Expression of Late Holocene Regression on an Arid, Monsoon-Impacted Upper Ramp/Carbonate Coastal Barrier System – Bar al Hikman, Oman

Thomas Teillet[1, 2], Peter Homewood[3], Monique Mettraux[3], Alexander Petrovic[4], Pankaj Khanna[5], Giorgio Spada[6], Daniele Melini[7], Volker Vahrenkamp[1, 2]

[1] KAUST
[2]KAUST
[3]Geosolutions TRD
[4]Carmeuse SA
[5]Discipline of Earth Sciences, Indian Institute of Technology Gandhinagar
[6]Istituto Nazionale di Geofisica e Vulcanologia
[7]Dipartimento di Fisica e Astronomia (DIFA), Alma Mater Studiorum Università di Bologna

Abstract

Barrier systems constitute 15% of the world's coastlines and shield low-lying shores against waves and storms. In the subsurface, these geomorphological structures (i.e. geobodies) often have a high reservoir potential due to their coarse sediment texture. Research has been predominantly focused on siliciclastic coastal barrier systems, but those composed of carbonate materials have received less attention, and their formations are still debated. The present study examines a remarkably well-preserved mid to late-Holocene carbonate barrier system along the Arabian Sea coast of Oman (Bar Al Hikman peninsula) using satellite imagery, fieldwork, sea level reconstruction, and radiocarbon dating. The formation of the carbonate coastal barrier of Bar Al Hikman was controlled by climatic and relative sea level changes. The initiation of the barrier around 5000-4500 years before the present aligns with two significant global events: (1) the end of the mid-Holocene highstand and (2) the beginning of the arid climate in Arabia. This aridity is attributed to the oscillation of the Intertropical Convergence Zone, which reduced inland precipitation, river flow, and upwelling strength and caused a shift in the primary carbonate-producing organisms from mollusks to corals. The internal geomorphological heterogeneities of the barrier were influenced by (1) the uneven supply of carbonate sediment reaching the shoreline due to the patchy distribution of coral patches offshore and (2) the seasonal changes in longshore currents. The development of carbonate coastal barriers obeys the physical processes that shape siliciclastic coastal barriers, and these results underscore the complex interplay between climate, sea level changes, carbonate production/supply, and coastal dynamics in the development of carbonate-dominated coastlines.