

CONSTRAINING THE TECTONO-THERMAL EVOLUTION OF THE EGYPTIAN RED SEA MARGIN: LINKING OBSERVATIONS FROM THE PROXIMAL TO HYPEREXTENDED RIFT DOMAIN

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ABSTRACT

Scientific understanding of the mechanics of continental breakup in the absence of voluminous magmatism has dramatically evolved over the past decades. Numerical and conceptual rift models have elucidated the temporal and spatial evolution of crustal structures and the processes operating during the onset and evolution of lithospheric extension. Critical questions remain, however, regarding the strain and thermal evolution of the lower crust during progressive rifting, particularly during hyperextension and the transition to oceanic spreading. The Gulf of Suez and Red Sea – one of the conceptually most influential continental rifts – define a Miocene rift system that preserves segments of the proximal and distal hyperextended rift margin and presents unique opportunities to study the extensional thermal history without the influence of subsequent orogenic overprinting. This study presents new basement U-Pb and (U-Th)/He data from both the proximal Egyptian margin and the distal hyperextended margin, exposed on Zabargad Island, to reconstruct the thermal evolution during progressive continental rifting. Apatite (U-Th)/He data from transects across upper- and lower-plate portions of the Egyptian margin record fault-controlled rift initiation, erosional retreat of the escarpment, and necking in the proximal margin at 23-19 Ma. Zircon U-Pb data from Zabargad, an exhumed portion of the highly-attenuated distal margin, record coeval Miocene hyperextension at ~23-19 Ma. In contrast, rutile and apatite U-Pb data from Zabargad document the exhumation phase (~8 Ma) and, for the first time, the reheating of a distal continental margin during initial oceanic spreading at 5 Ma. These data provide critical new insights into the thermal evolution of the crust and role of reheating during the transition from initial rifting, to hyperextension, and ultimately seafloor spreading.



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