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Geophysical characterization of a fault zone and its correlation with seismicity in the Talala region, Northwest India

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The Deccan volcanic province (DVP) is the largest continental volcanic province of the world, located in the north-western part of the Indian subcontinent. In the Talala region in the mid of the DVP, seismicity with swarm-like behaviour has been registered towards the end of, or shortly after the annual monsoon period, particularly in the years 2007 to 2012. Despite three moderate earthquakes (Mw $\geq$ 5.0) which occurred during the last decade independent of the swarm like behaviour, there is little information about the geometry of a probable causative fault and its attributes. A causal association between the seismic activity and the rainfall during the monsoon period is not proven yet but a statistical correlation has been found. It might be possible that pore pressure changes in the shallow crust due to increased water levels during the monsoon trigger the seismic activity. Secondly, neglecting the influence of the monsoon, the seismicity might be caused by accumulation of water in the system due to crystallization of magma in 15 to 25 km depth. Another hypothesis on its origin is based on internal tectonic activities causing accumulation of internal stresses along rheological discontinuities.

To investigate the structure of the causative fault, geophysical surveys were carried out in the Talala seismogenic region. Time-domain electromagnetic (TDEM) measurements conducted along two profiles in NW-SE direction, revealed an electrically conductive zone within the highly resistive surrounding. This zone likely delineates a fault zone with a high fracture density within the Deccan Traps. Parallel TDEM profiles allowed to determine a NE-SW orientation of the fracture zone within the first 250 m depth. Magnetotelluric (MT) measurements were also conducted across the fracture zone to characterize the deeper structure down to 20 km. Interpretation of the geophysical measurements with respect to the fault structure is supported by a geomorphological (drainage/ridge offset, abrupt meanders, deflected streams and topographic profiles) and geological mapping of the region. Location and fault parameters are integrated with epicentre distribution, the spatio-temporal evolution and possible slip planes of the registered earthquakes. Groundwater variations in the closer surrounding pre- and post monsoon are also compared to the seismic occurrence to check for temporal interrelation. Consequences of the analysis for all three hypothetical triggering mechanisms are presented.