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Scientific drilling of 3km-deep Koyna Pilot Borehole, Deccan Traps, India

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A 3km-deep scientific Pilot Borehole has been drilled successfully in the Koyna seismogenic zone located in the Deccan Traps of western India, a site of recurrent reservoir triggered seismicity (RTS) since the impoundment of the Shivaji Sagar Lake created by Koyna Dam in 1962. The observations and measurements carried out in this Pilot Borehole would help design the ∼7km-deep Main Borehole planned in the same region. Drilling was carried out primarily using air-hammer technique except in the 1030-1500 m section where mud circulation was employed. The borehole was completed in six months time including casing and cementation up to the bottom and standard well completion procedures. Study of cores and cuttings reveal a ∼1.25km thick pile of Deccan flood basalt underlain directly by granite-gneiss basement. Online gas monitoring and laboratory analysis on gas samples revealed the presence of formation gases CO_2, CH4, H2 and He. Gas-rich zones are detected mostly below 2100 m depth. A suite of downhole geophysical logs comprising gamma, electrical resistivity, density, neutron and sonic were run in the 500-3000m section. The logs bring out valuable information on the physical and mechanical properties of the Deccan basalt and granite-gneiss, including fracture patterns in the basement. In-situ stress measurements by hydrofrac testing were carried out at 9 test intervals in the 1600-2400 m section of the crystalline basement, the deepest so far in the Indian shield. Preliminary data analysis indicates a predominantly strike-slip stress regime in the Koyna seismogenic zone, which confirms the strike-slip dominted nature of the Donachiwada Fault inferred from focal mechanism studies. Future plans include the installation of a vertical seismometer array in the deepest part of the borehole for long-term monitoring.