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INVESTIGATIONS ON THE LUMINESCENCE PROPERTIES OF QUARTZ AND FELDSPARS EXTRACTED FROM LOESS IN THE CANTERBURY PLAINS, NEW ZEALAND SOUTH ISLAND

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Supplementary Materials

Table S1. *Quartz SAR-OSL and polymineral pIRIR protocols used for equivalent dose measurements in this study. (A) quartz SAR-OSL, (B) pIRIR$_{225}$ and (C) pIRIR$_{290}$.*

Step	(A) SAR protocol	(B) pIRIR$_{225}$	(C) pIRIR$_{290}$
1	Dose	Dose	Dose
2	Preheat (125°C; 10 s)	Preheat (250°C; 60 s)	Preheat (320°C; 60 s)
3	Blue OSL (125°C; 40 s)	IRSL (50°C; 200 s)	IRSL (50°C; 200 s)
4	Test dose (17 Gy)	IRSL (225°C; 200 s)	IRSL (290°C; 200 s)
5	Cutheat (180°C)	Test dose (17 Gy)	Test dose (17 Gy)
6	Blue OSL (125°C; 40 s)	Preheat (250°C; 60 s)	Preheat (320°C; 60 s)
7	Blue OSL (280°C; 40 s)	IRSL (50°C; 200 s)	IRSL (50°C; 200 s)
8		IRSL (225°C; 200 s)	IRSL (290°C; 200 s)
9		IRSL (290°C; 100 s)	IRSL (325°C; 100 s)

IRSL, infrared-stimulated luminescence; OSL, optically stimulated luminescence; pIRIR, post-infrared–infrared protocols; SAR, single-aliquot regenerative-dose.

Table S2. *The average luminescence signal intensities of the natural and a beta dose of 100 Gy, recorded during the first 1.2 s of stimulation.*

Sample code	Grain size (µm)	Number of measured aliquots	Natural signal intensity from 1.2 s	100 Gy signal intensity from 1.2 s	Tx/Tn maximum
NZ 2	90–125	3	475 ± 28	2524 ± 841	2.7 ± 8.0
NZ3	63–90	21	957 ± 375	3212 ± 1703	3.0 ± 4.4
	90–125	7	1214 ± 233	4116 ± 1580	5.4 ± 1.5
	125–180	8	1676 ± 303	7924 ± 2458	2.1 ± 0.4
	180–250	8	1483 ± 403	5580 ± 3031	3.5 ± 4.3
NZ 4	63–90	5	978 ± 387	3936 ± 1354	1.6 ± 0.3
NZ 5	63–90	3	602 ± 57	2646 ± 294	2.1 ± 0.1
	90–125	3	613 ± 15	3901 ± 2051	2.5 ± 0.6

Number of measured aliquots represents the number of aliquots that were taken into account for averaging the OSL signal.

Tx/Tn maximum is the average of the maximum Tx/Tn ratio obtained for each aliquot measured using the SAR-OSL protocol.

Table S3. *Measured equivalent doses using both pIRIR protocols along with the results of the recycling and recuperation tests.*

Sample code	Protocol	Measured equivalent dose (Gy)	Recycling	Recuperation (%)
NZ 2	pIRIR$_{225}$	64 ± 2	0.97 ± 0.01	1.6 ± 0.3
	pIRIR$_{290}$	83 ± 3	0.93 ± 0.01	1.4 ± 0.1
NZ 3	pIRIR$_{225}$	67 ± 1	1.00 ± 0.02	1.3 ± 0.3
	pIRIR$_{290}$	86 ± 4	0.98 ± 0.03	1.4 ± 0.2
NZ 4	pIRIR$_{225}$	84 ± 3	0.99 ± 0.01	1.1 ± 0.2
	pIRIR$_{290}$	123 ± 7	0.93 ± 0.01	1.1 ± 0.1
NZ 5	pIRIR$_{225}$	92 ± 3	0.98 ± 0.01	1.7 ± 0.4
	pIRIR$_{290}$	120 ± 6	0.99 ± 0.02	1.5 ± 0.1

pIRIR, post-infrared–infrared protocols.

Table S4. *Residual doses measured using pIRIR$_{225}$ and pIRIR$_{290}$ protocols after one month of bleaching.*

Sample code	Protocol	Residual dose (Gy)
NZ 2	pIRIR$_{225}$	3.3 ± 0.4
	pIRIR$_{290}$	8.3 ± 0.5
NZ 3	pIRIR$_{225}$	3.7 ± 0.3
	pIRIR$_{290}$	4.1 ± 0.6
NZ 4	pIRIR$_{225}$	3.7 ± 0.2
	pIRIR$_{290}$	13.6 ± 2.5
NZ 5	pIRIR$_{225}$	3.4 ± 0.5
	pIRIR$_{290}$	10.9 ± 1.4

pIRIR, post-infrared–infrared protocols.

Table S5. *g-values measured on polymineral fine grains using pIRIR$_{225}$ protocol.*

Sample code	Aliquot code	g-value (%/decade)	Average g-value (%/decade)
NZ 2	aliq 1	-0.93 ± -0.68	0.44 ± 0.69
	aliq 2	1.05 ± 0.69	
	aliq 3	1.21 ± 0.69	
NZ 4	aliq 1	2.87 ± 0.74	2.28 ± 0.44
	aliq 2	1.42 ± 0.72	
	aliq 3	2.55 ± 0.72	
NZ 5	aliq 1	1.09 ± 0.66	0.88 ± 0.12
	aliq 2	0.88 ± 0.69	
	aliq 3	0.68 ± 0.66	

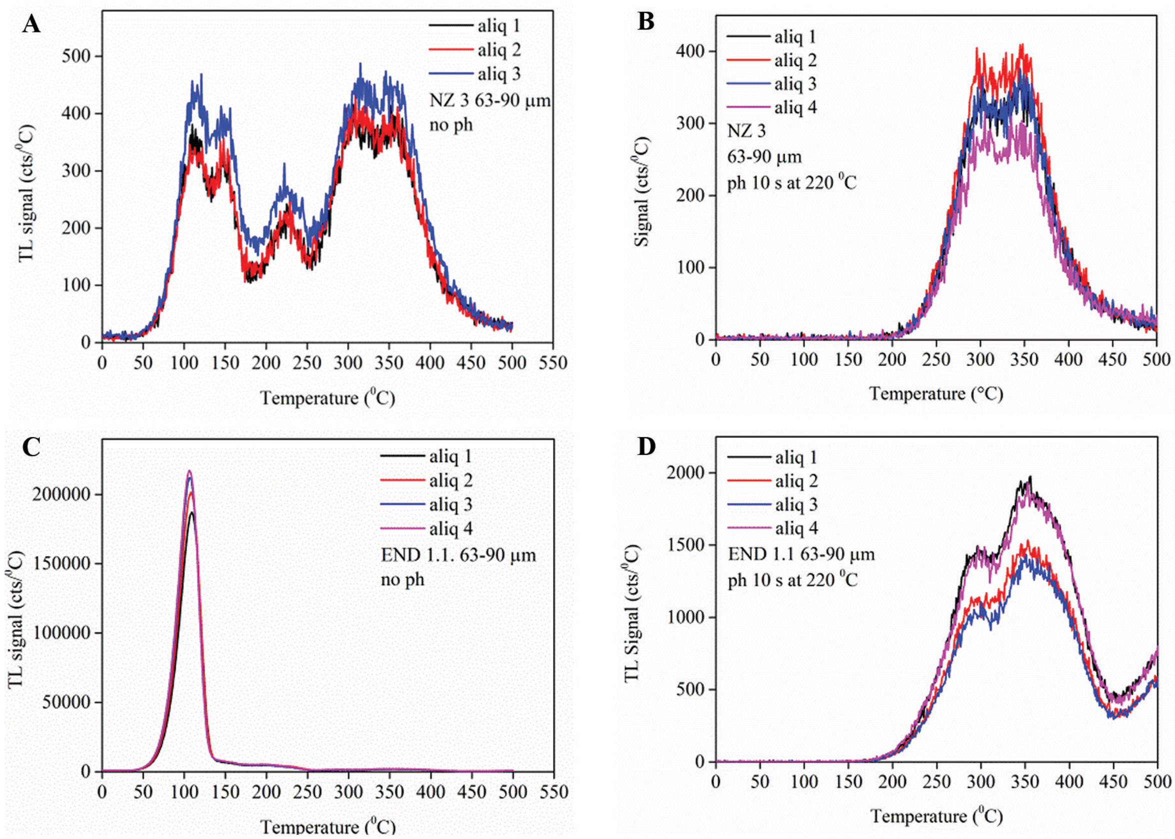

Fig S1*. Comparison between the TL glow curves recorded with a ramp heating of 5°C/s to 500°C for different aliquots of sample NZ3 (63–90 µm) and END 1.1 (63–90 µm). END 1.1 is considered a representative sample due to its ideal OSL properties (for more details see Tecsa et al., 2020).* ***(A)*** *TL signal recorded for sample NZ 3 immediately after an irradiation with 100 Gy;* ***(B)*** *Same as* ***(A)*** *but with a preheat of 10 s at 220°C inserted before measurement;* ***(C)*** *TL signal recorded for sample END 1.2 immediately after an irradiation with 100 Gy;* ***(D)*** *Same as* ***(C)*** *but with a preheat of 10 s at 220°C inserted before measurement. These signals are representative for samples that have not been previously annealed. OSL, optically stimulated luminescence; TL, thermoluminescence.*

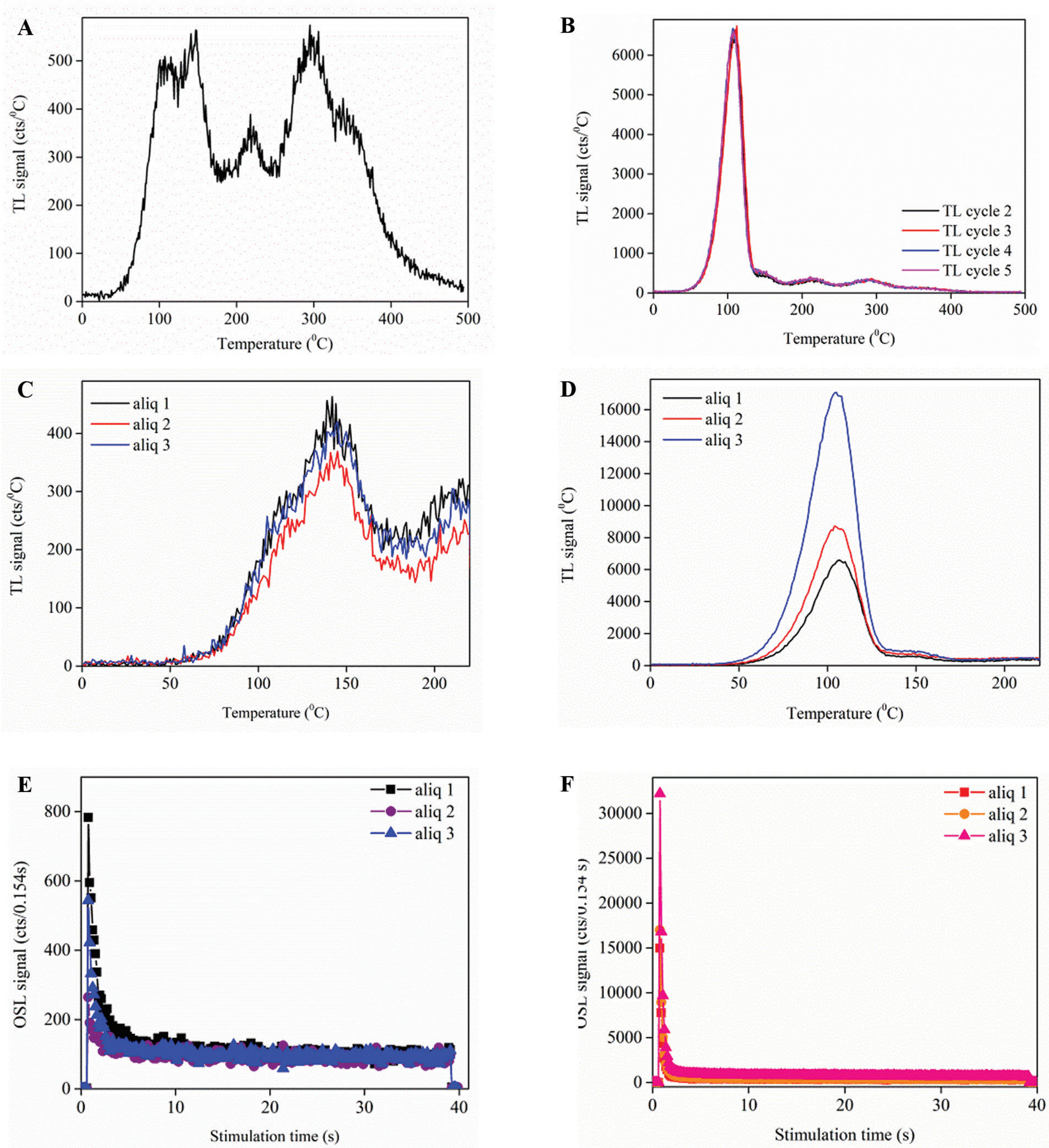

***Fig S2**. The effect of annealing on OSL and low temperature TL signals. **(A)** represents the TL response to 100 Gy recorded during first annealing of the sample in the dose recovery experiment denoted as experiment (ii) in the main text. **(B)** represents the TL recorded after 100 Gy in the subsequent annealing steps. **(C)** represents TL recorded during the preheat in the dose recovery test with no previous annealing on three distinct aliquots. **(D)** represents TL recorded during the dose recovery test with previous annealing (experiment (ii) in the main text) on three distinct aliquots. **(E)** represents OSL response to 100 Gy recorded on three distinct aliquots in a dose recovery test with no annealing. **(F)** represents OSL response to 100 Gy recorded on three distinct aliquots in a dose recovery test with previous annealing (experiment (ii) in the main text). OSL, optically stimulated luminescence; TL, thermoluminescence.*

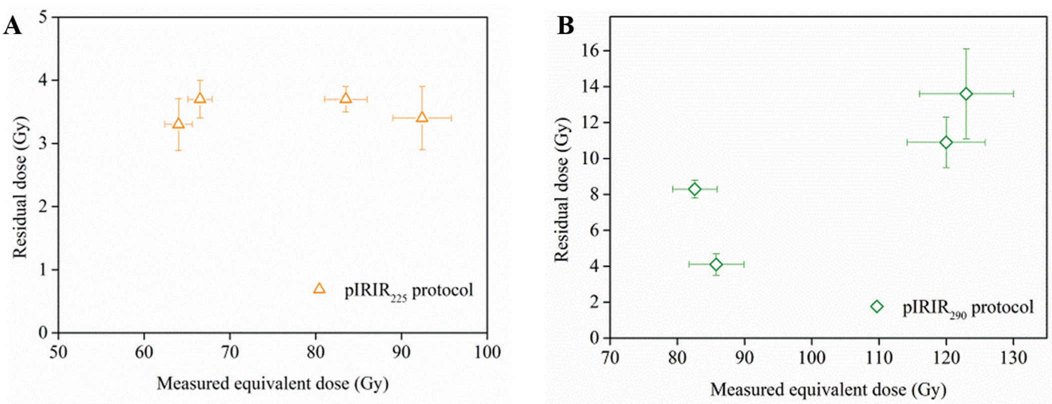

***Fig S3**. Residual doses as function of measured equivalent dose using **(A)** pIRIR$_{225}$ and **(B)** pIRIR$_{290}$ protocols. The aliquots used for residual dose measurements were exposed to window light for 1 month. pIRIR, post-infrared–infrared protocols.*

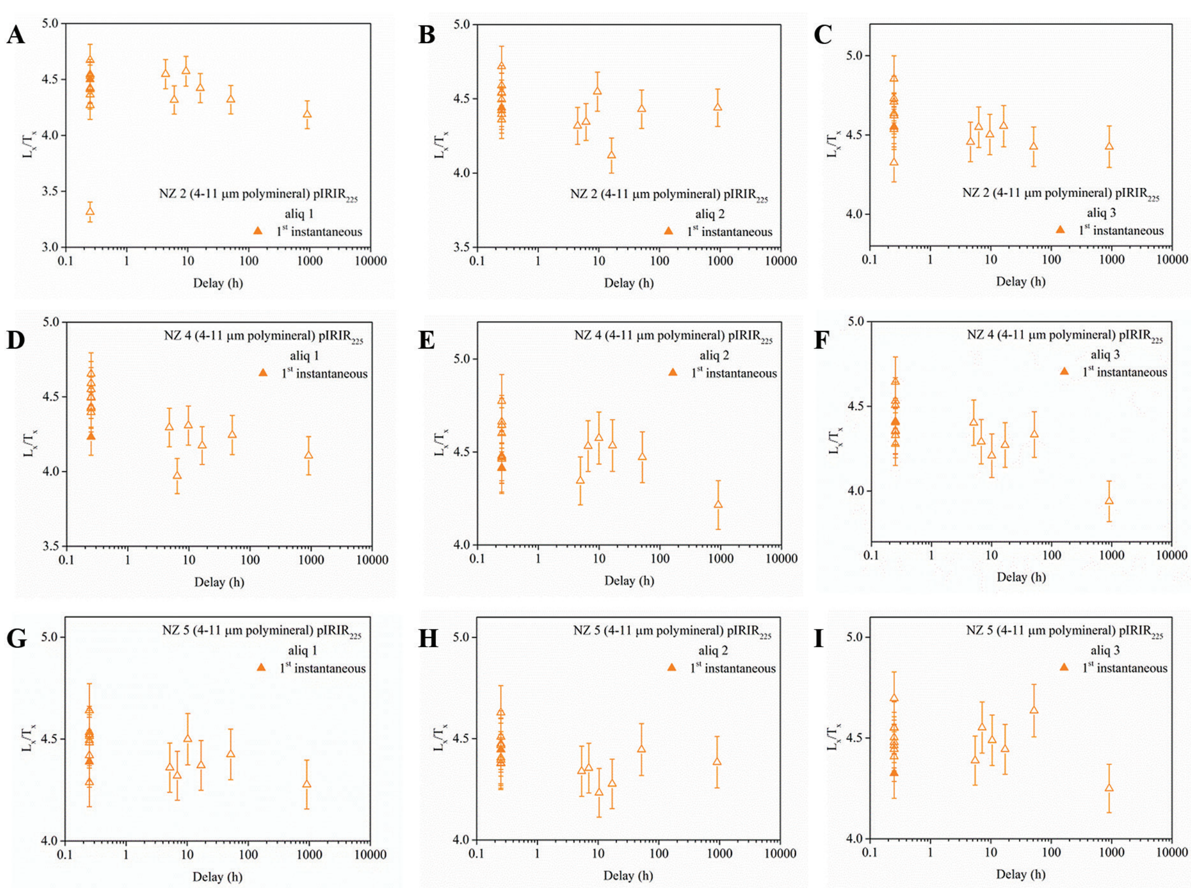

***Fig S4**. Results of the fading rate measurements on individual aliquots of 4–11 µm polymineral material using pIRIR$_{225}$ protocol on sample **(A, B, C)** NZ 2, **(D, E, F)** NZ 4 and **(G, H, I)** NZ 5. The signals were read after a maximum delay of 38 days. A number of four consecutive prompt read-outs were carried out before signal measurement after delay and two/three consecutive prompts read-outs were added after different delays times. The signal intensity of the first instantaneous read-out is represented with filled symbols.*

References

Tecsa V, Mason JA, Johnson, WC, Miao X, Constantin D, Radu S, Magdas DA, Veres D, MarkovićSB and Timar-Gabor A, 2020. Optically stimulated luminescence dating and multi-proxy analysis of the Enders loess section (Nebraska, USA). *Quaternary Science Reviews 229*: 106130.