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Present-day breakdown of a submerged shoreline and implications for the development of wave ravinement surfaces

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Submerged shorelines of Holocene age are traditionally studied in the context of the inner to mid-shelf. Submerged shorelines located within the shallow subtidal zone mantled by unconsolidated sediment are rarely reported. Such shorelines are situated within the active zone of wave ravinement marked by the currently slow progress of the beach and shoreface up the depositional profile during the contemporary highstand. As a result, their preservation potential is low. In this context, Limestone Reef is an elongate, coast parallel, slab-like beachrock outcrop situated above the contemporary fair-weather wave base. Its position thus offers a unique opportunity to examine the present-day breakdown and reworking of a submerged palaeo-shoreline.

Limestone Reef and the adjacent shoreface were examined using high-resolution seismic reflection profiling together with high-resolution, shallow-water multibeam echosounding. Seismic reflection profiles reveal that Limestone Reef rests within unconsolidated shoreface deposits. Its surface is characterised by reef-perpendicular spur and groove gullies and its seaward edge is fringed by rubble. The spur and groove morphology is indicative of wave plucking and abrasion of the shoreline. The shoreline slopes gently seaward, with a steep landward facing edge where the spur and groove features are most prominent. Teardrop-shaped depressions are located seaward of the submerged shoreline and are elongate in the seaward direction. Previous studies and diver observations indicate these to be filled by gravel-size material. All observations point to a seaward transfer of material derived from the landward edge of Limestone Reef.

This study sheds light on the dominant mechanical processes associated with wave ravinement of submerged shorelines during sea-level rise. The material left within the seaward facing scours is identical to that comprising the postglacial ravinement surface observed in the offshore stratigraphy. We consider these deposits to represent the expression of a presently forming wave ravinement surface. The dominant characteristic of the wave ravinement process appears to be the breakdown of the shoreline from its landward edge and the seaward entrainment of material. This is linked to drawback during storm surges. This study suggests that wave ravinement of submerged shorelines is a discontinuous process, controlled by high-energy events that operate at the seasonal scale and average out over the long-term millennial scale.