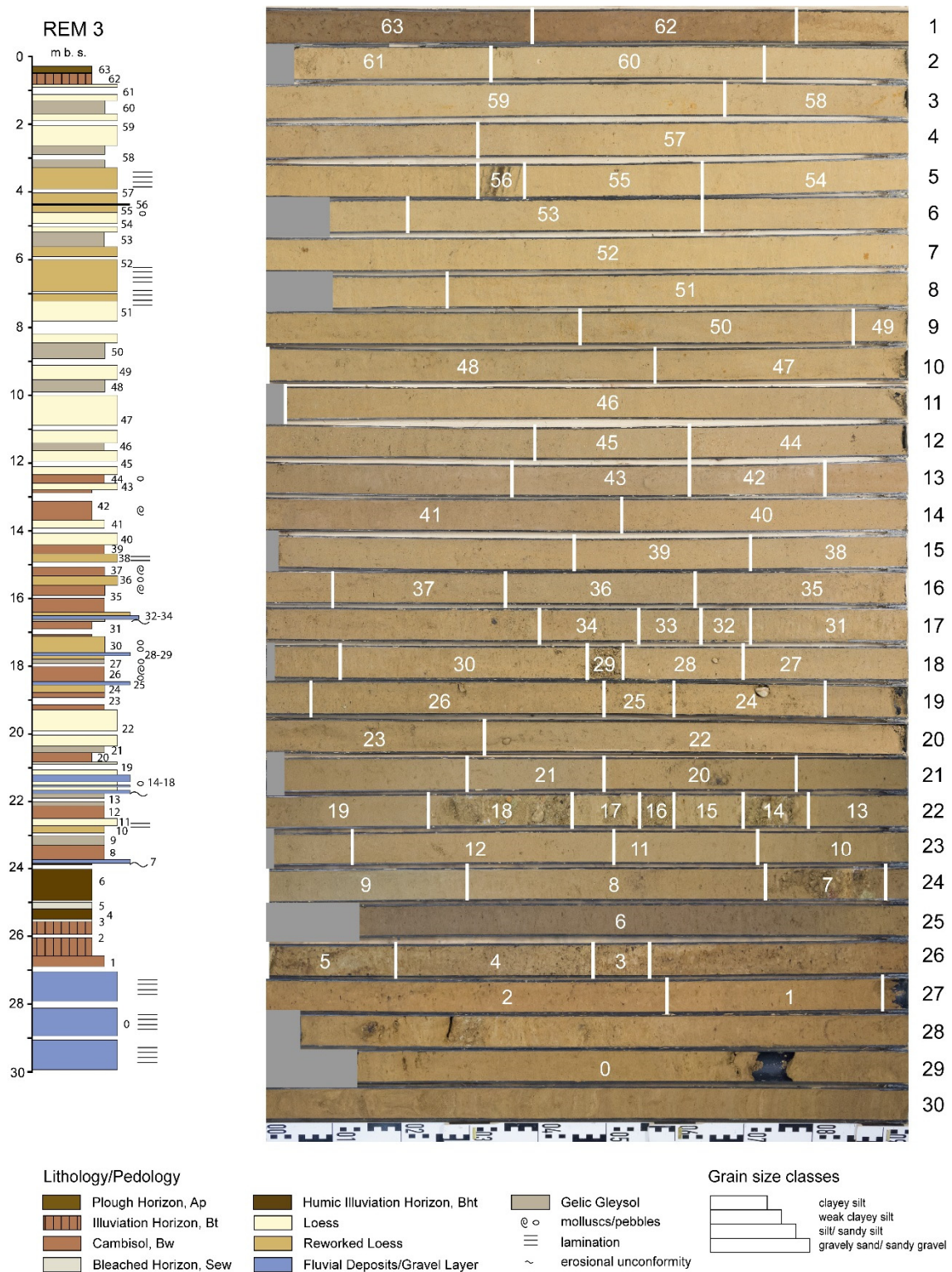


## Supplementary Information

### Stratigraphy



**Figure S1.** Photograph of core REM3A, collected adjacent REM3B, and stratigraphic log as documented in [54].

## Luminescence Measurements

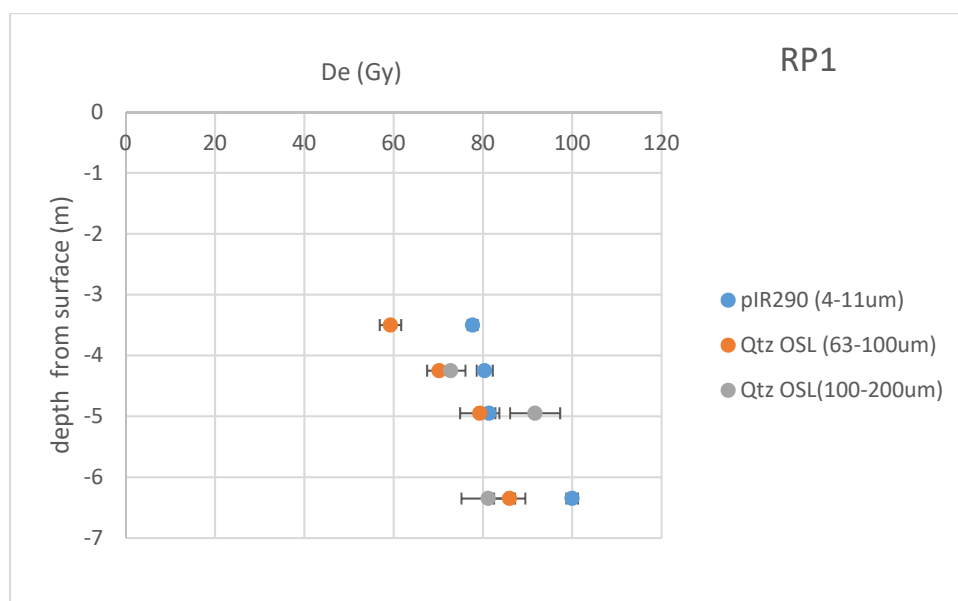
### Equivalent dose measurements, profile RP1

**Table S1.** Overview of luminescence samples collected from the profile RP1. The number of aliquots measured for each size and mineral fraction, determined by availability, is provided in the respective columns. Equivalent dose is given as the mean of the accepted aliquots.

Sample	Depth (m)	Approx. D <sub>e</sub> (Gy)	Stratigraphic Description	Luminescence Sensitivity Measurements (Number of Aliquots)		
				Quartz		Polymineral
				63-100 µm	100-200 µm	4-11 µm
MAL10349	3.50 ± 0.05	80	Primary loess (MIS2)	21	0	18
MAL10348	4.25 ± 0.05	80	Primary loess (MIS3)	24	18	18
MAL10347	4.95 ± 0.05	80	Weak paleosol (MIS3)	24	14	18
MAL10346	6.35 ± 0.05	96	Primary loess (MIS3)	24	24	18

**Table S2.** Summary of equivalent dose values for the different mineral and grain-size fractions measured for profile RP1 (see [53] for more details). The number of aliquots measured for each sample is given as n.

Sample	Depth from Surface (m)	Quartz D <sub>e</sub> (Gy)				Polymineral D <sub>e</sub> (Gy)	
		100-200 µm	n	63-100 µm	n	4-11 µm	n
MAL10349	3.50 ± 0.05	-	-	59.3 ± 2.4	21	77.7 ± 1.1	17
MAL10348	4.25 ± 0.05	72.8 ± 3.3	9	70.2 ± 2.7	18	80.4 ± 1.8	17
MAL10347	4.95 ± 0.05	91.7 ± 5.6	4	79.3 ± 4.4	20	81.4 ± 1.4	13
MAL10346	6.35 ± 0.05	81.2 ± 6.0	18	86.0 ± 3.5	21	100 ± 1.3	18



**Figure S2.** Equivalent dose vs. depth for the different mineral and grain-size fractions measured for profile RP1. Uncertainties shown are for  $1\sigma$ .

#### Equivalent dose measurements, REM3B core

**Table S3.** Overview of samples from core REM3B measured for this study with respect to measurement protocol, mineral and grain-size fraction. From a total of 102 samples collected from the core, 83 were measured for unprocessed IRSL<sub>50</sub>, 10 for 63-90 µm polymineral pIR<sub>200</sub>IR<sub>290</sub>, 8 for 63-90 µm K-feldspar pIR<sub>50</sub>IR<sub>290</sub>, 5 for 63-90 µm quartz OSL and 10 for 4-11 µm quartz OSL.

Sample	Depth (m)	IRSL <sub>50</sub> (Bulk)	pIR <sub>50</sub> IR <sub>290</sub> (63-90 µm, Polymineral)	pIR <sub>200</sub> IR <sub>290</sub> (63-90 µm, K-Feldspar)	OSL (63-90 µm, Quartz)	OSL (4-11 µm, Quartz)
A0164	29.80 ± 0.05					X
A0166	28.85 ± 0.05					X
A0167	28.45 ± 0.05					X
A0168	27.75 ± 0.05					X
A0171	26.35 ± 0.05	X				X
A0172	25.30 ± 0.05					X
A0174	24.25 ± 0.05	X				X
A0175	23.65 ± 0.05	X				X
A0176	23.45 ± 0.05	X				X
A0177	23.20 ± 0.05	X				X
A0179	22.55 ± 0.05	X				
A0180	22.35 ± 0.05	X				
A0181	22.15 ± 0.05	X				
A0182	21.85 ± 0.05	X				
A0183	21.65 ± 0.05	X				
A0184	21.35 ± 0.05	X				
A0185	21.15 ± 0.05	X				

A0186	20.80 ± 0.05	X				
A0187	20.55 ± 0.05	X				
A0188	20.35 ± 0.05	X				
A0189	20.10 ± 0.05	X				
A0190	19.80 ± 0.05	X				
A0191	19.45 ± 0.05	X				
A0192	19.15 ± 0.05	X				
A0193	18.80 ± 0.05	X				
A0194	18.55 ± 0.05	X				
A0195	18.15 ± 0.05	X				
A0196	17.80 ± 0.05	X				
A0197	17.60 ± 0.05	X				
A0198	17.35 ± 0.05	X				
A0199	17.15 ± 0.05	X				
A0200	16.80 ± 0.05	X				
A0201	16.55 ± 0.05	X		X		
A0202	16.35 ± 0.05	X				
A0203	16.15 ± 0.05	X				
A0204	15.80 ± 0.05	X				
A0205	15.45 ± 0.05	X				
A0206	15.15 ± 0.05	X				
A0207	14.85 ± 0.05	X				
A0208	14.65 ± 0.05	X				
A0209	14.35 ± 0.05	X				
A0210	14.15 ± 0.05	X				
A0211	13.85 ± 0.05	X				
A0212	13.65 ± 0.05	X				
A0213	13.45 ± 0.05	X				
A0214	13.20 ± 0.05	X				
A0215	12.85 ± 0.05	X				
A0216	12.65 ± 0.05			X		
A0217	12.45 ± 0.05	X				
A0218	12.25 ± 0.05	X				
A0219	12.10 ± 0.05	X				
A0220	11.80 ± 0.05			X		
A0221	11.50 ± 0.05	X				
A0222	11.30 ± 0.05	X				
A0223	11.10 ± 0.05	X				
A0347	10.80 ± 0.05	X				
A0348	10.50 ± 0.05			X		
A0349	10.30 ± 0.05	X				
A0350	10.10 ± 0.05	X				
A0351	9.80 ± 0.05	X				
A0352	9.60 ± 0.05	X				

A0353	9.40 ± 0.05	X				
A0354	9.20 ± 0.05			X		
A0355	8.75 ± 0.05	X				
A0356	8.55 ± 0.05	X				
A0357	8.35 ± 0.05	X				
A0358	8.15 ± 0.05	X				
A0359	7.80 ± 0.05	X				
A0360	7.60 ± 0.05			X		
A0361	7.40 ± 0.05	X				
A0362	7.15 ± 0.05	X				
A0363	6.85 ± 0.05	X				
A0364	6.65 ± 0.05	X				
A0365	6.45 ± 0.05			X	X	
A0366	6.25 ± 0.05	X				
A0367	6.10 ± 0.05	X				
A0368	5.81 ± 0.05	X				
A0369	5.65 ± 0.05	X				
A0370	5.45 ± 0.05			X	X	
A0371	5.25 ± 0.05	X				
A0372	5.10 ± 0.05	X				
A0373	4.80 ± 0.05	X				
A0374	4.60 ± 0.05	X				
A0375	4.45 ± 0.05			X	X	
A0376	4.25 ± 0.05			X	X	
A0377	4.10 ± 0.05	X				
A0378	3.75 ± 0.05	X				
A0379	3.45 ± 0.05		X	X	X	
A0380	3.15 ± 0.05	X	X			
A0381	2.85 ± 0.05	X	X			
A0382	2.55 ± 0.05	X	X			
A0383	2.35 ± 0.05	X	X			
A0384	2.15 ± 0.05	X	X			
A0385	1.80 ± 0.05	X	X			
A0386	1.50 ± 0.05	X				
A0387	1.25 ± 0.05	X	X			
A0388	0.75 ± 0.05	X				

**Table S4.** Dose recovery and residual dose results for selected samples from core REM3B measured using the pIR<sub>200</sub>IR<sub>290</sub> protocol. Three aliquots were measured for the dose recovery test, and six each for the residual dose tests.

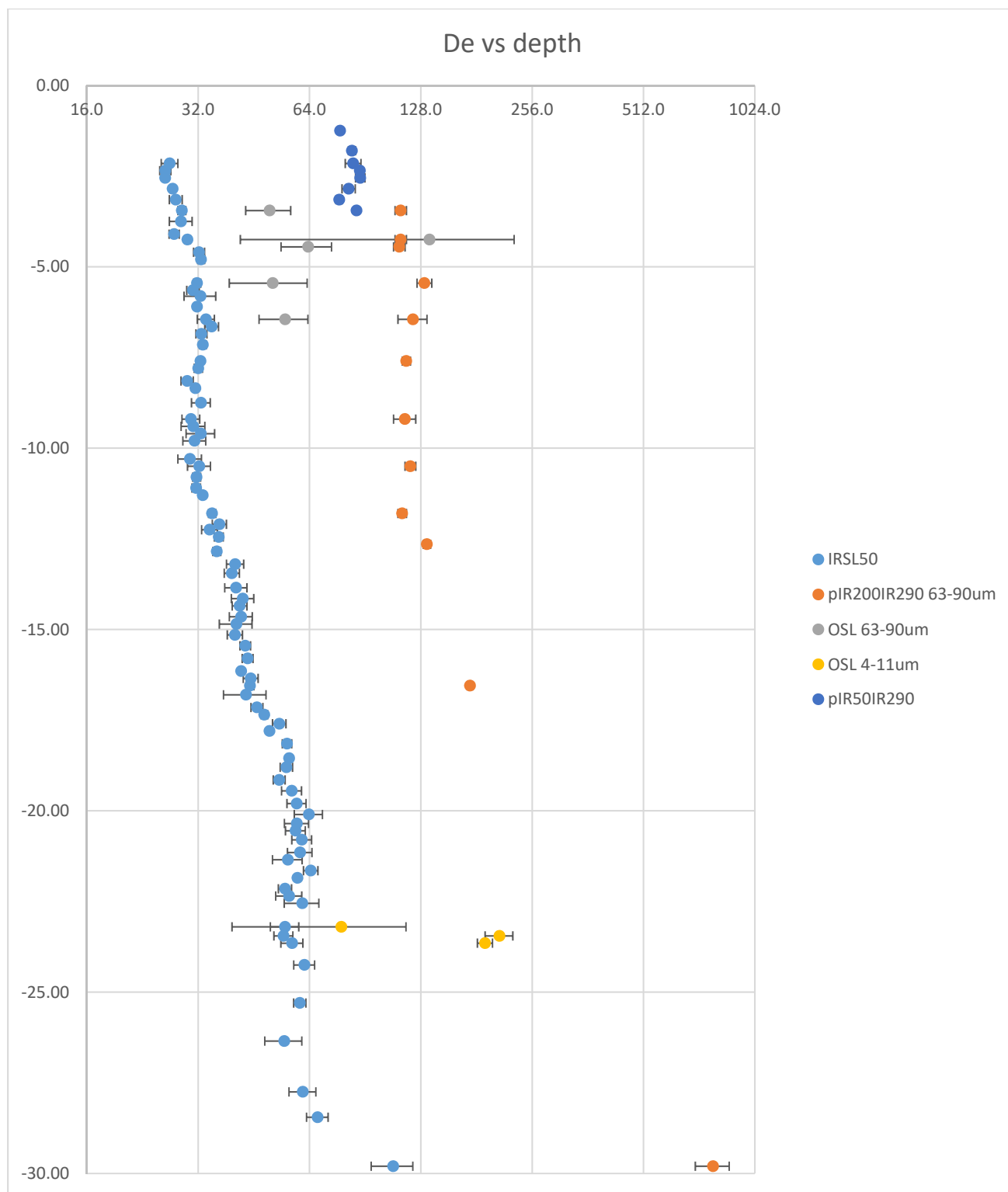
Sample	Dose Recovery			Residual Dose	
	Applied Dose (Gy)	Measured Dose (Gy)	Ratio	Bleaching Method	Dose (Gy)
A0375	104	107 ± 5	1.02	60 days direct sunlight	6.75 ± 0.3
A0376	-			300 hours LED lamp	32.7 ± 4.0

**Table S5.** Summary of depths and averaged  $D_e$  values and test dose sensitivity values for the ten fine-grained (4-11 $\mu$ m) and five very fine sand (63-90  $\mu$ m) quartz OSL samples measured in this study. Three aliquots were measured for each sample, using a measurement protocol involving three regenerative dose steps, preheat/cutheat temperatures of 260/240°C and a test dose of c. 37 Gy. Minimum equivalent doses are assumed to represent signal saturation.

Sample	Depth (m)	Grain-Size Fraction ( $\mu$ m)	Averaged $D_e$ (Gy)
A0164	29.80 ± 0.05	4-11	No signal
A0166	28.85 ± 0.05		>290
A0167	28.45 ± 0.05		>290
A0168	27.75 ± 0.05		>290
A0171	26.35 ± 0.05		>102
A0172	25.30 ± 0.05		>474
A0174	24.25 ± 0.05		>239
A0175	23.65 ± 0.05		191 ± 9
A0176	23.45 ± 0.05		209 ± 18
A0177	23.20 ± 0.05		78.1 ± 38.6
A0365	6.45 ± 0.05	63-90	55.1 ± 8.3
A0370	5.45 ± 0.05		51.0 ± 12.1
A0375	4.45 ± 0.05		63.5 ± 9.9
A0376	4.25 ± 0.05		135 ± 94
A0379	3.45 ± 0.05		50.0 ± 7.0

**Table S6.** Summary of depths, number of aliquots measured, measurement protocol and averaged uncorrected  $D_e$  values for the 18 very fine sand (63-90 $\mu$ m) feldspar samples measured in this study using pIR-IR protocols. The  $D_e$  uncertainty is given as the standard error.

Sample	Depth (m)	Number of Aliquots Measured	Measurement Protocol	Averaged $D_e$ (Gy) $\pm$ se
A0201	16.60 $\pm$ 0.05	6	pIR <sub>200</sub> IR <sub>290</sub>	174 $\pm$ 3
A0216	12.65 $\pm$ 0.05	6		133 $\pm$ 3
A0220	11.80 $\pm$ 0.05	6		114 $\pm$ 3
A0348	10.50 $\pm$ 0.05	6		120 $\pm$ 4
A0354	9.20 $\pm$ 0.05	6		116 $\pm$ 8
A0360	7.60 $\pm$ 0.05	6		117 $\pm$ 3
A0365	6.45 $\pm$ 0.05	12		122 $\pm$ 11
A0370	5.45 $\pm$ 0.05	12		131 $\pm$ 6
A0375	4.45 $\pm$ 0.05	12		112 $\pm$ 4
A0376	4.25 $\pm$ 0.05	6		113 $\pm$ 4
A0379	3.45 $\pm$ 0.05	6	pIR <sub>200</sub> IR <sub>290</sub>	113 $\pm$ 4
		24	pIR <sub>50</sub> IR <sub>290</sub>	85.8 $\pm$ 1.0
A0380	3.45 $\pm$ 0.05	24	pIR <sub>50</sub> IR <sub>290</sub>	77.0 $\pm$ 1.5
A0381	3.15 $\pm$ 0.05	24		81.7 $\pm$ 3.4
A0382	2.85 $\pm$ 0.05	24		87.8 $\pm$ 2.6
A0383	2.55 $\pm$ 0.05	24		87.7 $\pm$ 1.1
A0384	2.15 $\pm$ 0.05	24		84.1 $\pm$ 4.1
A0385	1.80 $\pm$ 0.05	24		83.4 $\pm$ 1.8
A0387	1.25 $\pm$ 0.05	24		77.5 $\pm$ 0.9



**Figure S3.** Differences in equivalent dose vs. depth for the different mineral and grain size fractions down the REM3B core, using pIR-IRSL equivalent dose values *uncorrected* for residual dose. The IRSL50 results are based on bulk, unprocessed sample.



## Sensitivity measurements

**Table S7.** Summary of depths, averaged  $D_e$  values and test dose sensitivity values for the bulk IRSL<sub>50</sub> measurements from the REM3B core. Three aliquots were measured for each sample, applying a test dose of c. 37 Gy following measurement of the natural IRSL signal at 50°C. Equivalent dose is given as the mean of the accepted aliquots.

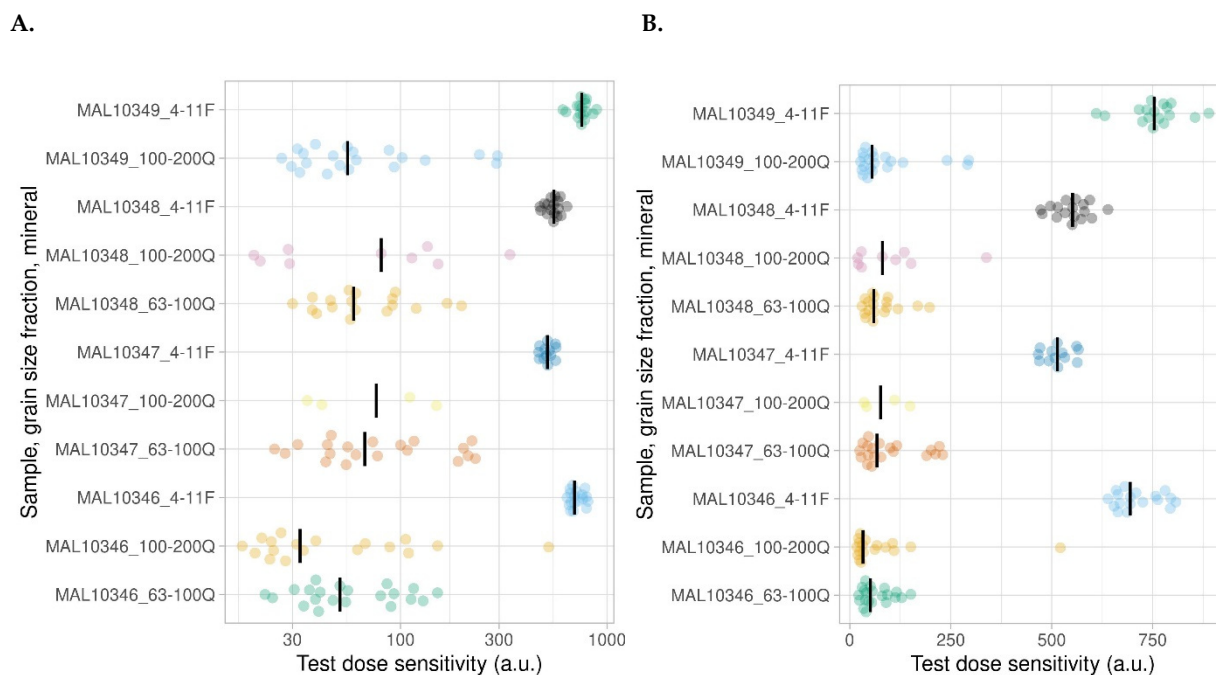
Sample	Depth (m)	Approximate $D_e$ (Gy)	Sensitivity (cts/s/Gy) $\pm 1\sigma$
A0171	26.35 $\pm$ 0.05	108	2980 $\pm$ 1513
A0174	24.25 $\pm$ 0.05	67	1259 $\pm$ 1027
A0175	23.65 $\pm$ 0.05	61	3088 $\pm$ 2115
A0176	23.45 $\pm$ 0.05	55	4855 $\pm$ 562
A0177	23.20 $\pm$ 0.05	60	6411 $\pm$ 3140
A0179	22.55 $\pm$ 0.05	62	5769 $\pm$ 2067
A0180	22.35 $\pm$ 0.05	57	6285 $\pm$ 1133
A0181	22.15 $\pm$ 0.05	54	10016 $\pm$ 3149
A0182	21.85 $\pm$ 0.05	55	9768 $\pm$ 2240
A0183	21.65 $\pm$ 0.05	61	6512 $\pm$ 1368
A0184	21.35 $\pm$ 0.05	56	4339 $\pm$ 3224
A0185	21.15 $\pm$ 0.05	55	6414 $\pm$ 1583
A0186	20.80 $\pm$ 0.05	59	5892 $\pm$ 1191
A0187	20.55 $\pm$ 0.05	65	5473 $\pm$ 985
A0188	20.35 $\pm$ 0.05	56	6189 $\pm$ 2591
A0189	20.10 $\pm$ 0.05	60	6577 $\pm$ 465
A0190	19.80 $\pm$ 0.05	61	6901 $\pm$ 1349
A0191	19.45 $\pm$ 0.05	59	5811 $\pm$ 1405
A0192	19.15 $\pm$ 0.05	59	3574 $\pm$ 972
A0193	18.80 $\pm$ 0.05	64	4632 $\pm$ 2671
A0194	18.55 $\pm$ 0.05	59	5932 $\pm$ 2793
A0195	18.15 $\pm$ 0.05	57	3871 $\pm$ 2123
A0196	17.80 $\pm$ 0.05	53	5014 $\pm$ 1927
A0197	17.60 $\pm$ 0.05	55	3988 $\pm$ 1972
A0198	17.35 $\pm$ 0.05	56	4087 $\pm$ 130
A0199	17.15 $\pm$ 0.05	56	4612 $\pm$ 496
A0200	16.80 $\pm$ 0.05	50	5673 $\pm$ 1201
A0201	16.55 $\pm$ 0.05	53	7767 $\pm$ 676
A0202	16.35 $\pm$ 0.05	48	4067 $\pm$ 10
A0203	16.15 $\pm$ 0.05	46	4411 $\pm$ 4525
A0204	15.80 $\pm$ 0.05	43	4252 $\pm$ 1835
A0205	15.45 $\pm$ 0.05	44	4984 $\pm$ 1475
A0206	15.15 $\pm$ 0.05	44	6868 $\pm$ 2365
A0207	14.85 $\pm$ 0.05	42	10013 $\pm$ 2312
A0208	14.65 $\pm$ 0.05	44	12048 $\pm$ 2868
A0209	14.35 $\pm$ 0.05	43	10922 $\pm$ 526
A0210	14.15 $\pm$ 0.05	40	7022 $\pm$ 2306

A0211	13.85 ± 0.05	41	5656 ± 2103
A0212	13.65 ± 0.05	42	4356 ± 825
A0213	13.45 ± 0.05	41	5881 ± 1798
A0214	13.20 ± 0.05	42	3795 ± 2393
A0215	12.85 ± 0.05	41	2859 ± 1380
A0217	12.45 ± 0.05	40	4004 ± 99
A0218	12.25 ± 0.05	40	6024 ± 1844
A0219	12.10 ± 0.05	36	9457 ± 4669
A0221	11.50 ± 0.05	36	7505 ± 674
A0222	11.30 ± 0.05	34	10127 ± 5499
A0223	11.10 ± 0.05	37	6342 ± 1475
A0347	10.80 ± 0.05	35	8559 ± 4055
A0349	10.30 ± 0.05	33	8615 ± 2753
A0350	10.10 ± 0.05	32	7136 ± 5420
A0351	9.80 ± 0.05	32	7380 ± 3412
A0352	9.60 ± 0.05	32	7048 ± 1114
A0353	9.40 ± 0.05	30	7890 ± 3359
A0355	8.75 ± 0.05	31	6132 ± 1365
A0356	8.55 ± 0.05	33	7086 ± 507
A0357	8.35 ± 0.05	31	6025 ± 2173
A0358	8.15 ± 0.05	31	7388 ± 982
A0359	7.80 ± 0.05	33	7378 ± 2956
A0361	7.40 ± 0.05	31	10536 ± 3801
A0362	7.15 ± 0.05	30	12860 ± 1520
A0363	6.85 ± 0.05	32	14730 ± 5158
A0364	6.65 ± 0.05	32	11213 ± 3898
A0366	6.25 ± 0.05	33	9223 ± 2026
A0367	6.10 ± 0.05	33	10675 ± 483
A0368	5.81 ± 0.05	35	10879 ± 2010
A0369	5.65 ± 0.05	34	11195 ± 3145
A0371	5.25 ± 0.05	32	20821 ± 3144
A0372	5.10 ± 0.05	33	23798 ± 4648
A0373	4.80 ± 0.05	31	19008 ± 4645
A0374	4.60 ± 0.05	32	22835 ± 650
A0377	4.10 ± 0.05	33	21749 ± 2602
A0378	3.75 ± 0.05	32	29515 ± 3227
A0380	3.15 ± 0.05	30	4946 ± 1244
A0381	2.85 ± 0.05	28	6511 ± 2459
A0382	2.55 ± 0.05	29	7640 ± 3245
A0383	2.35 ± 0.05	29	4509 ± 404
A0384	2.15 ± 0.05	28	5855 ± 1399
A0385	1.80 ± 0.05	27	6400 ± 431
A0386	1.50 ± 0.05	26	6982 ± 2741
A0387	1.25 ± 0.05	26	9499 ± 2552

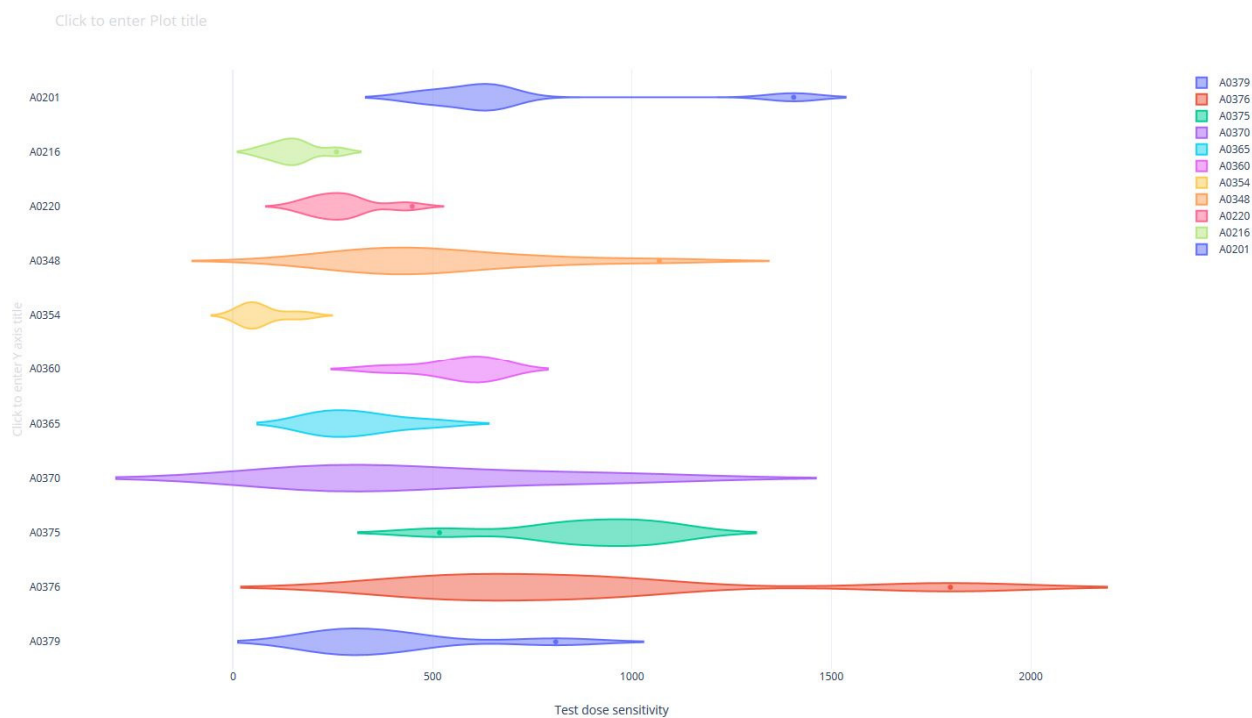
A0388	$0.75 \pm 0.05$	27	$8169 \pm 2899$
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**Table S8.** Summary of depths, average and standard deviation of test dose sensitivity values for the different mineral and grain-size fractions measured for profile RP1.

Sample	Depth from Surface (m)	Sensitivity (cts/s/Gy) $\pm 1\sigma$		
		100-200 $\mu\text{m}$ Quartz	63-100 $\mu\text{m}$ Quartz	4-11 $\mu\text{m}$ Polymineral
MAL10349	$3.50 \pm 0.05$	-	$87.8 \pm 83.6$	$756 \pm 67.2$
MAL10348	$4.25 \pm 0.05$	$102 \pm 103$	$76.6 \pm 45.8$	$549 \pm 44.7$
MAL10347	$4.95 \pm 0.05$	$84.4 \pm 55.2$	$98.3 \pm 71.7$	$514 \pm 35$
MAL10346	$6.35 \pm 0.05$	$77.47 \pm 117$	$65.3 \pm 37.5$	$713 \pm 55$

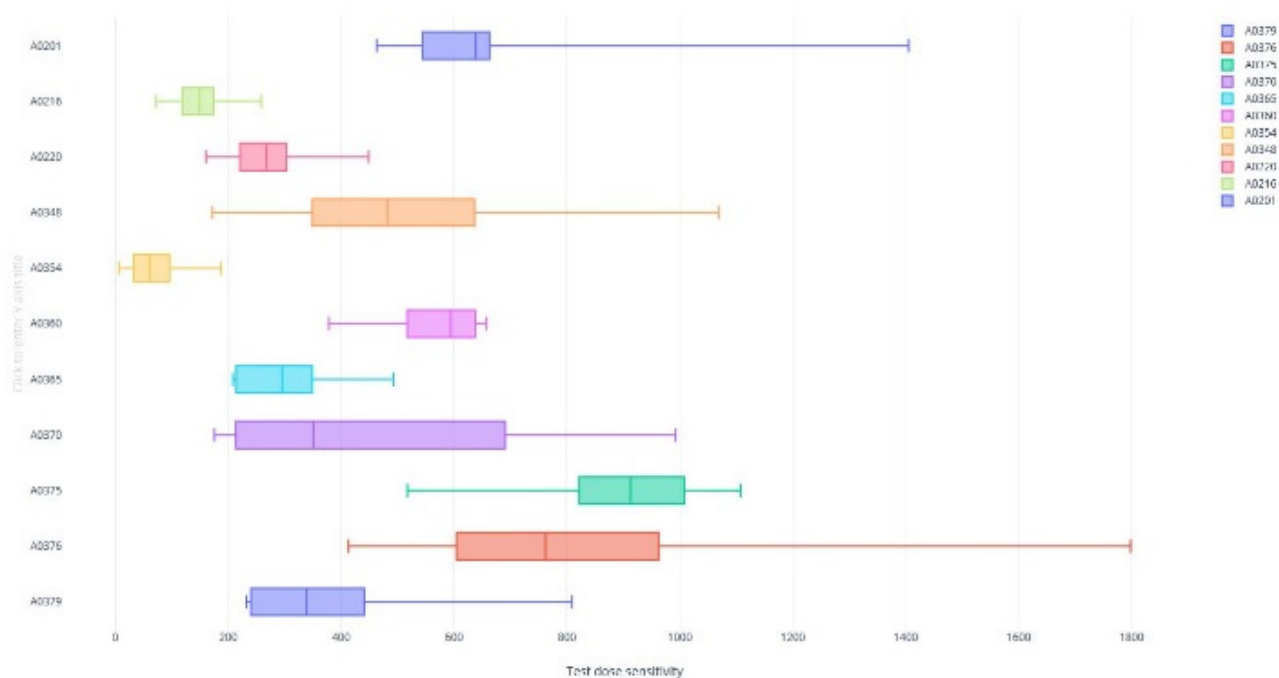


**Figure S4.** Test dose sensitivity for the different mineral and grain-size samples measured for profile RP1, expressed as dot plots. The median of each set of values is marked by a black line. A logarithmic scale in (A) highlights differences between the quartz sensitivities, and a linear scale in (B) highlights differences between the polymineral fine-grained sensitivities.

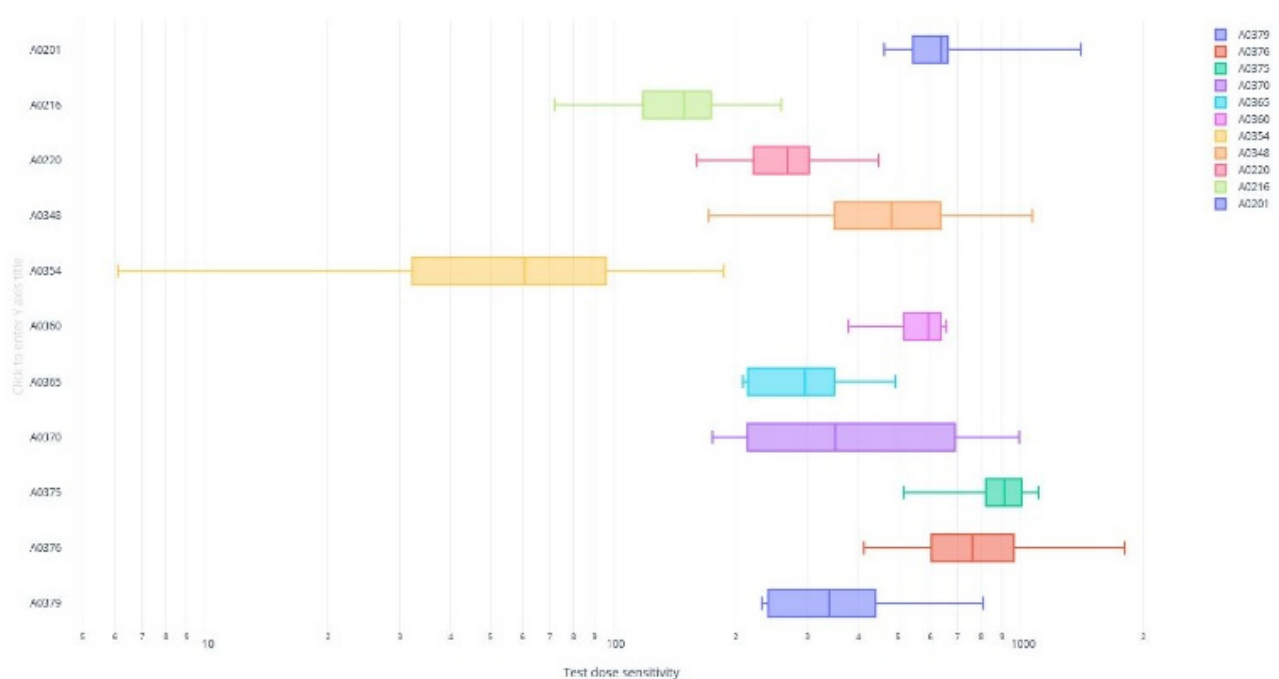


**Figure S5.** Test dose sensitivity for the very fine sand (63-90  $\mu\text{m}$ ) K-feldspar samples measured from RP1 in this study expressed as violin plot distributions.

A

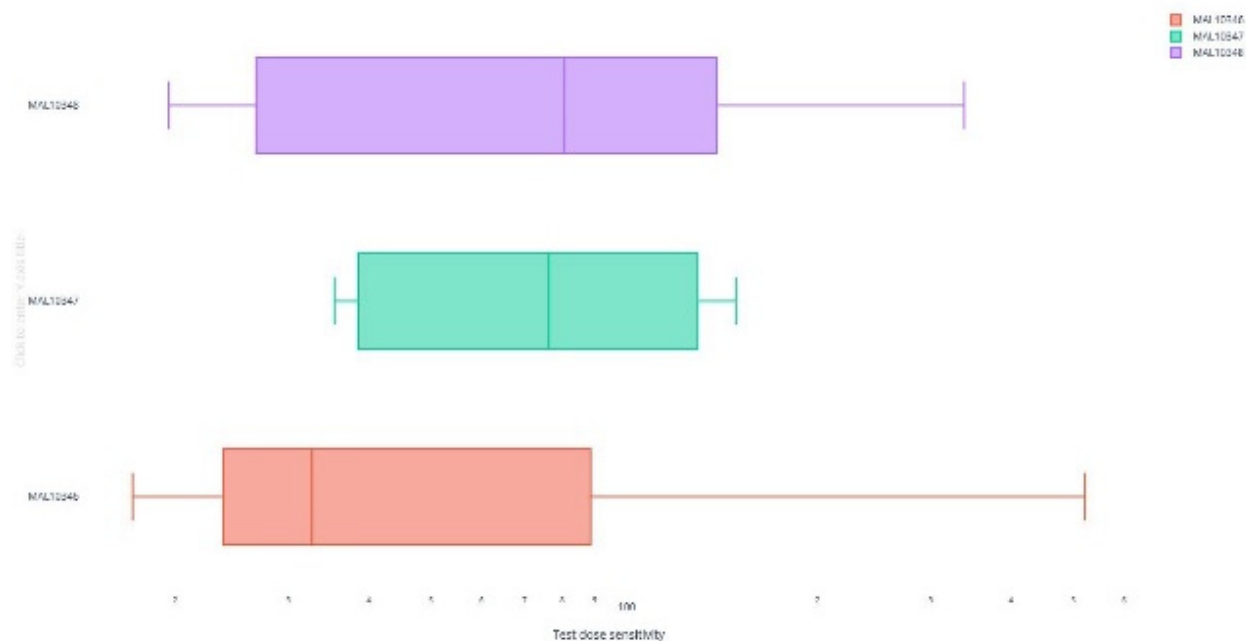


B

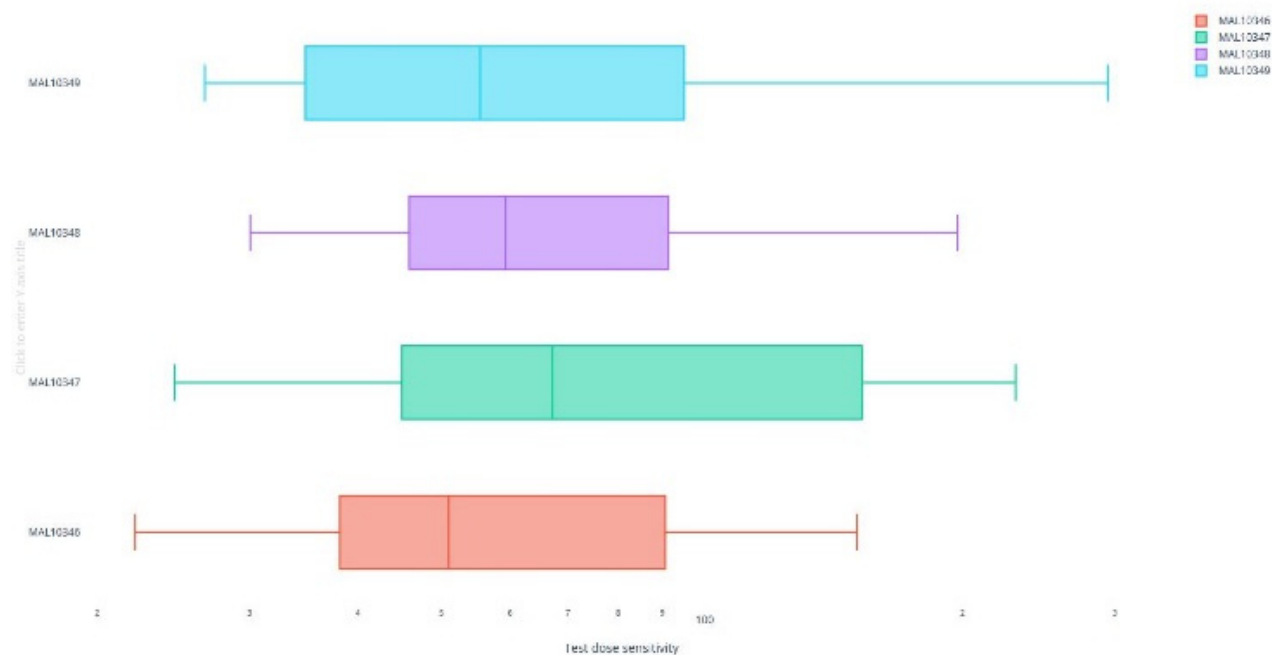


**Figure S6.** Test dose sensitivity for the very fine sand (63-90  $\mu\text{m}$ ) K-feldspar samples measured from RP1 in this study expressed as box plots with A) linear and B) logarithmic scale on the x-axis.

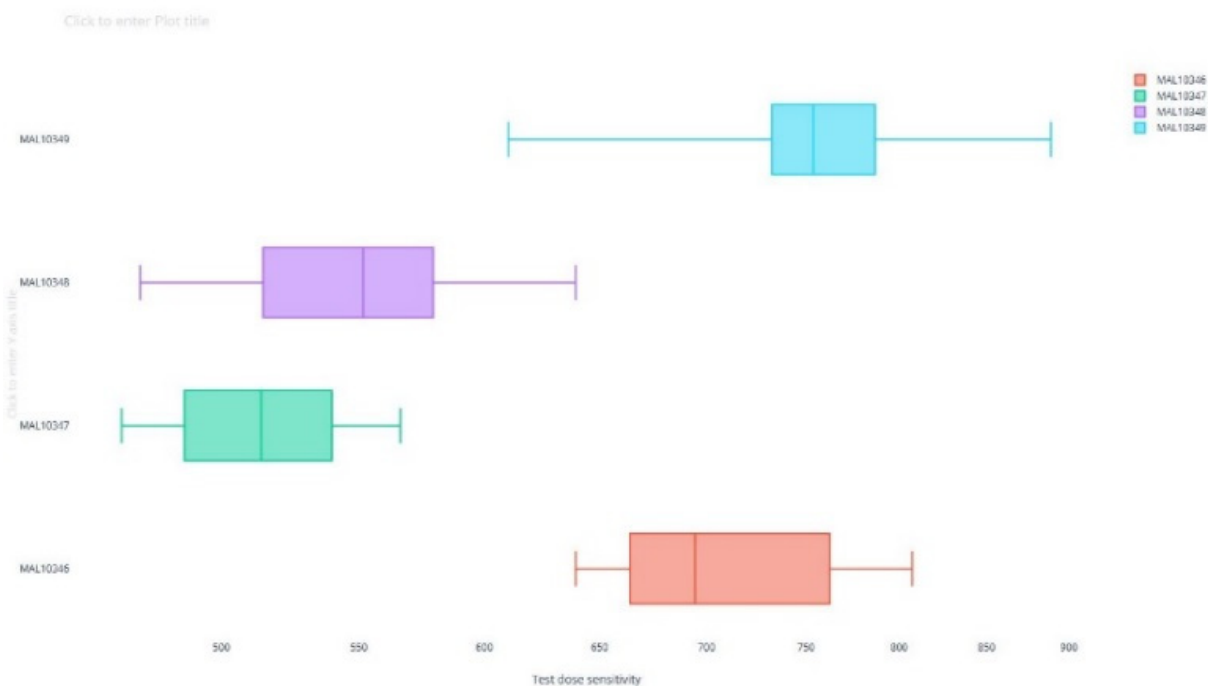
**A**



**B**



**Figure S7.** Box-plots of test-dose sensitivity for the A) 100-200 µm and B) 63-100 µm quartz fraction of samples measured from profile RP1, using a logarithmic scale.



**Figure S8.** Box-plots of test-dose sensitivity for the 4-11  $\mu\text{m}$  polymineral fraction of samples measured from profile RP1, using a logarithmic scale.

**Table S9.** Summary of depths, averaged  $D_e$  values and test dose sensitivity values for the ten fine-grained (4-11 $\mu\text{m}$ ) quartz OSL samples measured in this study. Three aliquots were measured for each sample, using a measurement protocol involving three regenerative dose steps, preheat/cutheat temperatures of 260/240°C and a test dose of c. 37 Gy. Minimum equivalent doses are assumed to represent signal saturation.

Sample	Depth (m)	Averaged $D_e$ (Gy)	Sensitivity (cts/s/Gy) $\pm 1\sigma$
A0164	29.80 $\pm$ 0.05	No signal	26.9 $\pm$ 11.4
A0166	28.85 $\pm$ 0.05	>290	222 $\pm$ 75
A0167	28.45 $\pm$ 0.05	>290	646 $\pm$ 456
A0168	27.75 $\pm$ 0.05	>290	460 $\pm$ 27
A0171	26.35 $\pm$ 0.05	>102	405 $\pm$ 69
A0172	25.30 $\pm$ 0.05	>474	1698 $\pm$ 672
A0174	24.25 $\pm$ 0.05	>239	859 $\pm$ 139
A0175	23.65 $\pm$ 0.05	191 $\pm$ 9	1321 $\pm$ 239
A0176	23.45 $\pm$ 0.05	209 $\pm$ 18	719 $\pm$ 88
A0177	23.20 $\pm$ 0.05	78.1 $\pm$ 38.6	1621 $\pm$ 2613

**Table S10.** Summary of depths, averaged  $D_e$  values and test dose sensitivity values for the five very fine sand (63-90  $\mu\text{m}$ ) quartz OSL samples measured in this study. Three aliquots were measured for each sample, using a measurement protocol involving two regenerative dose steps, preheat/cutheat temperatures of 260/240°C and a test dose of c. 37 Gy.

Sample	Depth (m)	Averaged $D_e$ (Gy)	Sensitivity (cts/s/Gy) $\pm 1\sigma$
A0365	6.45 $\pm$ 0.05	55.1 $\pm$ 8.3	86.2 $\pm$ 15.9
A0370	5.45 $\pm$ 0.05	51.0 $\pm$ 12.1	221 $\pm$ 84
A0375	4.45 $\pm$ 0.05	63.5 $\pm$ 9.9	195 $\pm$ 153
A0376	4.25 $\pm$ 0.05	135 $\pm$ 94	573 $\pm$ 132
A0379	3.45 $\pm$ 0.05	50.0 $\pm$ 7.0	275 $\pm$ 214

**Table S11.** Summary of depths, averaged uncorrected  $D_e$  values and test dose sensitivity values for the 11 very fine sand (63-90 $\mu\text{m}$ ) K-feldspar samples measured in this study using the pIR-IR protocols. The number of aliquots measured for each sample is listed and the  $D_e$  uncertainty is given as the standard error.

Sample	Depth (m)	Number of Aliquots Measured	Measurement Protocol	Averaged $D_e$ (Gy) $\pm$ se	Sensitivity (cts/s/Gy) $\pm 1\sigma$
A0201	16.60 $\pm$ 0.05	6	pIR <sub>200</sub> IR <sub>290</sub>	174 $\pm$ 3	400 $\pm$ 216
A0216	12.65 $\pm$ 0.05	6		133 $\pm$ 3	884 $\pm$ 492
A0220	11.80 $\pm$ 0.05	6		114 $\pm$ 3	880 $\pm$ 208
A0348	10.50 $\pm$ 0.05	6		120 $\pm$ 4	462 $\pm$ 317
A0354	9.20 $\pm$ 0.05	6		116 $\pm$ 8	309 $\pm$ 107
A0360	7.60 $\pm$ 0.05	6		117 $\pm$ 3	563 $\pm$ 103
A0365	6.45 $\pm$ 0.05	12		122 $\pm$ 11	72.7 $\pm$ 56.4
A0370	5.45 $\pm$ 0.05	12		131 $\pm$ 6	512 $\pm$ 248
A0375	4.45 $\pm$ 0.05	12		112 $\pm$ 4	277 $\pm$ 85
A0376	4.25 $\pm$ 0.05	6		113 $\pm$ 4	726 $\pm$ 154
A0379	3.45 $\pm$ 0.05	6	pIR <sub>200</sub> IR <sub>290</sub>	113 $\pm$ 4	168 $\pm$ 63
		24	pIR <sub>50</sub> IR <sub>290</sub>	85.8 $\pm$ 1.0	4762 $\pm$ 2501
A0380	3.45 $\pm$ 0.05	24	pIR <sub>50</sub> IR <sub>290</sub>	77.0 $\pm$ 1.5	2243 $\pm$ 1533
A0381	3.15 $\pm$ 0.05	24		81.7 $\pm$ 3.4	780 $\pm$ 426
A0382	2.85 $\pm$ 0.05	24		87.8 $\pm$ 2.6	9478 $\pm$ 4034
A0383	2.55 $\pm$ 0.05	24		87.7 $\pm$ 1.1	11098 $\pm$ 5365
A0384	2.15 $\pm$ 0.05	24		84.1 $\pm$ 4.1	4939 $\pm$ 7907
A0385	1.80 $\pm$ 0.05	24		83.4 $\pm$ 1.8	5662 $\pm$ 2908
A0387	1.25 $\pm$ 0.05	24		77.5 $\pm$ 0.9	3876 $\pm$ 2000

### Statistical analysis of bulk IRSL<sub>50</sub> luminescence sensitivity measurements

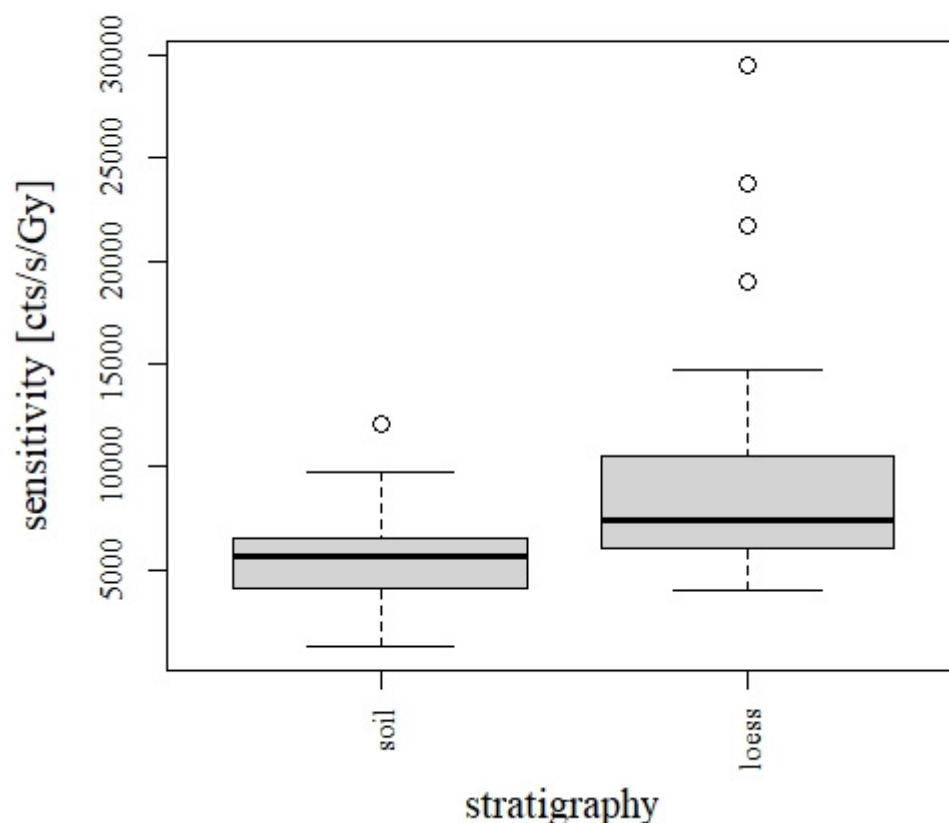
We used RStudio 2021.09.0 to statistically analyse the relationship of bulk IRSL<sub>50</sub> luminescence sensitivity with the following variables:

- stratigraphy, i.e., palaeosol vs. (reworked) loess

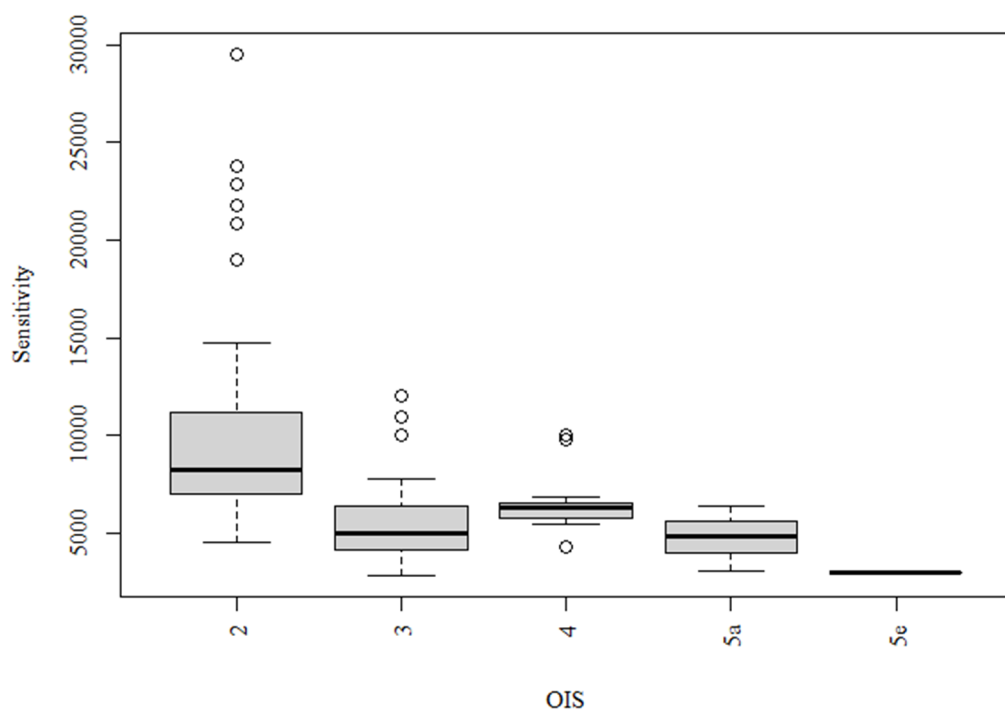


- OIS
- depth
- clay
- Si/Al

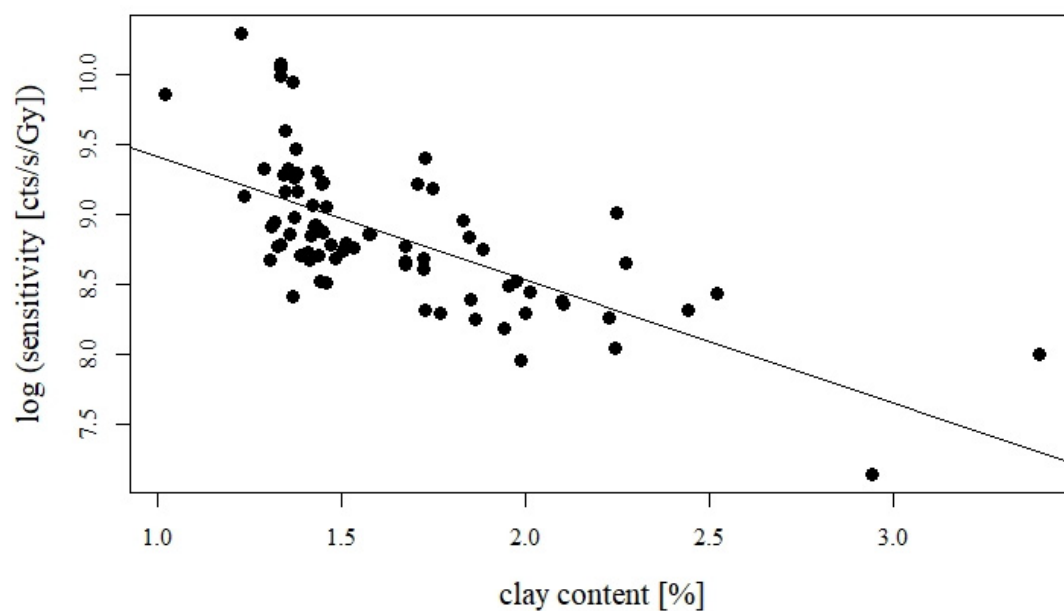
Please refer to the spreadsheet provided in the supplementary material section for the full dataset. Due to the sensitivity data not being normally distributed, we used non-parametric tests to assess the relationship of sensitivity with the listed parameters (Table S12). All tests yielded p-values  $< 0.05$ , suggesting that the difference between sensitivities in loess and palaeosol samples as well as in samples from different OIS is statistically significant, and that there is a statistically significant correlation between sensitivity and depth, sensitivity and clay, and sensitivity and Si/Al. The resulting rho-values show a strong positive correlation between Si/Al and sensitivity, a strong negative correlation between clay and sensitivity, and a strong positive correlation between depth and sensitivity (cf. Table S12).



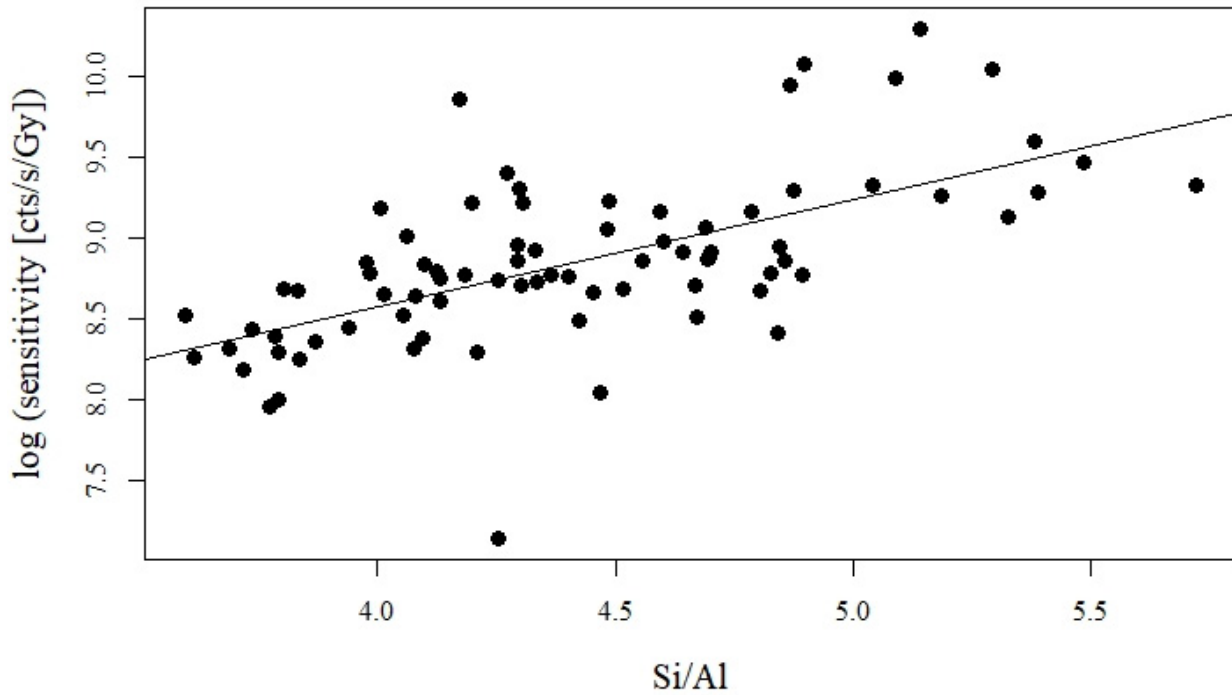
**Figure S9.** IR<sub>50</sub> sensitivity vs. stratigraphy, as divided between soils and loess (including reworked loess).



**Figure S10.** IR<sub>50</sub> sensitivity vs. OIS as defined in [53].



**Figure S11.** Log-transformed IR<sub>50</sub> sensitivity plotted against clay content (data from [53]).



**Figure S12.** Log-transformed  $IR_{50}$  sensitivity plotted against Si/Al (data from [88]).

**Table S12.** Settings and results of the statistical analyses testing the relationship of sensitivity with stratigraphy, OIS, depth, clay, and Si/Al ratio.

Parameters Tested	Test Used	p-Value	Correlation Coefficient (rho)
Stratigraphy vs. sensitivity	Wilcoxon rank sum exact test	9.54e-05	-
OIS vs. sensitivity	Kruskal-Wallis rank sum test	1.163e-06	-
Depth vs. sensitivity	Spearman's rank correlation rho	2.539e-07	0.5329829
Clay vs. sensitivity	Spearman's rank correlation rho	1.693e-12	-0.6916748
Si/Al vs. sensitivity	Spearman's rank correlation rho	1.997e-11	0.6666261

In order to further assess the relationship of stratigraphy, OIS, depth, clay, and Si/Al with sensitivity we performed multiple linear regression analyses, taking all potential explanatory variables into account. After a visual inspection of the graphs plotting sensitivity against depth, clay, and Si/Al we decided to conduct a log transformation on the sensitivity data before the regression analyses. Please note that the data do not meet all conditions that are usually assumed for a multiple linear regression analysis; the variables may be autocorrelated. Multivariate normality is not given for all variables.

We conducted both a forward selection multiple regression and a backward elimination multiple regression aiming to identify which variables (stratigraphy, OIS, depth, clay, Si/Al) were the best predictors for sensitivity. Both analyses yielded that the best regression model for sensitivity uses only clay and Si/Al as predictors; all

other variables did not improve the model's fit. The model created by forward selection uses Si/Al as the main predictor and clay as the secondary predictor while the backward elimination model suggests that clay is the main predictor and Si/Al is the secondary predictor.