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Evolution of foredune barriers at Admiral Bay, Western Australia – Implications for Holocene relative sea levels and extreme wave events

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Only few geomorphological studies on the Canning Coast of Western Australia exist to date, most probably reflecting its remoteness and low population density. However, WA's annual gross state product (GSP) growth of ∼5 % during the past decade and the highest GSP per capita nationwide resulting from a mining boom increase public attention as well as the demand for precise information on landscape inventory and evolution. In this paper, new data from a sequence of vegetated foredune barriers, gradually being eroded by a migrating estuary inside the macrotidal Admiral Bay (also known as McKelson Creek, Whistle Creek or Panganunganyjal), 110 km southwest of Broome, are presented. Based on sediment cores, DGPS-based elevation transects, and stratigraphical analyses on outcrops of the relict foredunes, we aim at (i) reconstructing lateral coastal changes during the Holocene, (ii) drawing inferences on relative sea-level (RSL) change, and (iii) identifying and dating imprints of extreme-wave events. Sedimentary analyses comprise documentation of bedding structures, foraminiferal content and macrofaunal remains (including shell taphonomy), grain size, and organic matter. Chronological contexts are established using 26 14C-AMS datings.

Marine flooding of the pre-Holocene base landward of the 2.5 km-wide foredunes can be pinpointed to 7400–7200 cal BP. A mangrove ecosystem established and was quickly replaced by intertidal coarse sands after only 200–400 years. The high-energy intertidal environment prevailed until c. 4000 cal BP before turning into the present supralittoral mudflat environment. At that time, coastal regression led to beach progradation and isochronic formation of foredune barriers. Drivers of progradation were a stable RSL or gradual RSL fall after the mid-Holocene highstand and a positive sand budget provided by high sublittoral productivity of calcareous shells in combination with erosion at the adjacent sandstone capes and longshore drift. The foredunes overlie upper beach deposits located up to >2 m above the present upper beach level. Discontinuous, bimodal layers and wedges of coarse shells and sand, 5–20 cm thick, are intercalated in the aeolian foredunes and indicate exceptional marine flooding events. One such event layer was traced over three foredune barriers and dated to c. 1550–1700 cal BP.