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Extending the luminescence dating age range using feldspar

J.-P. Buylaert (1,2), C. Thiel (1,2), A.S. Murray (1), M. Jain (2), K.J. Thomsen (2), and R. Sohbati (1)

(1) Department of Geoscience, Aarhus University, DTU Risø campus, 4000 Roskilde, Denmark (jabu@risoe.dtu.dk), (2) Center for Nuclear Technologies, Denmarks Technical University, DTU Risø campus, 4000 Roskilde, Denmark

The application of optically stimulated luminescence (OSL) dating has been largely limited to the last glacial cycle due to the low characteristic saturation dose in quartz and anomalous fading in feldspar; the latter results in age underestimation, for which a correction method is not available beyond ∼50 ka. Recent work at the Nordic Centre for Luminescence Research has focused on finding and testing a feldspar infrared stimulated luminescence (IRSL) signal with low or negligible fading rates, in the hope to significantly extend the age range.

We have found and characterised a new infra-red stimulated luminescence (IRSL) signal in feldspars named as the post-IR IRSL signal (pIRIR290). This signal is measured at a stimulation temperature of 290°C following an extended IR bleach at 50°C (IR50). Physical and empirical studies have shown that fading of this signal is negligible, both in the laboratory and in nature. We have compared pIRIR290 data using 36 samples (13 sites on 3 continents) sampled from 4 sedimentary environments with independent age control. Our results shows that the pIRIR290 signal is stable and that using this signal yields accurate ages back to ∼600 ka.

The pIRIR290 signal does not deplete as rapidly on exposure to daylight as the more commonly used quartz OSL; as a result its application is likely to be limited to younger (usually >10 ka) samples that have experienced considerable light exposure (e.g. aeolian or beach sediments) or to older samples (usually >50 ka) that received less exposure (e.g. fluvial, colluvial) where any residual signal at deposition is likely to be small compared to that arising during subsequent burial (the size of any residual is independent of the subsequent burial dose).

However, this slower bleaching rate also has some advantages. If two signals are zeroed at different rates, then age agreement between these two signals implies that they both must have been well bleached at deposition. Thus the different signal resetting rates of the various luminescence signals (quartz OSL, IR50, pIRIR290) can be used to identify those samples for which at least the more rapidly bleaching signals (e.g. quartz OSL) must have been have been completely reset prior to deposition. This new approach provides an independent measurement of the degree of bleaching at deposition, one of the most significant sources of uncertainty in the luminescence dating of daylight-bleached sediments. We present the results of a high-resolution pIRIR290 dating study of a lake core in which the differential bleaching rates of IR50 and pIRIR290 are used to identify and reject poorly bleached layers.