EGU2020-18537, updated on 02 Feb 2023
https://doi.org/10.5194/egusphere-egu2020-18537
EGU General Assembly 2020

OSL rock surface exposure dating as a novel approach for reconstructing transport histories of coastal boulders over decadal to centennial timescales

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Wave transported boulders represent important records of storm and tsunami impact over geological timescales. Their use for hazard assessment requires chronological information that in many cases cannot be achieved by established dating approaches such as radiocarbon and U-Th dating. To fill this gap, we investigated the potential of optically stimulated luminescence rock surface exposure dating for estimating transport ages of coastal boulders. The approach was applied to wave-emplaced calcarenite clasts at the Rabat coast, Morocco. Calibration of the OSL surface exposure model was based on samples with rock surfaces exposed for ~2 years, and OSL exposure ages were evaluated against age control deduced from satellite images. The dating precision is very limited for all boulders due to the local source rock lithology, which contains low amounts of quartz and feldspar and was formed after MIS 5 (OSL signals are not in field saturation). Nevertheless, we propose a robust relative chronology for boulders that are not affected by significant post-depositional erosion and that share surface angle of inclination with the calibration samples. The relative chronology indicates that most boulders were moved by storm waves; these storms lifted boulders with masses of up to ~40 t; indicating that the role of storms for the formation of boulder deposits along the Rabat coast is much more significant than assumed previously. While OSL rock surface exposure dating cannot provide reliable absolute exposure ages for the coastal boulders from Rabat, the approach has great potential for boulder deposits composed of rocks with larger amounts of quartz or feldspar, older formation histories and lower susceptibility for erosion.