

# Testing infrared radiofluorescence dating on polymineral fine-grains from the Luochuan loess-palaeosol sequence, Chinese Loess Plateau

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## Introduction

Previous studies on infrared radiofluorescence (IR-RF) dating are mainly based on coarse-grain K-feldspar samples (Fig. 1). Polymineral fine-grains (4-11  $\mu\text{m}$ ) have been used successfully in conventional infrared stimulated luminescence (IRSL) dating, and may also have the potential for IR-RF dating. In this study, we investigated the IR-RF signals generated from polymineral fine-grains and tested the performance of these signals for dating on 6 loess samples ( $\sim 30$ -480 ka) from the well documented Luochuan loess-palaeosol sequence on the Chinese Loess Plateau.

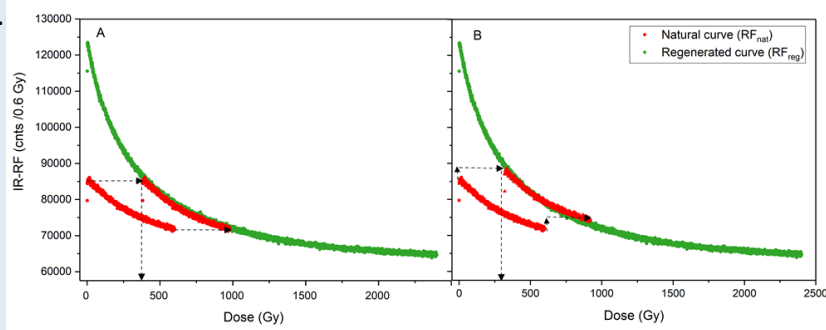


Fig. 1 : Coarse-grain example of the data output of the IR-RF signal and A) the horizontal sliding method and B) the vertical and horizontal sliding method; used to determine  $D_e$  for each aliquot.

## Applied methods

IR-RF measurements were done on an automated Risø TL/OSL DA-20 reader and the protocol used was modified after Frouin et al. (2017). Apart from polymineral fine-grains, mid-grains (38-63 $\mu\text{m}$ ) rich in K-feldspar and Na-feldspar were also prepared and compared. The feldspar chemistry was evaluated using the XRF attached to the reader (Fig. 2). Two bleaching durations of 1500 s and 20000 s (between the natural and regenerated measurements) were tested on the polymineral fine-grains (Fig. 3). Both the horizontal sliding method and the vertical and horizontal sliding methods (Fig. 1) were used to determine  $D_e$  where possible (Fig. 4). Dose recoveries were done on all samples (Fig. 5).

Step	IR-RF protocol	Observed
1	Preheat (70 °C, 500 s)	
2	Irradiation (70 °C, 5000 s)	Natural decay curve ( $RF_{nat}$ )
3	Bleach (1500 s, 20 000 s)	
4	Pause 1 hr	
5	Preheat (70 °C, 500 s)	
6	Irradiation (70 °C, 20 000 s)	Regenerated decay curve ( $RF_{reg}$ )

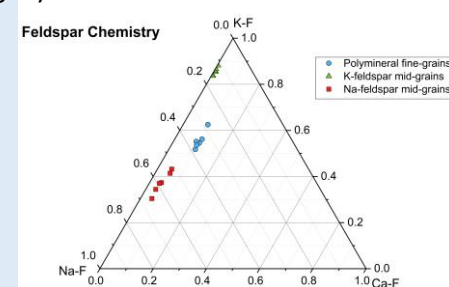


Fig. 2: Ternary diagram illustrating the feldspar chemistry of the polymineral fine-grains (circles), K-feldspar mid-grains (triangles) and the Na-feldspar mid-grains (squares).

## Results

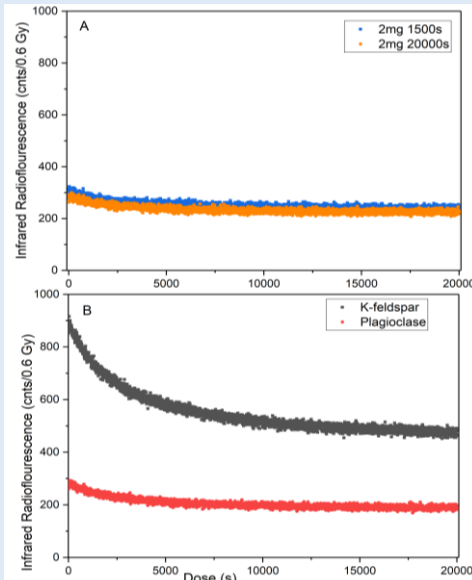


Fig. 3: Shape of the regenerated IR-RF curves for: A) polymineral fine grains and B) K-feldspar and Na-feldspar mid-grains (1500s).

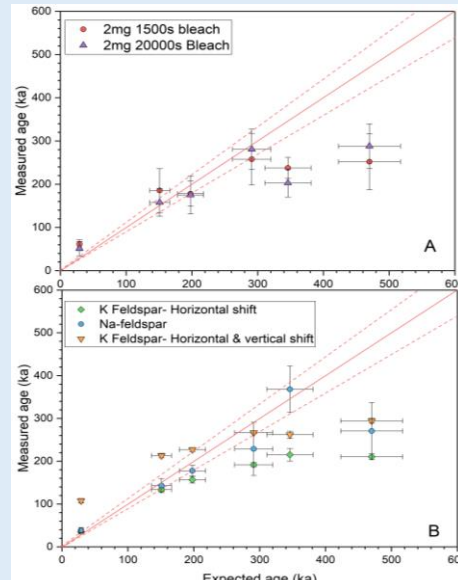


Fig. 4: Age results for: A) the polymineral fine-grains and B) the mid-grains (1500s).

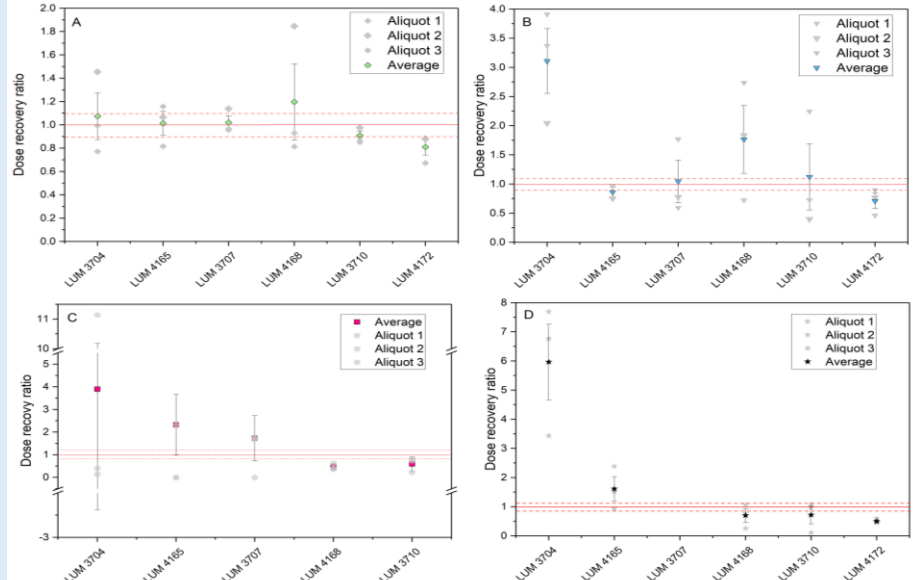


Fig. 5: Dose recovery test results where a dose recovery ratio of 1 (red solid line) within 10% (the red dashed line) is considered successful. A) K-feldspar mid-grains, B) Na-feldspar mid-grains, C) Polymineral fine-grains (1500 s bleach) and D) Polymineral fine-grains (20000 s bleach)

## Summary

1. The flat nature of the polymineral fine-grain IR-RF curves is likely due to the dominance of Na-feldspar and quartz grains.
2. The polymineral fine-grain ages are consistent with the reference ages up to 300 ka.
3. The different bleaching durations when testing the polymineral fine-grains between the natural and regenerated measurements do not result in significantly different age results.
4. The K-feldspar mid-grain ages (horizontal slide method) are consistent with the reference ages up to 200 ka. The vertical and horizontal slide method did not improve upon the horizontal slide method results

5. The Na-feldspar mid-grain ages were consistent with the reference ages up to 360 ka.
6. Poor dose recovery ratios do not correspond to failed equivalent dose estimation and vice versa, indicating that dose recovery test is not a useful tool in predicting which samples would perform better during the natural measurements.
7. Despite the flat nature of the polymineral fine-grain curves, fine-grains appear to be a useful dosimeter, as do Na-feldspar mid grains, however the K-feldspar mid grains would likely benefit from a longer bleaching duration in the same way that coarse grains do.

## References

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