



Kingdom of Saudi Arabia
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Seismic Hazard Assessment of Makkah Al-Mokarramah Region

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ABSTRACT

Historical and recent seismic records for Makkah region and central Red sea for the period from 640 -2003 A.D. were analyzed. Most of seismic activities (76 %) are concentrated along the main axial trough of the Red sea, whereas the other 24 % are located on the land. Some epicenters of small magnitudes are poorly located.

Existence of large active structural basin which traverse Ad Damm fault zone with the Red Sea transform faults is delineated.

Based on the seismic activity, focal mechanism solutions, geological structures and tectonics, four seismic source zones were defined. The maximum expected magnitude for each seismic source zone was estimated. The b values correlate well with the tectonic environment and seem to increase gradually toward NE, where it has 0.75 for the central Red Sea and attains 1.25 for the central Arabian Shield. This may reflect the heterogeneity of the crust and regional stress field which indicates that most of activities on the land are man-made origin (induced), where those in the Red Sea are tectonic origin.

Composite focal mechanism solutions and slip vector analyses were carried out for two sets of earthquakes. The slip vector at Ad Dam structure zone is trending NE-SW which is in good agreement with the Red Sea rifting.

Probabilistic seismic hazard estimates of Makkah were estimated. Peak ground acceleration (PGA) predicted for 10% probability of being exceeded in 50 and 100 years are about 0.16 g and 0.20 g, respectively. Values for Taif are 0.1 g for 50 years and 0.13 g for 100 years, respectively, which represent the lowest in the study area, whereas for Makkah city the PGA values are 0.11 and 0.14 for 50 and 100 years, respectively.

Generally speaking, seismic hazard level for Makkah region is below average and the maximum expected magnitude may not exceed $M 6.7$ with a recurrence of 4 times every 100 years, and $M 4.7$ is 6 times every 100 years.