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Thermal stability of the quartz OSL signal – a case study of quartz derived from the Northern Alpine Foreland (Austria)

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Using quartz for dating via the optically stimulated luminescence (OSL) method comprises various advantages compared to the infrared stimulated luminescence (IRSL) of feldspar. First of all the quartz OSL signal is not affected by anomalous fading. Secondly, bleaching of the signal by exposure to sunlight during transportation of the sediment is more rapid for quartz than for feldspar. Therefore the occurrence of incomplete bleaching is less likely for quartz. On the downside, the quartz OSL signal may be affected by unfavorable, thermally unstable signal components (e.g. medium and slow components) possibly leading to considerable age underestimation.

Linearly modulated OSL (LM-OSL) analyses were conducted to investigate the composition of quartz OSL signals from four samples of three neighboring valleys of the Northern Alpine Foreland (Austria). Three samples were taken from glaciofluvial terrace deposits (attributed to MIS6 in literature) while the fourth sample was taken from an eolian loess deposit covering the terrace gravels. The glaciofluvial samples exhibited a significant contribution of a medium component to the bulk OSL signal. Moreover, an additional signal build up was identified for the regenerated signal after an artificial irradiation of 157 Gy. A LM-OSL measurement protocol was developed to explore the thermal characteristics of the quartz OSL signal and especially the quartz medium component using varied preheat temperatures (220, 240 and 260 °C) and preheat durations (10-300 s). The protocol also incorporated a hot bleach step (270 °C @ 470 nm illumination) between each measurement cycle to reduce the effect of recuperation in the regenerative cycle.

A big share of aliquots measured did exhibit a thermally unstable medium component and an unfavorable increase of that component in the regenerated signal. It was possible to identify suitable combinations of preheat time and preheat duration to minimize the medium component signal contribution for individual samples. However, the highly variable sample characteristics inhibited the development of a commonly applicable preheat combination for samples from the Northern Alpine Foreland. To prevent age underestimation of quartz OSL it is of utmost importance to minimize the effect of thermally unstable signal components to determine reliable ages.