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OSL surface exposure dating of wave-emplaced tsunami and/or storm boulders from Morocco

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Fields of wave-emplaced blocks and boulders represent impressive evidence of cyclone and tsunami flooding over Holocene time scales. Unfortunately, their use for coastal hazard assessment is in many cases impeded by the absence of appro-priate dating approaches, which are needed to generate robust chronologies. The commonly applied AMS-14C, U/Th or ESR dating of coral-reef rocks and marine organisms attached to the clasts depends on a – mostly hypothetical – coincidence between the organisms' death and boulder displacement, and inferred event chro-nologies may be biased by the marine 14C-reservoir effect and reworked orga-nisms. Here we discuss the potential of the recently developed optically stimulat-ed luminescence (OSL) surface exposure dating technique to directly date the relocation process of wave-emplaced boulders. Exposure dating may even allow to decipher more complex transport histories of boulders that were relocated and overturned repeatedly, thus experiencing multiple phases of exposure and burial.

For this, we sampled 11 coastal boulders from the Rabat coast, Morocco, which were either relocated by tsunami-induced flooding (e.g. during the 1755 Lisbon tsunami and similar events) or by exceptional North Atlantic winter storms. All sampled boulders (i) show clear indication of overturning during wave transport in the form of downward-facing bio-eroded surfaces; (ii) are composed of sand-stones that contain quartz with adequate luminescence signals; (iii) are of Holo-cene age and, therefore, in the dating range of OSL surface exposure dating. The measured signal-depth profiles indicate time-dependent resetting of luminescence signals in the freshly exposed post-transport surfaces of all investigated boulders.

Calibration samples with known exposure ages of 2 years are used to determine local values for light attenuation in the rock and signal resetting at the rock sur-face. These parameters are required to transform signal-depth profiles of sampled boulders into exposure ages. Results so far indicate that dating accuracy of most boulders is significantly affected by post-transport erosion of the surfaces. How-ever, the approach nevertheless provides relative age differences for boulder dislo-cation, and the observed patterns agree with the relative chronology expected due to the macroscopic appearance of the boulder surfaces. Thereby, it promises to overcome some of the limitations of existing dating techniques and will provide first chronological information on the frequency-magnitude relationship of ex-treme wave events at the Rabat coast.