

# Syntectonic Sedimentation and Sequential Filling of Half-Graben Basins, Red Sea

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## Abstract

Half-graben basins in the Red Sea are filled with Oligo-Miocene sediments and are usually capped by allochthonous salt. The sedimentary fill varies in facies and partially in age between the marginal and the adjacent basinal half-grabens. This study utilizes outcrop, borehole and seismic data to characterize the facies and to investigate the relative timing of sedimentation in these half-grabens. Core logging allowed the recognition of fluvial and lacustrine facies that were deposited during the earliest phase of sedimentation in the half-grabens. Outcrop sections depict gravel- to sand-filled channels changing distally into sheet sandstones and flood basin mudstones. These facies vary up-section into transgressive tidal flat, lagoonal and shoreline deposits. The latter transitions upwards into deltaic sandstones, open-marine shales and diverse deep-marine facies deposited in slope to basin-floor fans. The fan lobe successions are retrogradationally stacked in the axial troughs of the half-grabens. They are blanketed by laterally extensive shales, marking a period of sediment starvation that lasted longer in the basinal than in the adjacent marginal half-grabens. The starvation shales in the marginal half-grabens are overlain by progradational slope apron deposits dominated by debrites, slumps and channel complexes filled with very fine-grained turbidites. These slope facies are unconformably overlain by varied shelf to coastal plain deposits that record multiple transgressions and forced regressions, modulated by climatic and relative sea-level fluctuations. The transgressions were ensued by the development of inner shelf deltas in lows adjacent to the bounding faults. The deltas were commonly flanked by carbonate buildups, developed on the crests of the rotated hanging wall blocks. The regressions induced the development of shelf-margin deltas, in lows in between the then

exposed buildups. These deltas sourced abundant sediments to the still starving basinal half-grabens. This initiated their gradual filling with progradational basin floor fan to slope deposits. Their upper slope channel complexes are preferentially filled with coarse-grained gravelly turbidites, with abundant crystalline basement pebbles. These were eroded from the uplifted rift shoulders. Such uplift provided copious sediments that were partly deposited on the shelf of the now filled marginal half-grabens and were partly transferred to the floor of the still filling basinal half-grabens.