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Dating loess with high temperature IRSL signals from polymineral fine grains: luminescence characteristics and comparison with conventional techniques

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It is well known that loess deposits contain detailed terrestrial archives of palaeoenvironmental changes. Unfortunately, loess sequences often lack a reliable absolute chronology, and thus these changes are difficult to constrain in time. Luminescence dating is the technique of choice to address this issue.
Quartz and feldspar are the most commonly used dosimeters in luminescence dating. The age range of standard quartz OSL is usually limited by the saturation level of ∼200 Gy (corresponding to ∼50 ka). In contrast, the age range of feldspar IRSL signals - which usually have a more extended growth curve (up to ∼2000 Gy) - is hampered by anomalous fading for which a reliable correction is still not available.

Recently, Thomsen et al. (2008) identified several laboratory-induced feldspar signals which show less anomalous fading than the standard IRSL signal stimulated at 50°C. Based on this work, Buylaert et al. (accepted) tested a post-IR IR signal, i.e. IR bleach at 50°C and subsequent IRSL measurement at 225°C, and observed significantly lower fading rates in nature for a number of coarse-grained K-feldspar samples. In this study we explore the possibility of using such a post-IR IR signal from polymineral fine grains extracted from loess. Murray et al. (accepted) showed that a more stringent preheat treatment (320°C for 60 s) can be safely used for feldspar; as a result, we have been able to use a post-IR IR measurement temperature of 290°C, higher than that in the study of Buylaert et al. (accepted), with the expectation that this might further reduce the observed fading rate.

The results of the elevated temperature IRSL signal fading measurements clearly indicate a significantly lower fading rate (g2days values typically 1-1.5 %/decade) than the standard IRSL measured at 50°C (g2days values typically 3 %/decade). Results of the performance in the SAR protocol (recycling ratios, recuperation and dose recovery) are very encouraging (measured dose within 15% of the given dose). This high temperature signal is also bleachable by daylight, as confirmed by the values of De observed in young samples and by performing controlled laboratory bleaching experiments.

The enhanced post-IR IR dating protocol was applied to loess samples from Austria and Japan and compared with standard IRSL at 50°C and quartz OSL measurements. First results suggest that there is good agreement for the younger samples of Weichselian age but that the ages begin to deviate for the older samples. Final results, including a comparison with independent age control provided by known age tephra layers for the Japan samples (Watanuki et al., 2005), will be presented.

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Watanuki, T., Murray, A. S., Tsukamoto, S., 2005. Quartz and polymineral luminescence dating of Japanese loess over the last 0.6 Ma: Comparison with an independent chronology. Earth and Planetary Science Letters, 240, 774-789.