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Post-rift deformation of the Red Sea Arabian margin

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Starting from the Oligocene, the Red Sea rift nucleated within the composite Neoproterozoic Arabian-Nubian shield. After about 30 Ma-long history of continental lithosphere thinning and magmatism, the first pulse of oceanic spreading occurred at around 4.6 Ma at the triple junction of Africa, Arabia, and Danakil plate boundaries and propagated southward separating Danakil and Arabia plates. Ocean floor spreading between Arabia and Africa started later, at about 3 Ma and propagated northward (Schettino et al., 2016). Nowadays the northern part of the Red Sea is characterised by isolated oceanic deeps or a thinned continental lithosphere.
Here we investigate the deformation of thinned continental margins that develops as a consequence of the continental lithosphere break-up induced by the progressive oceanisation. This deformation consists of a system of transcurrent and reverse faults that accommodate the anelastic relaxation of the extended margins. Inversion and shortening tectonics along the rifted margins as a consequence of the formation of a new segment of ocean ridge was already documented in the Atlantic margin of North America (e.g. Schlische et al. 2003).
We present preliminary structural data obtained along the north-central portion of the Arabian rifted margin of the Red Sea. We explored NE-SW trending lineaments within the Arabian margin that are the inland continuation of transform boundaries between segments of the oceanic ridge. We found brittle fault zones whose kinematics is consistent with a post-rift inversion. Along the southernmost transcurrent fault (Ad Damm fault) of the central portion of the Red Sea we found evidence of dextral movement. Along the northernmost transcurrent fault, which intersects the Harrat Lunayyir, structures indicate dextral movement. At the inland termination of this fault the evidence of dextral movement are weaker and NW-SE trending reverse faults outcrop. Between these two faults we found other dextral transcurrent systems that locally are associated with metre-thick reverse fault zones.
Along the analysed faults there is evidence of tectonic reworking. Relict kinematic indicators or the sense of asymmetry of sigmoidal Miocene dykes may suggest that a former sinistral movement was locally accommodated by these faults. This evidence of inversion of strike-slip movement associated with reverse structures, mostly found at the inland endings of these lineaments, suggests an inversion tectonics that could be related to the progressive and recent oceanisation of rift segments.

Schettino A., Macchiavelli C., Pierantoni P.P., Zanoni D. & Rasul N. 2016. Recent kinematics of the tectonic plates surrounding the Red Sea and Gulf of Aden. Geophysical Journal International, 207, 457–480.
Schlische R.W., Withjack M.O. & Olsen P.E., 2003. Relative timing of CAMP, rifting, continental breakup, and basin inversion: tectonic significance, in The Central Atlantic Magmatic Province: Insights from Fragments of Pangea, eds Hames W., Mchone J.G., Renne P. & Ruppel C., American Geophysical Union, 33–59.