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An onshore-offshore record of sedimentation and shoreline shift through two glacial-interglacial cycles

Cawthra, H.C.[1,2], Compton, J.S.[3], Fisher, E.C.[2,4,5], Jacobs, Z.[6], Karkanas, P.[7], Marean, C.W.[2,4]

[1] Geophysics Competency, Council for Geoscience, Bellville, South Africa, hcawthra@geoscience.org.za
[2]Centre for Coastal Palaeosciences, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa
[3]Department of Geological Sciences, University of Cape Town, South Africa
[4]Institute of Human Origins, School of Human Evolution and Social Change, Arizona State University
[5]Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg, South Africa
[6]School of Earth and Environmental Sciences, University of Wollongong, Australia
[7]Malcolm H. Wiener Laboratory for Archaeological Science, American School of Classical Studies, Athens, Greece

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Pleistocene deposits preserved on mid-latitude coastlines have long been studied as indicators of past sea levels or to unravel the sedimentary response to shifting shorelines in accordance with sea-level change. With the rapid advancement in marine geophysical and hydrographic techniques, margin successions can be used to decipher sea-level changes, and these deposits are increasingly being mapped and studied on continental shelves. Links have been drawn to correlate fragmentary onshore and offshore records in South Africa but the preservation is generally hindered by large gaps through space and in time. Along the South African South Coast, we have examined both subaerially preserved highstand deposits and submerged Pleistocene geological units where a regressive Last Interglacial (LIG) sequence [1,2] has now been mapped onto the offshore platform for the first time. Here we report on a continuum across the same profile from 10 m above- to 55 m below Mean Sea Level (MSL). We consider one transect across one sediment-supplied fluvial-coastal system at the Great Brak River, Mossel Bay. Using these data, we describe sedimentary indicators of relative sea-level change in coastal South Africa, describing deposits preserved despite a high wave energy shoreline. The South Coast margin is an ideal locale to examine sedimentary facies. It has deposits preserved, they can be dated by Optically Stimulated Luminescence (OSL) (e.g. [3]) and the substrate has been considered a relatively stable margin.

The exposed geological outcrop at the Great Brak raised sequence reaches a maximum measured height of 23 m above MSL and lies at the modern-day backshore-dune. The modern beach, a mixed sandy/rocky coastline, transitions to the offshore below a relatively flat shoreface. On the inshore area, a steep drop-off of 5 m separates the rocky upper shoreface from the inner shelf. Here a consistent seaward dipping average gradient of 1:74 prevails, punctuated by low-relief cemented ridges up to 3 m. The inner shelf offshore of the Great Brak River is characterised by the presence of linear- to cuspate or parabolic shoals representing submerged palaeocoastlines which were classified according to their acoustic texture on side-scan sonar mosaics and geological mapping by scuba diving. Multibeam bathymetric mapping has demonstrated that these shoals and ridges reach a maximum relief of 8 m above the seafloor. From a distance of 2700 m from the modern coast, the mid shelf ridges are characterised by steep landward faces and trailing seaward margins and a maximum shore-perpendicular breadth of 650 m. The commencement of the mid-shelf sequence is marked by three adjacent ridges which lie on a 1500 m wide surface with a low gradient of 1:750. Six sedimentary facies were identified in this work and are reported here, from samples obtained and a comparison to

depositional environments in the modern littoral zone of Mossel Bay. These depositional environments include dunes, the upper shoreface, foreshore, the intertidal swash zone and back-barrier settings. A total of twenty five OSL dates were obtained for this investigation, showing a distribution in ages ranging from MIS 7 – MIS 3 [206 ± 19 - 59 ± 6 ka].

References:

[1] Carr AS et al. (2010) Quaternary Research 73:351–363
[2] Roberts DL et al (2012) Earth and Planetary Science Letters 357–358: 226–237
[3] Jacobs Z et al. (2011) Quaternary Geochronology 6: 491–513