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Geomorphology, sedimentology and coastal evolution of a tectonically active coastline; the record of the Makran marine terraces

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The Makran subduction zone is host to one of the largest sedimentary prism on Earth, most of which is emerged. Prism erosion back to the accretionary wedge is apparent at the coast, where extensive beach systems and tombolos have developed since the Holocene. Although the western Makran has a low historical seismic activity, steady tectonic uplift of the prism is evidenced by the presence of numerous uplifted marine terraces along the coast. Here, we present the results of an in depth study of the Western Makran marine terraces. Understanding the timing and formation mechanisms of the terraces improves our knowledge of the coastal evolution and the tectonic activity along the coast.

The coastal plain is a flat and wide area, due to the easily erodible nature of its shale bedrock. Locally, rocky headlands of sandstone-dominated lithology stick out of the topography. Terraces built on sandstone bedrock are analogous to the classic staircase terraces model. The morphology of the terraces deposited on soft, shale-dominated bedrock, on the other hand, is unique to Makran. Due to the differential erosion between the resisting sandstone deposits capping the terraces and the surrounding shale, they take the form of cliff bound platforms. Moreover, these terraces are extensive (up to 3km wide) and present striking similarities with the beaches currently developing in the bays between headlands. Sedimentological study of the 2-20m thick layer systematically found above the wave-cut platform confirmed their beach origin. Optically stimulated luminescence dating (OSL) of these deposits permitted the reconstruction of the coastal evolution throughout the Late Quaternary by correlating the different terraces to the latest sea-level highstands. We show that the Makran coast evolution has not only been responding to a steady tectonic uplift but has also been strongly dictated by differential erosion between soft and hard rock.