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OSL-dating of fluvial deposits of the Middle Elbe River Flood Plains using different statistical approaches

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With the optically stimulated luminescence (OSL) dating method, the time elapsed since the last deposition of sediments can be determined. OSL-dating can be applied to sediments from different depositional environments. OSL-dating has therefore become an important tool in geochronological studies. Due to the sedimentation mechanism for fluvial sediments, incomplete bleaching of the mineral grains prior deposition can occur. This can result in a wide distribution of equivalent doses obtained from single aliquot or single grain measurements leading to an incorrect estimation of the depositional age. To overcome this problem, good measurement techniques and good data analysis with an adequate statistic are important. This is especially true in cases where other dateable material is missing and independent age control cannot be provided. In this study, fluvial samples from the Elbe River in northern Germany are investigated. Two sections have been sampled for OSL-dating. The samples are taken from sand layers deposited by the river. The quartz was extracted and dated using the single aliquot regenerative dose protocol. The OSL-properties of the quartz are good even though the luminescence signal is not very bright. Due to the dim signal, it was not useful to use the single grain approach. From each sample, 96 small aliquots are measured. The final equivalent dose was calculated using different statistical approaches, e.g. Leading Edge Model and Central Age Model. For each statistical method the age of deposition was calculated. The results are compared with the evolution of the river in this region, which is well-documented by historical records and maps. These records show changes in river morphology over the last 1000 years. The obtained OSL-ages of the river deposits fit well into the documented river evolution. It can be demonstrated that, depending on the statistical approach, the depositional age differs greatly from the most likely depositional age. Ages calculated using the Central Age Model or from the average or median of the dose distribution do not represent the depositional age. These methods lead to age-overestimation about three times higher than the depositional age documented by historical records. The best results that fit together with the historical evolution of the river are obtained from age models based on the lowest equivalent doses in a distribution, e.g. Leading Edge Model. This study shows that it is important to use an adequate statistical approach to calculate the equivalent dose to get reliable ages.