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Abstract

An earthquake of magnitude (M=5.4) occurred on 19 May 2009 in the Lunayyir Volcanic Field (LVF), Saudi Arabia. The LVF is covered by recent basaltic rocks. The earthquake caused damages to the surrounding areas and resulted in surficial rapture trending in NNW-SSE direction with about 8-km length. Due to concern in future damaging earthquakes or volcanic activities, the government evacuated the residents for over 3 months.

Seismologists from the Saudi Geological Survey (SGS) studied the recorded seismicity data around the damaged area to locate the epicenter of the (M=5.4) earthquake. After extensive studies, they suggested that the main cause of the M=5.4 event was magma dike intrusion at depth of about 5 km. However; the dike did not reach the surface and no eruption took place.

Detailed ground and airborne gravity surveys around the earthquake area was carried out in an attempt to understand the reason of the earthquake and imaging the subsurface geology. In that regard, 380 gravity stations were measured in an area of about 600 km^2 covering the surficial rupture. The gravity data was analyzed using edge detection tools and a 3D inversion technique.

The results indicate that the 8-km surficial rupture extends toward the SE direction into the sub-surface which suggested a future seismic activity along this extension. Additionally, the dike intrusion location has low density values compared with the surrounding area which imply that this dike intrusion was created in the past, cooled, and solidified. Consequently, we assign the M 5.4 earthquake and the associated seismic swarm to simultaneous Red-Sea-Rift-parallel faulting and magmatic intrusion.