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Reservoir-Triggered Seismicity of Water Level Variation in the Lake Aswan

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Abstract : Lake Aswan is one of the largest man-made reservoirs in the world. The reservoir began to fill in 1964 and the level rose gradually, with annual irrigation cycles, until it reached a maximum water level of 181.5 m in November 1999, with a capacity of 160 km3. The filling of such large reservoir changes the stress system either through increasing vertical compressional stress by loading and/or increased pore pressure through the decrease of the effective normal stress. The resulted effect on fault zones changes stability depending strongly on the orientation of pre-existing stress and geometry of the reservoir/fault system. The main earthquake occurred on November 14, 1981, with magnitude 5.5. This event occurred after 17 years of the reservoir began to fill, along the active part of the Kalabsha fault and located not far from the High Dam. Numerous of small earthquakes follow this earthquake and continue till now. For this reason, 13 seismograph stations (radio-telemetry network short-period seismometers) were installed around the northern part of Lake Aswan. The main purpose of the network is to monitor the earthquake activity continuously within Aswan region. The data described here are obtained from the continuous record of earthquake activity and lake-water level variation through the period from 1982 to 2015. The seismicity is concentrated in the Kalabsha area, where there is an intersection of the easterly trending Kalabsha fault with the northerly trending faults. The earthquake foci are distributed in two seismic zones, shallow and deep in the crust. Shallow events have focal depths of less than 12 km while deep events extend from 12 to 28 km. Correlation between the seismicity and the water level variation in the lake provides great suggestion to distinguish the micro-earthquakes, particularly, those in shallow seismic zone in the reservoir–triggered seismicity category. The water loading is one factor from several factors, as an activating medium in triggering earthquakes. The common factors for all cases of induced seismicity seem to be the presence of specific geological conditions, the tectonic setting and water loading. The role of the water loading is as a supplementary source of earthquake events. So, the earthquake activity in the area originated tectonically (ML ≥ 4) and the water factor works as an activating medium in triggering small earthquakes (ML ≤ 3). Study of the inducing seismicity from the water level variation in Aswan Lake is of great importance and play great roles necessity for the safety of the High Dam body and its economic resources.

Keywords : Aswan lake, Aswan seismic network, seismicity, water level variation
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