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Geological assessment of beach erosion history based on OSL dating of cut-and-fill deposits, Bengello Beach at Moruya, SE Australia

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High-wave events result in significant beach erosion and retreat. While understanding of the extent and frequency of extreme beach retreat is critical for conservation of coastal property, modern beach observation is generally too short for the infrequent nature of such events. Here we show a geological assessment of extreme beach retreat in Bengello Beach at Moruya, southeastern Australia, based on the high-resolution quartz optically-stimulated luminescence (OSL) dating coupled with the Bayesian outlier modeling, and ground-penetrating radar (GPR) survey. Beach monitoring since 1972 reveals that the Bengello Beach has shown a typical cut-and-fill pattern, in which the beach retreats several tens of meters in relation to storm events and immediately recovers within a following few years. A storm event caused extreme beach retreat up to 50 m in 1974. Since then, no storm event has been associated with retreat exceeding 30 m. It has thus been argued that the 1974 erosion was an event that happens once in 50–100 years. The beach monitoring defines a beach profile envelope, and indicates that the upper foreshore deposits can only be preserved as stratigraphic records during rapid beach recovery following a large retreat deeper than the envelope. Thus, ages of the preserved upper foreshore deposits are considered as roughly corresponding to timings of large retreat. Sediment samples for OSL dating were collected from the subsurface of the beach-ridge plain behind the Bengello Beach. Sample sites were located at 5–10 m intervals along a shore-normal transect extending from the modern foredune to 120 m inland. The GPR profile confirmed all the samples were taken from prograded upper foreshore deposits. The most landward, oldest sample was dated as 510 yr, indicating that the net seaward accretion rate of beach-ridge plain is 0.24 m/yr, concordant with the average rate since the mid Holocene. Other OSL ages show four events of beach retreat at 350, 180, 130, 90 yr, and also reflects the presence of the beach scarp resulting from the 1974 event. Assuming a constant rate of beach accretion of 0.24 m/yr, the retreat of the four events is estimated as 45–55 m, respectively, similar to that in 1974. A 40-m interval of beach deposits following the 350 yr event shows four identical OSL ages ranging from 350 to 330 yr, and is associated with a 150 yr gap before the unit immediately seawards. This suggests beach retreat was relatively modest during 330–180 yr. In Bengello Beach, extreme beach retreat, including that in 1974, happened at least five times over the last 350 years at a variable recurrence interval of 50–150 years.