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Study of earthquakes using a borehole seismic network at Koyna, India

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Koyna, located near the west coast of India, is a classical site of artificial water reservoir triggered earthquakes. Triggered earthquakes started soon after the impoundment of the Koyna Dam in 1962. The activity has continued till now including the largest triggered earthquake of M 6.3 in 1967; 22 earthquakes of M $\geq$ 5 and several thousands smaller earthquakes. The latest significant earthquake of ML 3.7 occurred on 24th November 2016. In spite of having a network of 23 broad band 3-component seismic stations in the near vicinity of the Koyna earthquake zone, locations of earthquakes had errors of $\sim$ 1 km. The main reason was the presence of $\sim$ 1 km thick very heterogeneous Deccan Traps cover that introduced noise and locations could not be improved. To improve the accuracy of location of earthquakes, a unique network of eight borehole seismic stations surrounding the seismicity was designed. Six of these have been installed at depths varying from 981 m to 1522 m during 2015 and 2016, well below the Deccan Traps cover. During 2016 a total of $\sim$2100 earthquakes were located. There has been a significant improvement in the location of earthquakes and the absolute errors of location have come down to $\pm$ 300 m. All earthquakes of ML $\geq$ 0.5 are now located, compared to ML $\geq$1.0 earlier. Based on seismicity and logistics, a block of 2 km x 2 km area has been chosen for the 3 km deep pilot borehole. The installation of the borehole seismic network has further elucidated the correspondence between rate of water loading/unloading the reservoir and triggered seismicity.