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Rifting kinematics along the Arabian Margin, Red Sea

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The Red Sea represents a young basin floored by oceanic, transitional, or thinned continental crust that formed between Nubia and Arabia. According to most authors, rifting between Nubia and Arabia started in the late Oligocene (∼27 Ma) and it is still in progress in the northern part of the Red Sea at latitudes greater than 24°N. Conversely, the area south of ∼20.3°N displays a linear spreading ridge extending as south as 14.8°N, which formed in the early Pliocene (the first pulse of sea floor spreading occurred during chron C3n.2n, ∼4.62 Ma).
A transition zone (between 24°N and 20.3°N, present–day coordinates) exists between the northern and the southern sectors, characterized by a segmented spreading center that started forming at ∼2.58 Ma (chron 2A, late Pliocene) in the southernmost area and propagated northwards. Some authors suggest that the present–day NE–SW spreading directions can be extended back to the early Miocene. However, we are going to show, on the basis of geological evidence from the Arabian margin, that at least two phases of rifting, characterized by distinct extension directions, are necessary to explain the observed structural pattern of deformation in a wide area extending from 28°N to 20°N.
At present, there is no magnetic evidence for the existence of a linear spreading center in the northern Red Sea at latitudes higher than ∼24°N. In this area, the syn–rift pattern of deformation along the Arabian margin is only partly coherent with the present day NE–SW sea floor spreading directions and with the observed trend of fracture zones in the Red Sea. In fact, an older set of rift structures was found during 3 field trips performed along the northern and central Red Sea Arabian margin (2015-2016), suggesting the existence of an earlier rifting stage characterized by N–S trending strike–slip faults and E–W normal faults.
The objective of the field trips was to investigate the hypothesis that an early phase of N–S extension and formation of left–lateral pull–apart basins characterized the separation of Arabia from Nubia, as suggested by some authors and by a preliminary analysis of remote sensing data. The necessity of performing structural observations along a wide area along the eastern margin of the northern and central Red Sea led us to select 30 sites where the preliminary morpho–structural analysis of ASTER–GDEM data and geological maps suggested the possibility to study the overprint of younger NE–SW structures on pre–existing N–S strike–slip faults.
For each survey site, a number of stations were established to measure kinematic indicators. Most of the mapped structures are E–W and NW-SE normal faults or N–S and NE-SW high–angle strike–slip faults. These different faults belong to the older N-S/E-W system and the younger NW–SE/NE–SW system. Field evidence shows that the second system cuts the first one.