Clues on Seismic Hazard and Stress Orientations from InSAR Observations in the Red Sea Region

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Earthquakes in the Red Sea region primarily occur along the rift axis, while the basin-boundary faults and rift flanks have been thought to be mostly aseismic. However, increasing evidence has been found during the past decades for considerable earthquake activity away from the rift, suggesting that earthquake hazard along the Saudi Arabian coastline may be significantly underestimated.

The recently discovered Qadimah fault is located on the Red Sea coast north of Jeddah and runs through King Abdullah Economic City, a planned $50 billion harbor city. This normal fault is parallel to the Red Sea and may be driven by gravitational gliding on mobile salt layers or by continued Red Sea extension. Not much is known about the fault's age or activity. We processed the available Envisat InSAR data of the area and they show very strong atmospheric signals that dominate any possible tectonic signals. The data were successfully corrected using data from the MERIS instrument onboard the Envisat satellite. Time-series results of the InSAR data show very low interseismic deformation rates of ~1 mm/year, which are below the estimated uncertainty of 2 mm/year.

The most recent volcanic activity in the region were the 2007-8 Jebel at Tair island (Red Sea) eruption, the 2009 Harrat Lunayyir magmatic intrusion, and the 2011-12 Zubair islands (Red Sea) eruption. We use a combination of Envisat, ERS, ALOS, TerraSAR-X and high-resolution optical imaging to study this activity. The results show that the Harrat Lunayyir intrusion almost made it to the surface to start an eruption, and that its orientation is parallel to the Red Sea, a manifestation of the extensional stress field that governs in the Red Sea region. The dike that fed the Jebel at Tair eruption, on the other hand, is oriented perpendicular to the Red Sea rift axis, and was therefore likely controlled by local stresses within the volcanic edifice, rather than the regional stress field.