The 11 November 2019, extremely shallow Le Teil earthquake (France): a constrained 3D geometry of two surface rupturing faults and implications for the observed damage in Le Teil village

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Résumé

The 11 November 2019 Le Teil earthquake was extremely shallow, occurring at a depth between 1 and 2 km. Despite its moderate magnitude, this seismic event caused significant damage, particularly in some districts of the nearest village of Le Teil. It was interpreted to have nucleated near the intersection of two surface rupturing faults, possibly triggered by a hydraulic overpressure due to an intense rainfall episode preceding the mainshock (Burnol, 2023). Here, we have combined all available data, including two unpublished seismic reflection profiles (JD20183, JD20184), two published EDF profiles (EDF 22-TRI-104, 21-CR-104), and a lidar-based digital surface model to constrain the 3D geometry of the three-fault system (La Rouvière Fault LRF, Bayne Rocherenard Fault BRF and Paurière Fault PF). Assuming a planar shape, the faults are represented by multiple strands delineated by the observed surface fault traces and the true dips estimated by the interpretation of the available seismic 2D profiles. The intersection of the three faults lies at a depth of about 1350 m ± 150 m. This value is the most likely hypocentre depth, consistent with the best estimate of 1300 m ± 500 m based on seismological analyses (Delouis, 2021).The northeast part of the 3D geometry reveals other details:
(1) LRF is, in part, subparallel to BRF but then diverges from it in a northly direction through Le Teil districts and the easternmost termination is located at the base of a 100 m high cliff.

(2) the eastern continuation of BRF extends along a 30 m high cliff before continuing towards the northeast across Le Teil districts and Le Rhône river.

This northeast geometry of LRF and BRF provides a rationale for the distribution of the observed damage across the different districts of the town of Le Teil (Negulescu, 2025). Similar extremely shallow fault systems should be systematically investigated to anticipate possible climate-modulated moderate seismicity in stable continental regions.

References :

*Intervenant

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