Earthquake Reconnaissance

Surface Rupture and Damage Patterns in the M_S = 6.4, September 29, 1993 Killari (Latur) Earthquake in Central India

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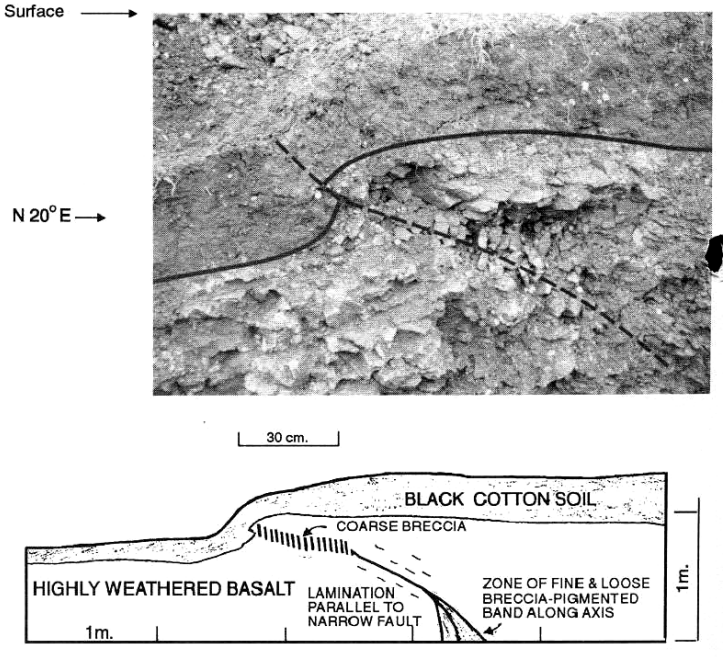
The September 29 earthquake in central India is not particularly large (M_s=6.4), yet is one of the most devastating intracratonic events known (about 10,000 people dead and more than twenty villages destroyed). Factors that may have contributed to the destruction are: shallow rupture; high population density; stone and mud construction; middle of the night timing; lowland sites for villages where site-response is unfavorable; and a false sense of security derived from absence of historical seismicity – the earthquake is centered in an area with the lowest level of perceived hazard.

The highest intensity, VIII-IX, is concentrated in a well-defined area about 10-15 km across. We mapped the surface trace of the rupture over a distance of about 1 km on the eastern side of this area. This trace is discontinuous and complex with scarps facing in opposite directions, but the overall strike is west-northwest and the deformation as exposed in three trenches indicates shortening of about 1/2 meter in a north-northeast direction. The surface trace probably extended to the northwest at least for another 2 km into an area characterized by deep soil where it had been obliterated by rain and plowing. A profile of a canal in that area shows a broad warp consistent with a reverse fault dipping southwest.

The epicenter is well within the vast area covered by Late Cretaceous basalt flows (Deccan Traps). Layering in the basalts is thought to contribute to the complexity of the rupture trace. We found no evidence of pre-earthquake faulting or folding in the basalts along or close to the rupture, nor did we see evidence of prehistoric scarps or accumulated deformation in the morphology.

This earthquake may fit into a class of shallow intra-cratonic earthquakes that are on faults without discernible neotectonic activity. Thus, neither geology nor historical seismicity offered clues to the oncoming earthquake. Precursory seismicity in 1992, however, included a damaging event (M=4.5) and many felt events. Furthermore, the earthquake is close (~10 km) to the Lower Tirna Reservoir (max water depth ~20 m). Several other recent earthquakes in peninsular India, including the well known 1967 Koyna earthquake, are located close to reservoirs. If a substantial portion of the recent seismicity in India is associated with reservoirs, earthquake hazard maps should reflect their distribution.



The photo and figure above present a cross-sectional view of the fault. The top of the fault can be seen approximately 30 cm from the surface at the boundary between the soil and rock layers.