# Modern Carbonate Sediments from Rift-Margin Buildups and Shelf-Platform: Saudi Arabian Red Sea

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## ABSTRACT

Reconnaissance studies compared Red Sea analogs from (1) rift-margin buildup and (2) shelf-platform environments. Sediments from known water-depths were characterized by microscopic allochem counting, grain-size, and neoichnology analysis (study of modern organismal behavior producing such traces as footprints, feeding pits, burrow networks, and biolaminates). Bioturbation intensity was measured by ichnofabric index (ii) and ranged from ii1 (0% bioturbation) to ii6 (100% bioturbation). Hydrochemical and multi-isotope analyses were performed on seawater samples from various depths and environmental settings (i.e., inner lagoon vs. open sea) to characterize fluid heterogeneities over the study areas. In addition, visible spectrum DigitalGlobe satellite data helped compare and contrast observed environments. Some carbonate allochems, including peloids and bivalve fragments, show trends in their proximal-to-distal distributions, whereas other allochems (i.e., green and red algae, and oncoids) can meaningfully be characterized by water-depth. Water depth is not related to ii, but some allochems and fine-grained material can meaningfully be characterized by ii (i.e., fine-grained material other than peloids, red algae, arthropods, bivalves, gastropods, and echinoderms). Modern traces and responsible burrowing organisms were observed in greatest numbers and highest densities at moderate water-depths (about 5 to 15 m). Most bioturbation was produced by such echinoids as sea urchins, heart urchins, and sea cucumbers, as well as a variety of annelids. Environments with the highest depositional energy had the lowest ii (ii1–2), whereas those with the lowest depositional energy and bottom currents had the highest ii (ii5–6). Areas where sediments showed the greatest apparent impact and modification by modern trace makers included: (1) landward edges of rift-margin buildups at intermediate proximal-to-distal positions, and (2) shelf-platform lagoon environments. Rift-margin buildups and shelf-platform study areas provide insights on the relative influences of sedimentation, related to water-depth and proximal-to-distal locations. Neoichnologic analysis provides constraints on the proximal-to-distal distribution and areal extent in environments influenced by bioturbation (paleoichnology). This sets more robust modeling constraints in exploration and production developments that take better advantage of porous and permeable zones.