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Delineating active faults across the Narmada-Son Lineament (NSL), India using the technique of Fracture Induced Electromagnetic Radiation (FEMR)

Shreeja Das and Jyotirmoy Mallik
Indian Institute of Science Education & Research (IISER), Bhopal, Earth & Environmental Sciences (EES), Bhopal, India (shreeja17@iiserb.ac.in)

The Fracture Induced Electromagnetic Radiation (FEMR) technique has gradually progressed in the past decade as a useful geophysical tool to determine the direction and magnitude of recent crustal stresses, visualize the modification and realignment of stresses inside tunnels thus proving to be an important precursor for geohazards, earthquake forecasting, as well as delineate landslide-prone slip planes in unstable regions. Its working principle is based on the generation of geogenic electromagnetic radiation emanating from the brittle rock bodies that are fractured being subjected to an incremental increase of the differential stress in the near-surface of the Earth's crust. The "Process zone" at the fractured crack tip contains numerous microcracks which subsequently creates dipoles due to the polarization of charges on such microcrack tips which rapidly oscillates emitting FEMR waves of frequencies between KHz to MHz range. The coalescence of the microcracks eventually leads to a macro failure dampening the amplitude of the FEMR pulses. The attenuation of FEMR pulses is comparatively lesser than seismic waves making it a more efficient precursor to potential tectonic activities indicating an upcoming earthquake a few hours/days before the actual event. In the current study, we have attempted to exploit this technique to identify the locations of the potential active faults across the tectonically active Narmada-Son Lineament (NSL), Central India. Although the first tectonic stage involved rifting and formation of the NSL during the Precambrian time, the rifting continued at least till the time of Gondwana deposition. Later, tectonic inversion took place as a result of the collision between the Indian and the Eurasian plate resulting in reverse reactivation of the faults. Episodic reverse movement along NSL caused recurrent earthquakes and linear disposition of the sediments that were deposited at the foothills of the Satpura Horst. Although the origin of East-West trending NSL dates back to the Precambrian time, it is very much tectonically active as manifested by recent earthquakes. The study has been conducted by taking linear FEMR readings across 3 traverses along the NSL which on analysis provides an idea about the potential active faults, their locations, and frequency of occurrence. The accumulation of strain in the brittle rocks that can eventually lead to a macro failure is demarcated as an anomalous increase in the amplitude of the FEMR pulses indicative of an upcoming tectonic episode in the region. To further corroborate the analysis, we have attempted to determine the neo-tectonic activity in the region by calculating the morphometric parameters across the Khandwa-Itarsi-Jabalpur region, Central India. Finally, we

attempt to comment on the tectonic evolution of Central India in the recent past. We also encourage researchers to adapt the novel technique of FEMR which is swift, affordable, and feasible compared to conventional techniques deployed to survey the active tectonics of a region.