

Insights into the Red Sea area from magnetic analysis

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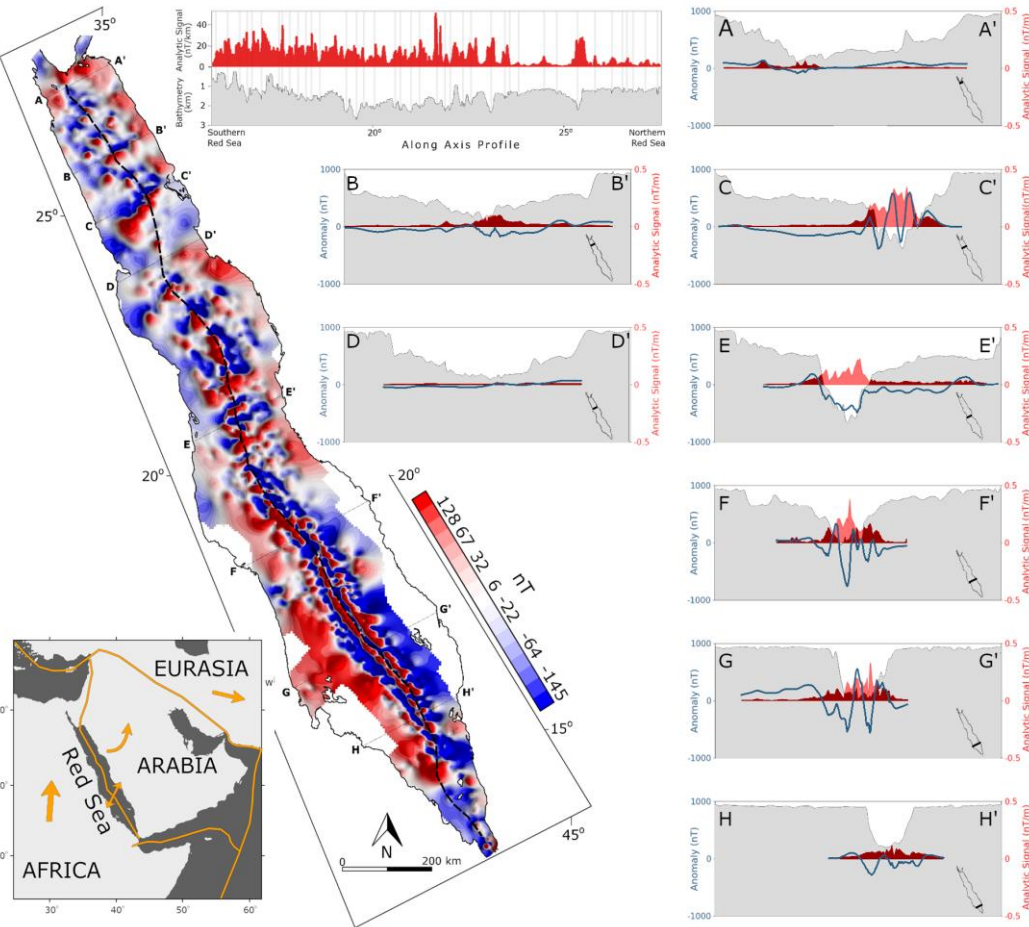
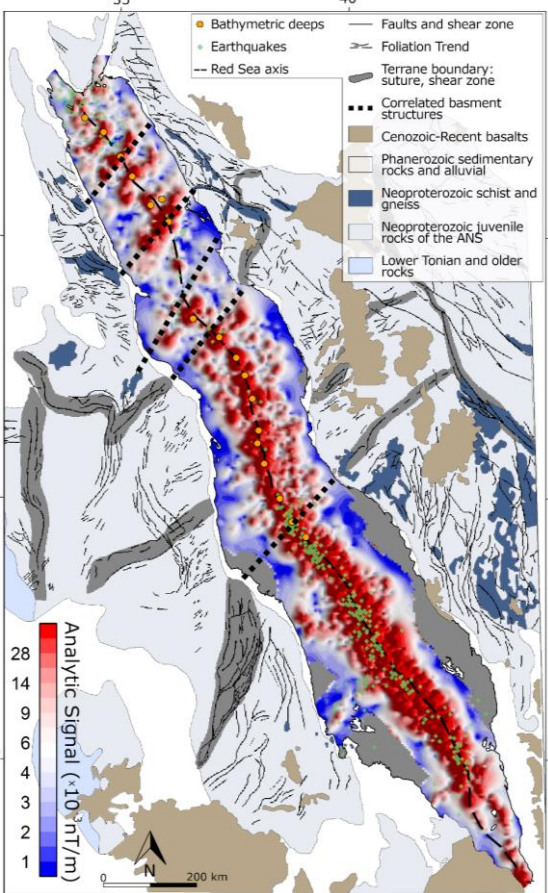


Fig 1. Tectonic settings of the Red Sea area (bottom left). The new magnetic anomaly map of the Red Sea from re-processed marine data conformed to satellite derived magnetic model (LCS-1). The cross sections show bathymetry (grey), magnetic anomaly (blue) and analytic signal (red). The cross sections show peaks of the analytic signal usually limited to the axial trough. The section on the top shows bathymetry and analytic signal along the Red Sea axis (black dashed line in the map), we recognize peaks in the analytic signal above each of the bathymetric deeps.

Fig 2. Analytic signal map of the Red Sea and onshore geology after Stern & Johnson (2019). Illustrating sub-perpendicular patterns, parallel to geological reconstruction lines.



We present a new magnetic anomaly map (Fig. 1) for the entire length of the Red Sea. We re-processed and merged marine data of past magnetic surveys and conformed it to a satellite derived magnetic model.

The amplitudes of the anomalies show correlation with bathymetry, and are generally higher above the axial trough, both in the southern and in the northern-central regions. We recognize peaks in the analytic signal above each of the bathymetric deeps. We associate the high amplitude magnetic anomalies with the development of oceanic crust within the axial trough, and, supports hyperextended continental crust cover in the main trough and coastal plains.

We recognize two sets of magnetic trends: (1) a regional trend and (2) a local trend: (1) The regional trend shows patterns of anomalies in: (i) sub-parallel direction to the Red Sea axis (Fig. 1), associated with magnetic stripes along seafloor spreading center in the southern Red Sea, and (ii) patterns of anomalies in sub-perpendicular direction to the axis of the Red Sea (Fig. 2) which are coaxial with reconstruction lines from onshore pre-rift rocks (dashed black lines in Fig. 2) and GPS motions. (2) The local trends is analyzed from the Total Horizontal Derivative (THDR) at each grid point. The THDR shows apparent strikes of the anomalies in NW-SE directions (Fig. 3). These trends are indicate ~27° and ~20° counterclockwise deviation from the Red Sea axis in the northern-central and southern regions respectively. We argue that the magnetic trends are associated with large transcurrent structures within the rifted hyperextended crust, where the regional patterns denote major dextral strike-slip faults and the local trends represent internal secondary structures. Horizontal shear is greater in the northern-central regions and lessened in the southern regions.

Acknowledgments to the National Geophysical Data Center (NGDC) for providing geophysical data and to the GEMCO Compilation Group (2020) for providing bathymetry data. The Study is supported by grants from Minerva Stiftung.

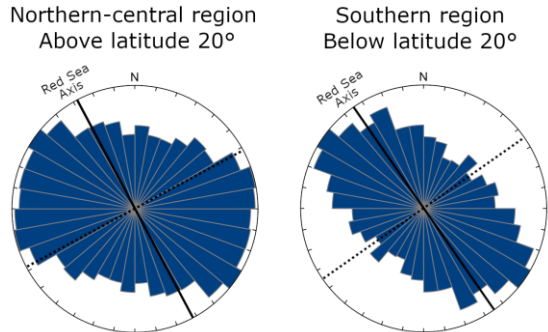


Fig 3. Directional analysis of the Total Horizontal Derivative suggesting deviation of the magnetic apparent strikes in ~27° and ~20° counterclockwise from the Red Sea axis in the northern-central and southern regions respectively.