Contents:

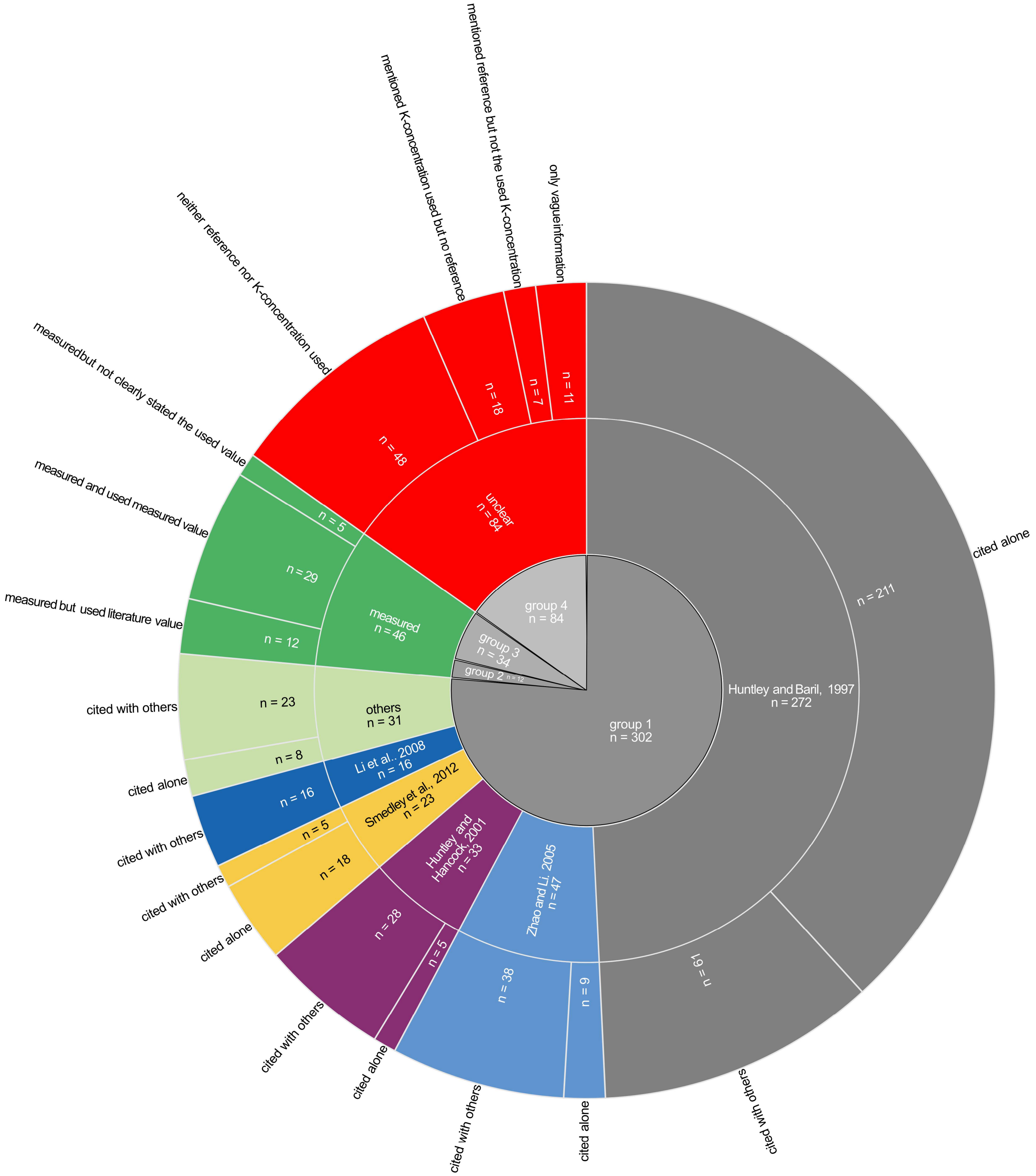

Figure S1. Detailed summary of the literature review. **Inner circle**: allocation of the 432 articles into four groups, where group 1 used one or more literature values for the K-concentration, group 2 measured the K-concentration of their samples but used a literature value instead, group 3 measured the K-concentration of their samples and used it, group 4 did not clearly state what K-concentration they used or where the used K-concentration came from. **Middle circle**: numbers of citations per source for the five most cited literature sources, number of citations of all other sources, number of articles that performed measurements and number of articles that provided only inaccurate information on K concentration. **Outer circle**: detailed information on the categories from the middle circle.

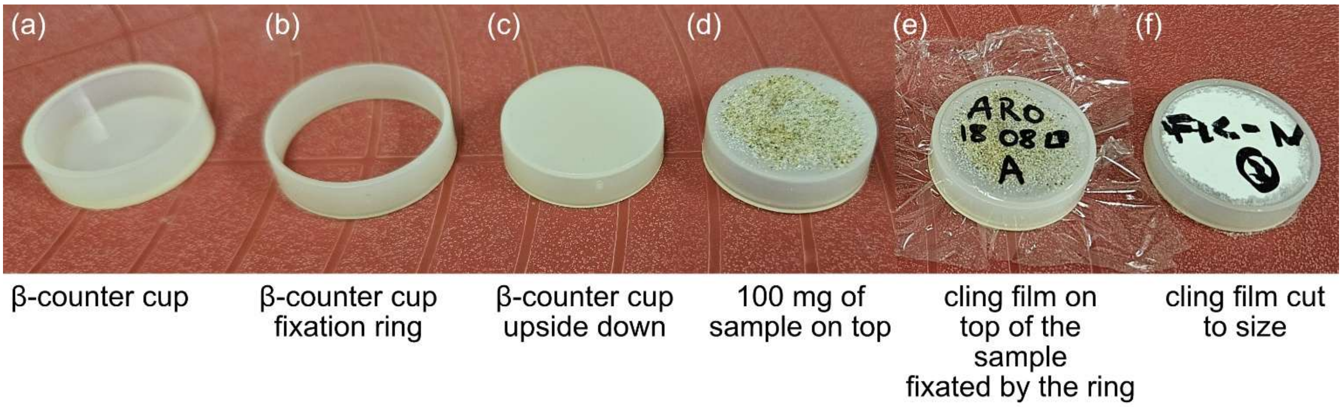

Figure S2. Preparation of feldspar samples for measurements in the β-counter. a) a plastic β-counter cup in its normal position. b) a plastic ring with a slightly larger diameter than the β-counter cup. c) a plastic β-counter cup in the upside-down position. d) 100 mg of feldspar sprinkled onto the upside-down β-counter cup. e) a piece of cling film labelled with the sample name is placed on top of the sample material on the upside-down β-counter cup and secured by the plastic ring. f) the same as shown in e) but with the excess cling film cut off.

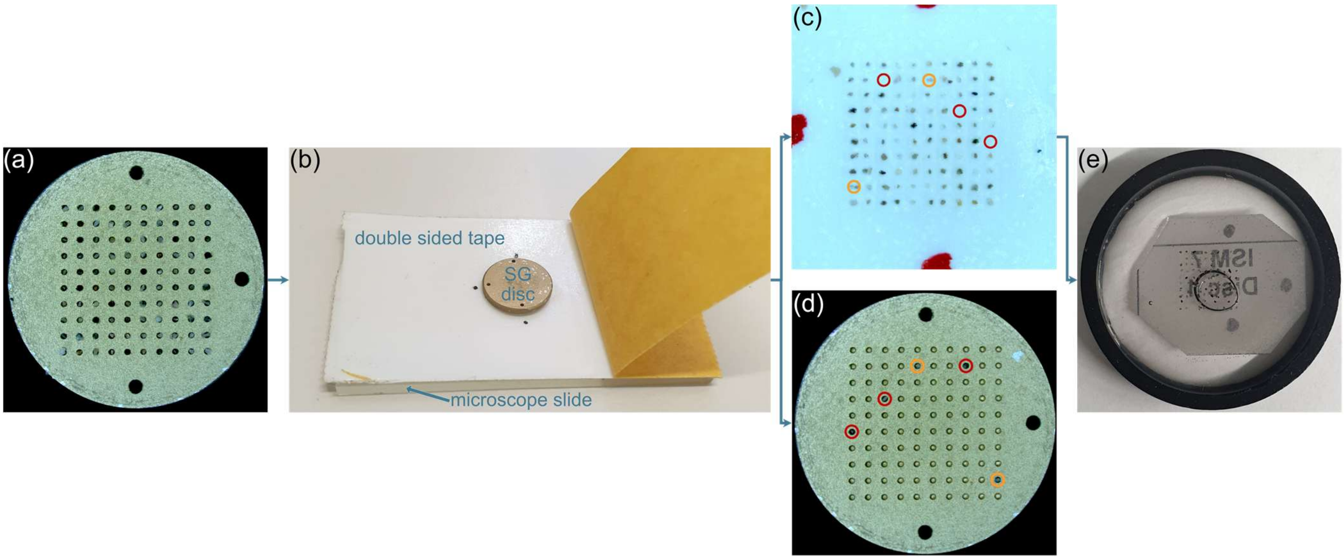

Figure S3. Sample preparation for the single grain SEM-EDX and µ-XRF measurements. a) a single grain (SG) sample disc after luminescence measurements filled with all 100 grain holes filled. b) SG disc facing downward onto double sided sticky tape. The tape is attached to a glass microscope slide on the other side. The directions of the three positioning holes are marked on the tape. c) grains on the sticky tape after disc removal. Red circles show locations where no grain was transferred and yellow circles show locations where only parts of a grain where transferred while still parts stuck in the SG disc. d) SG disc after removal from sticky tape. Red circles show position of grains still within grain holes, corresponding to the red circles in c), and yellow circles show part of grains still within grain holes, corresponding to the yellow circles in c). e) grains fixated in resin with a polished surface.

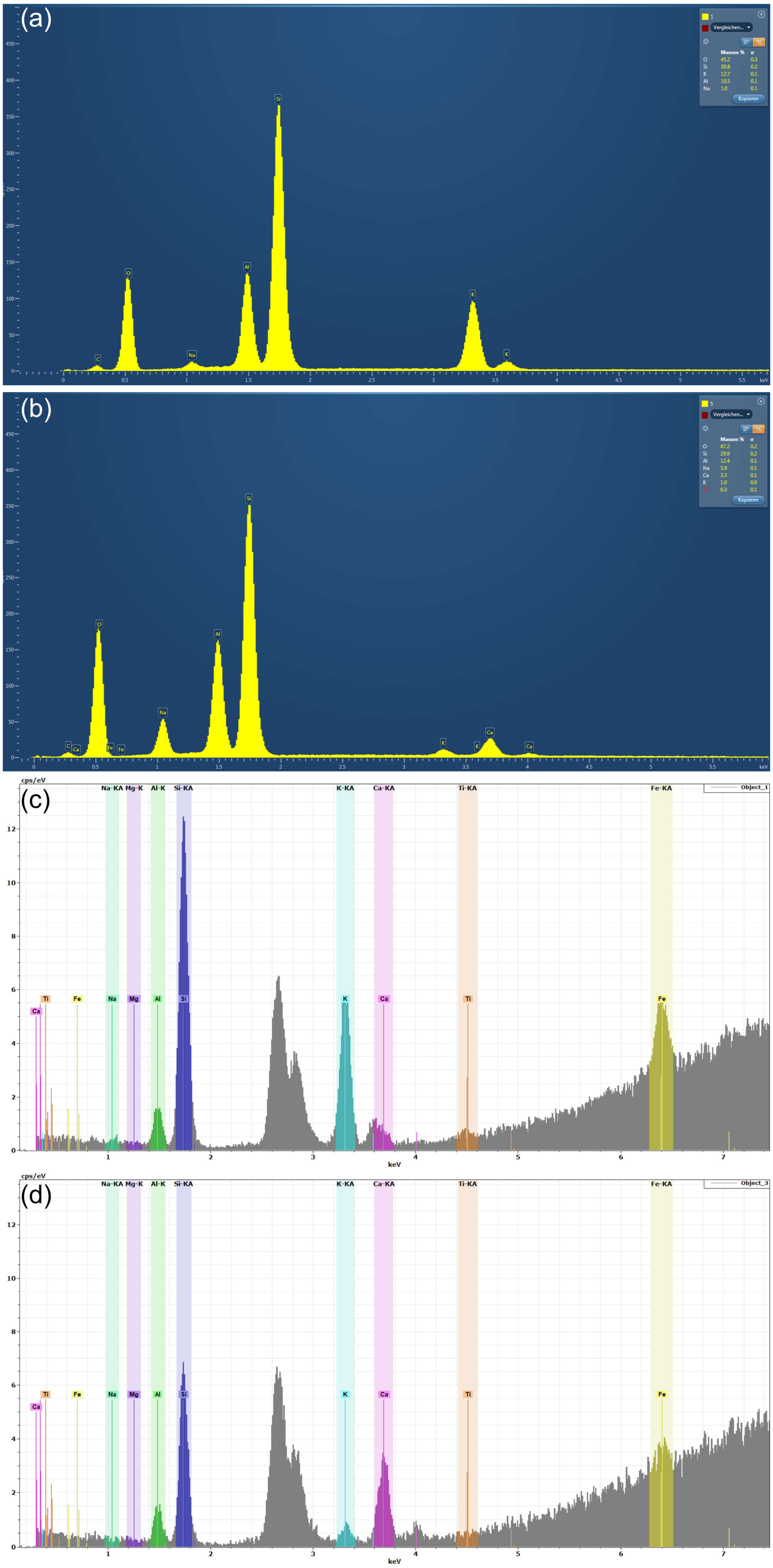

Figure S4. Exemplary spectra including peak fits for selected elements (Na, Mg, Al, Si, K, Ca, Ti, and Fe). a) SEM-EDX spectrum of a grain with ~8 wt% K. b) SEM-EDX spectrum of a grain with ~2 wt% K. c) µ-XRF spectrum of the same grain depicted in a) with ~8 wt% K. d) µ-XRF spectrum of the same grain depicted in b) with ~2 wt% K. The peak observed between ~2.5–3 keV in c) and d) originates from the Rh anode of the µ-XRF instrument. Note that oxygen concentrations are not measured directly in either method but are inferred from the stoichiometry of the detected elements assuming their oxide forms.

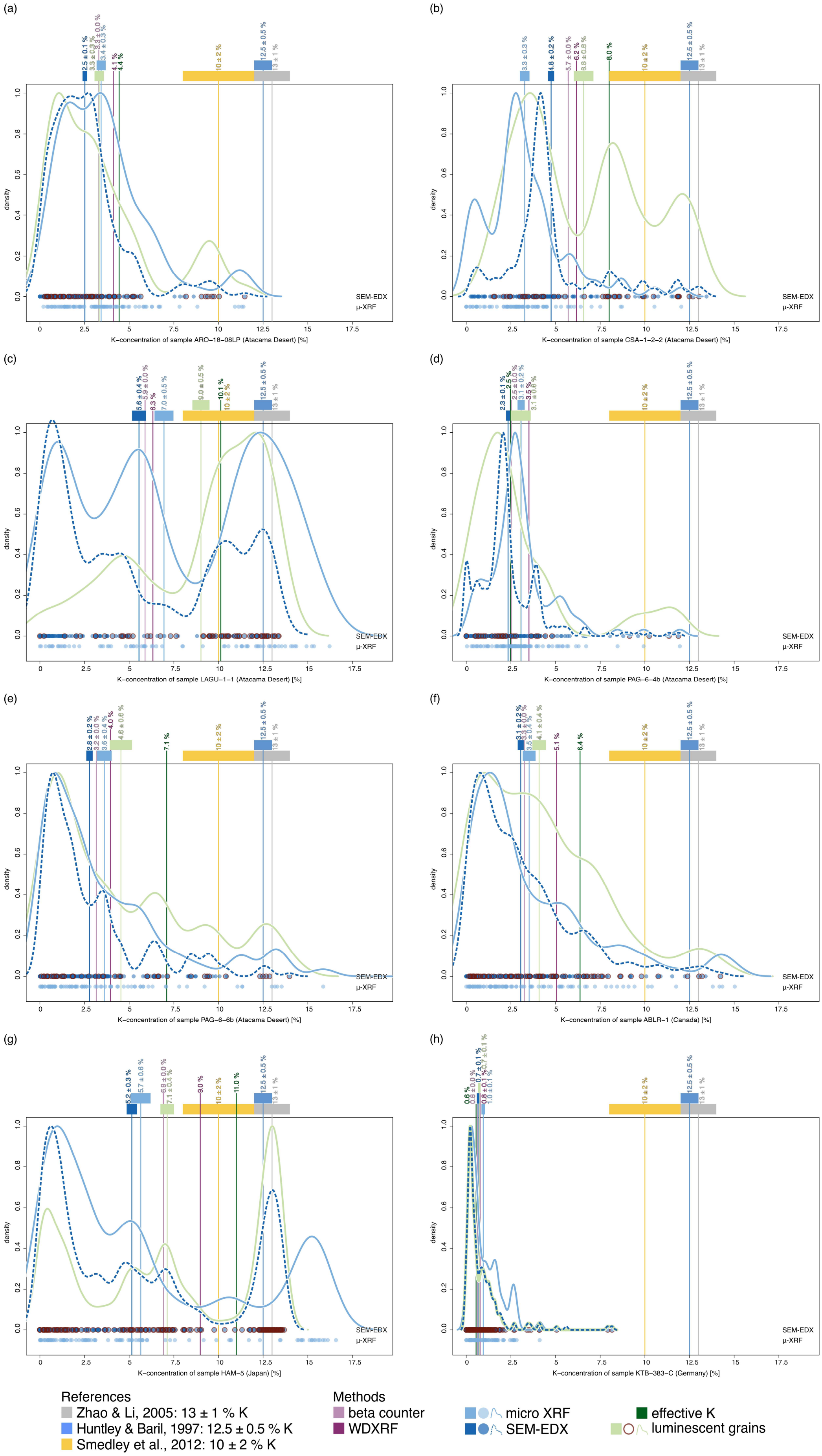

Figure S5. Single-grain K-concentrations for the eight samples not depicted in Fig. 3 of the main text. The dark blue dotted density curves and dots are based on the SEM-EDX measurements and the light blue ones on the µ-XRF measurements. The red circles around the dark blue dots and the light green density curve represent the *luminescent grains*. The vertical lines represent the K-concentrations presented in section 4.1, boxes above the graph representing their errors.

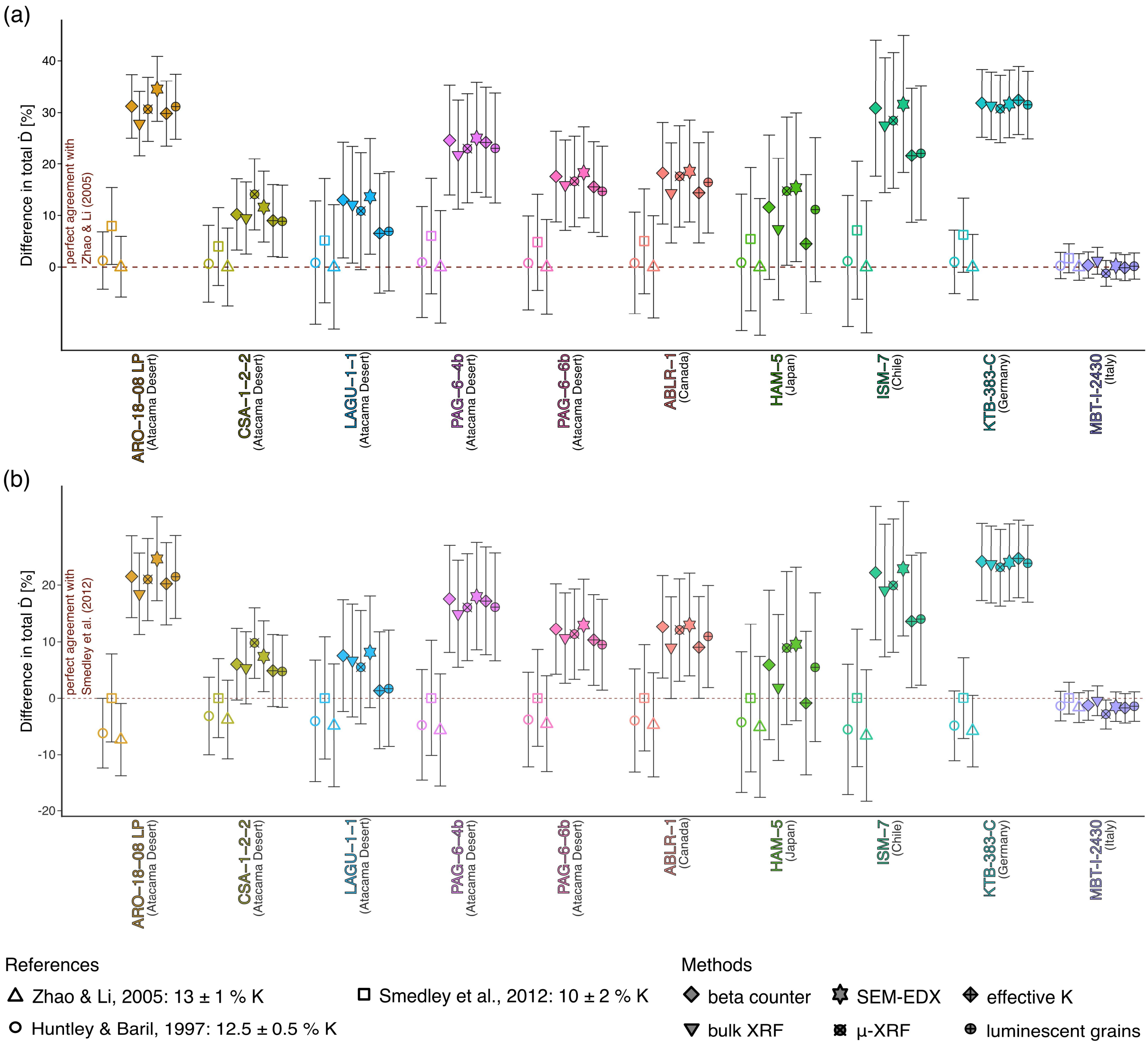

Figure S6. Ḋ results. a) a comparison between the total Ḋ based on the K-concentration of 13 ± 1 (Zhao & Li, 2005) and the total Ḋ based on the measured K-concentrations and luminescence-weighted K estimates. b) a comparison between the total Ḋ based on the K-concentration of 10 ± 2 (Smedley et al., 2012) and the total Ḋ based on the measured K-concentrations and luminescence-weighted K estimates. The dashed lines indicate a perfect agreement with the total Ḋ based on the K-concentration of 13 ± 1 (Zhao & Li, 2005) in a) and of 10 ± 2 (Smedley et al., 2012) in b).

For Table S1. and S5. see attached supplementary Table 1 and Table 5 file.

Table S2. Overview of the K-concentrations with which the five most frequently cited sources were quoted.

Reference	recommended/mentioned K-concentration	cited as	Frequency
Huntley and Baril, 1997	12.5 ± 0.5 %	12.5 ± 0.5 %	204
		12 %	2
		12 ± 1 %	2
		12 ± 2 %	1
		12 ± 0.5 %	7
		12.5 ± 1 %	12
		12.5 ± 2.5 %	2
		12.5 %	8
		13 ± 1 %	25
		12.5 ± 5	1
		12.5 ± 0.12 %	2
		no mentioned	7
Zhao and Li. 2005	13 - 14 %	13 ± 1 %	35
		13 ± 0.5 %	1
		13.5 ± 0.2 %	1
		12.5 ± 0.5 %	7
		12.5 ± 1 %	2
		12.5 %	1
Huntley and Hancock, 2001*	No recommendation but used 12.5 0.5 %	12.5 ± 0.5 %	12
		12.5 ± 2 %	1
		13 ± 1 %	15
		12.5 ± 1 %	2
		not mentioned	3
Smedley et al., 2012	10 ± 2 %	10 ± 2 %	17
		10 ± 3 %	3
		12 ± 0.5 %	2
		not mentioned	2
Li et al., 2008	No recommendation but used 13 ± 1 %	13 ± 1 %	14
		12.5 ± 0.5 %	2

*this paper refers to the ratio of K-concentration and Rb-concentration and was three times cited alone without an additional citation

Table S3. Single-grain dose recovery test SAR measurement protocol. Heating rate for steps 2–4 and 6–8 2 °C/s.

Step	Treatment[a]	Observation
1	Given dose D_i	
2	Preheat, 60s at 200°C	
3	IRSL, 2s at 50°C	
4	IRSL, 3s at 175°C	L_x
5	Given test dose D_t	
6	Preheat, 60s at 200°C	
7	IRSL, 2s at 50°C	
8	IRSL, 3s at 175°C	T_x
9	Return to step 1	

[a] given dose D_i [Gy]: 150, 0, 50, 150, 300, 500, 800, 0, 50, 150; test dose D_t [Gy]: 50

Table S4. Example of stoichiometric calculations of elemental concentrations for SEM-EDX and µ-XRF measurements. First the spectral peaks of each target element get fitted to the acquired spectrum (see Fig. S4). Next, the net peak areas (= net counts) under each fitted peak are summed per element and converted to mass concentrations (wt %). Oxygen concentrations are then derived from these oxide formulations rather than measured directly. Finally, these mass concentrations are normalised to 100 %.

Element	∑ net counts	Mass concentration (wt %)	Normalised concentrations (wt %)
O	-	8.41	50.09
Na	17	0	0
Mg	0	0	0
Al	642	1.38	8.22
Si	6513	5.81	34.6
K	3784	1.08	6.43
Ca	224	0.04	0.24
Ti	88	0.01	0.06
Fe	2298	0.06	0.36
Sum	13566	16.79	100

References:

Huntley, D. J. and Baril, M. R.: The K content of the K-feldspars being measured in optical dating or in thermoluminescence dating, Ancient TL, 15, 3, 1997.

Huntley, D. J. and Hancock, R. G. V.: The Rb contents of the K-feldspar grains being measured in optical dating, Ancient TL, 19, 43–46, 2001.

Li, B., Li, S.-H., Wintle, A. G., and Zhao, H.: Isochron dating of sediments using luminescence of K-feldspar grains, Journal of Geophysical Research: Earth Surface, 113, https://doi.org/10.1029/2007JF000900, 2008.

Smedley, R. K., Duller, G. A. T., Pearce, N. J. G., and Roberts, H. M.: Determining the K-content of single-grains of feldspar for luminescence dating, Radiation Measurements, 47, 790–796, https://doi.org/10.1016/j.radmeas.2012.01.014, 2012.

Zhao, H. and Li, S.-H.: Internal dose rate to K-feldspar grains from radioactive elements other than potassium, Radiation Measurements, 40, 84–93, https://doi.org/10.1016/j.radmeas.2004.11.004, 2005.