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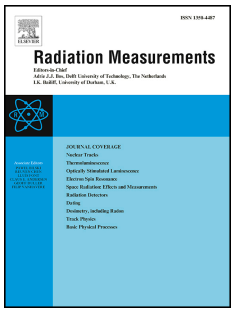

On the importance of grain size in luminescence dating using quartz

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On the importance of grain size in luminescence dating using quartz

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Abstract

There are two major problems commonly encountered when applying Optically Stimulated Luminescence (OSL) dating in the high dose range: (i) age discrepancy between different grain sizes, and (ii) age underestimation. A marked and systematic discrepancy between fine-grain (4-11 µm) and coarse-grain (63-90 µm) quartz single aliquot regeneration protocol (SAR) ages has been reported previously for Romanian and Serbian loess >40 ka (D_e of ~100 Gy), generally with fine-grain ages underestimating the depositional age. In this paper, we show a similar age pattern for two grain size fractions from Chinese loess, thus pointing to a potential worldwide phenomenon. While age underestimation is often attributed to signal saturation problems, this is not the case for fine grain material, which saturates at higher doses than coarse grains, yet begins to underestimate true ages earlier. Here we examine the dose response curves of quartz from different sedimentary contexts around the world, using a range of grain sizes (diameters of 4-11 µm, 11-30 µm, 35-50 µm, 63-90 µm, 90-125 µm, 125-180 µm, and 180-250 µm). All dose response curves can be adequately described by a sum of two saturating exponential functions, whose saturation characteristics (D_0 values) are clearly anticorrelated with grain diameter (φ) through an inverse square root relationship, $D_0=A/\sqrt{\varphi}$, where A is a scaling factor. While the mechanism behind this grain-size dependency of saturation characteristics still needs to be understood, our results show that the observation of an extended SAR laboratory dose response curve does not necessarily warrant the ability to record high doses accurately, or provide a corresponding extended age range.