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ULTRAFAST COMPONENT EFFECTS ON QUARTZ SINGLE GRAINS DOSE ESTIMATION FROM KHUTAGT UUL MOUNTAINS, MONGOLIA

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The environmental radiation dose rates were measured using a range of methods. Neutron activation analysis (NAA) was applied to the external layer of the pottery sample L-EVA-1201 to determine K, U and Th concentrations. These values were combined with radionuclide concentrations from the surrounding sediment determined using high-resolution γ-spectrometry at the Felsenkeller, RFI Dresden, Germany. For all samples, total β dose rates were measured using a *GM-25-5*β counter at MPI, Leipzig. For polymineral fine-grains, 'α-values' of 0.10 ± 0.02 and 0.12 ± 0.02 were used for IR_{50} and $pIRIR_{225}$ measurements, respectively. An internal potassium content of $12.5 \pm 0.5\%$ (Huntley and Hancock, 2001) and an α-efficiency factor of 0.08 ± 0.2 was assumed. In-situ water content measured shortly after sampling was taken into account. The contribution from cosmic radiation to the dose rate was calculated following Prescott and Hutton (1994), assuming an uncertainty of 5%. The radionuclide concentrations were converted to dose rate data using the conversion factors from (Guerin and Mercier, 2011).

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Table S1. *Sample description, mineral fraction and dose rate data.*

Sample description	Sampling site	Grain size (μm)	Dr_i (mGy/a)			Dr_e (mGy/a)
			β^a	$\beta^{b,c}$	α^b	γ^c
L-EVA-1201, pottery	MKC 115, layer 3 Depth 280 cm	212 ÷ 250 4 ÷ 11	2.76 ± 0.07 3.06 ± 0.08	2.52 ± 0.04 2.75 ± 0.10	- 0.76 ± 0.10	1.45 ± 0.02 1.38 ± 0.06
L-EVA-1202, sediment	MKC 115, layer 3 Depth 280 cm	212 ÷ 250 4 ÷ 11	2.90 ± 0.04 3.22 ± 0.04	2.52 ± 0.04 2.51 ± 0.12	- 0.64 ± 0.09	1.39 ± 0.02 1.40 ± 0.05
L-EVA-1203, sediment	MKC 65, layer 2 Depth 300 cm	212 ÷ 250 4 ÷ 11	2.53 ± 0.08 2.81 ± 0.09		0.56 ± 0.09	1.40 ± 0.05

[a]Risø GM-25-5*Beta-Counter MPI, Leipzig.*
[b]*Neutron activation analysis NAA, CEZA Mannheim.*
[c]*High-resolution gamma spectrometry Felsenkeller, Dresden.*

Table S2. *The single grain regenerative-dose procedure for quartz.*

Step	Treatment	Observed
	D_e measurement	
1	Give dose, D_i	
2	Preheat (260°C for 10 s)	
3	SG green laser, 1 s at 125°C	L_x
4	Give test dose, D_t (1.8 Gy)	
5	Cutheat to 220°C	
6	SG green laser, 1 s at 125°C	T_x
7	Return to step 1	

Table S3. *The single grain regenerative-dose procedure for feldspar.*

Step	Treatment	Observed
	D_e measurement	
1	Give dose, D_i	
2	Preheat (250°C for 60 s)	
3	IRSL, 60 s at 50°C	
4	IRSL, 60 s at 225°C	L_x
5	Give test dose, D_t (1.8 Gy)	
6	Preheat (250°C for 60 s)	
7	IRSL, 60 s at 50°C	
8	IRSL, 60 s at 225°C	T_x
9	Return to 1	

Table S4. *(A) the relative uncertainty on the first test dose signal T_N was less than 3 sigma above its corresponding background or its relative standard error is >20%; (b) the recycling ratio is >10% and the recuperation is >10% of L_N/T_N; (C) the L_N/T_N value exceeded the laboratory measured dose-response curves; (D) OSL IRSL depletion ratio differed from unity by more than 2 sigma.*

Sample ID	Number of single grains, N	Reasons for rejection of grains				Total rejected	Total accepted	% used
		A	B	C	D			
L-EVA 1201	300	120	0	0	0	120	180	60
L-EVA 1202	500	293	50	66	19	428	72	29.5
L-EVA 1203	300	150	32	59	10	251	49	16.3

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