A comparison of OSL ages derived from silt-sized quartz and polymineral grains from Chinese loess

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Recent work (Watanuki et al., preparing) has shown by comparison with independent age control that silt-sized quartz grains extracted from Japanese loess can be used for OSL dating for equivalent doses of up to 425 Gy (~500 ka at these sites). Further comparison with IR stimulated and post-IR blue stimulated OSL showed that the latter signal gave accurate ages, and was probably dominated by quartz, whereas the former systematically underestimated ages in the range 30 to 600 ka, and showed fading in laboratory tests. The main source of the loess deposits in Japan is the Chinese mainland; in eastern Asia, loess is widely distributed by the prevailing westerly winds, and one of the main sources is in the western desert areas of China. Unfortunately independent age control is very unusual in loess deposits in China, and there is little evidence for the accuracy of existing (mainly IR based) OSL dates from this material. As an alternative approach to determining the reliability of loess luminescence ages, this study builds on the Japanese results by examining the relationship between polymineral IR and post-IR blue stimulated, and quartz luminescence ages in loess from two sites, Zhengjian in Jiangsu Province (eastern China; 5 samples) and Urumuqi in Xinjian Uygur Zizhiqu (western China; 6 samples). All OSL signals were measured using blue (U-340) filters, and measured dose rates were between 3 and 4 Gy/ka. The normalised blue-stimulated OSL intensity from quartz from the eastern site was about 10 times that from the west, suggesting either a different source of material, or (less likely) an increase in quartz sensitivity with transport distance. Equivalent doses (De) were estimated using polymineral IR OSL and post-IR blue OSL, and quartz OSL, by the single-aliquot regenerative-dose (SAR) protocol.

Unfortunately 3 of the quartz extracts from the Zhengjian samples were in saturation (doses over 300 Gy) but the two younger samples gave similar values of De using both the polymineral post-IR blue OSL and the quartz OSL signals; that measured using polymineral IR OSL was ~20% greater for the youngest (~2 ka) sample, but 30% smaller for the other (70 ka) sample. The latter sample was tested for fading (100oC for 2 weeks); the post-IR blue signal did not fade, but the IR signal faded by about 15%. We conclude that the feldspar IR signal in the ~2 ka sample was incompletely bleached before deposition, but that the post-IR blue polymineral signal was dominated by quartz, which is almost certainly the more accurate phosphor (Roberts et al. have reached a similar conclusion for their Holocene loess samples). In the ~70 ka sample any incomplete bleaching was probably negligible, and fading dominates. Quartz was recovered from 5 of the 6 Urumuqi samples, and in all cases values of De increased in the order:- polymineral IR; polymineral post-IR blue; quartz. The quartz age range was from about ~20 to 45 ka (~60 to 150 Gy). It seems likely that the post-IR blue OSL signal still contained some contribution from feldspar, because this signal also showed laboratory fading. We conclude that, in our samples of Chinese loess, the post-IR blue stimulated OSL is the more reliable polymineral signal, but that it may include a feldspar component, and this should be tested for using laboratory fading experiments.

References

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