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Performance of a novel multiple-signal luminescence sediment tracing method

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Optically Stimulated Luminescence (OSL) is commonly used for dating sediments. Luminescence signals build up due to exposure of mineral grains to natural ionizing radiation, and are reset when these grains are exposed to (sun)light during sediment transport and deposition. Generally, luminescence signals can be read in two ways, potentially providing information on the burial history (dating) or the transport history (sediment tracing) of mineral grains. In this study we use a novel luminescence measurement procedure (Reimann et al., submitted) that simultaneously monitors six different luminescence signals from the same sub-sample (aliquot) to infer the transport history of sand grains. Daylight exposure experiments reveal that each of these six signals resets (bleaches) at a different rate, thus allowing to trace the bleaching history of the sediment in six different observation windows.

To test the feasibility of luminescence sediment tracing in shallow-marine coastal settings we took eight sediment samples from the pilot mega-nourishment Zandmotor in Kijkduin (South-Holland). This site provides relatively controlled conditions as the morphological evolution of this nourishment is densely monitored (Stive et al., 2013). After sampling the original nourishment source we took samples along the seaward facing contour of the spit that was formed from August 2011 (start of nourishment) to June 2012 (sampling). It is presumed that these samples originate from the source and were transported and deposited within the first year after construction.

The measured luminescence of a sediment sample was interpolated onto the daylight bleaching curve of each signal to assign the Equivalent Exposure Time (EET) to a sample. The EET is a quantitative measure of the full daylight equivalent a sample was exposed to during sediment transport, i.e. the higher the EET the longer the sample has been transported or the more efficient it has been exposed to day-light during sediment transport. The EET increases with increasing distance from the nourishment source, indicating that our method is capable to quantify sediment transport distances. We furthermore observed that the EET of an aeolian analogue is orders of magnitudes higher than those of the water-lain transported Zandmotor samples, suggesting that our approach is also able to differentiate between different modes of coastal sediment transport.
This new luminescence approach offers new possibilities to decipher the sedimentation history of palaeo-environmental archives e.g. in coastal, fluvial or aeolian settings.

References:

Reimann, T.et al. Quantifying the degreeof bleaching during sediment transport using a polymineral multiple-signalluminescence approach. Submitted.

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