

Distribution of the August 24, 2016 Amatrice (Central Italy) earthquake-induced slope movements pointing out the existence of hanging wall/footwall effects in near-field regions

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INTRODUCTION

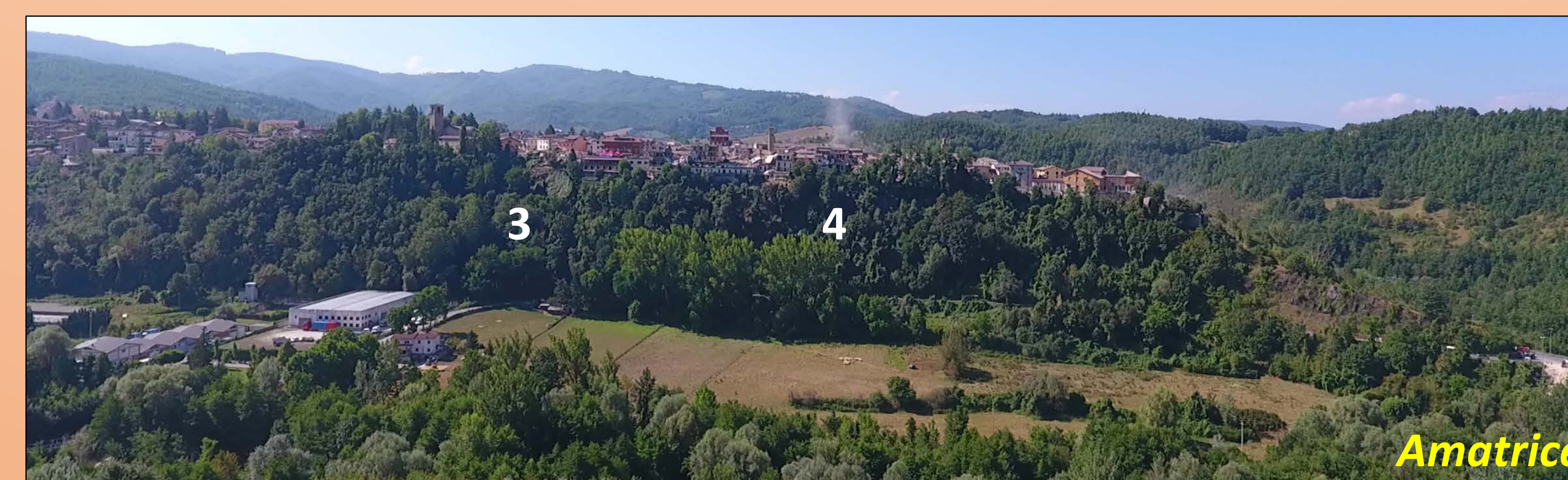
On August 24, 2016 an Mw 6.0 earthquake struck Central Italy resulting in 299 fatalities, 388 injuries, about 3000 homeless and many earthquake environmental effects. Based on mapping of the 2016 Amatrice earthquake-induced slope movements, it is clearly shown that their distribution in the hanging wall (HW) and the footwall (FW) of the seismic fault are quite different resulting in an asymmetric distribution around the causative fault and the observed coseismic surface ruptures and accompanied structures. These differences refer to the observed number, concentration and scale of recorded slope movements in the HW and FW of the seismic fault of Mt. Vettore and the faults along the Laga Mts.

SLOPE MOVEMENTS IN THE FOOTWALL OF MT. VETTORE FAULT

- Slope movements in the FW were observed in seven (7) localities within the Pretare and Arcuata del Tronto areas and in a site east of Amatrice.
- Slope movements north of Pretare affected Lias to Miocene pelagic deposits and Upper Tortonian-Lower Messinian turbidite deposits, while those in Arcuata del Tronto area and east of Amatrice affected only Upper Tortonian-Lower Messinian turbidite deposits.
- Their distance from the aforementioned faults was short, varying from 1.5 to 3 km.
- They were of low concentration and of small scale.
- They resulted in negligible to slight damage to road network.

SLOPE MOVEMENTS IN THE HANGINGWALL OF MT. VETTORE FAULT

- Slope movements in the HW were much more (98 localities) than those in the FW.
- They affected Lias to Miocene pelagic deposits and Upper Tortonian-Lower Messinian turbidite deposits along slopes in the road leading from Pescara del Tronto village to Norcia town and Upper Tortonian-Lower Messinian turbidite deposits within the Amatrice basin and more specifically in Amatrice and Accumoli areas.
- Their distance from the aforementioned faults was larger, varying from 0 to 15 km.
- They were comparatively of higher concentration and of larger scale.
- They caused severe damage to buildings and infrastructures and increased human fatalities in Amatrice, Accumoli and Pescara del Tronto villages founded on top of flat hills.



(1, 2, 3, 4) Landslides generated along the steep slopes of the Pescara del Tronto and Amatrice flat hills due to topographical amplification of earthquake motion along with the already established instability conditions resulted from river incision and erosion at the base of the hill. They resulted in partial or total collapse of buildings found at the edge of the hills and damage to infrastructures including roads, retaining walls and squares.

ANALYSIS OF STRONG GROUND MOTION DATA

In order to further support these field observations, the phenomenon of rupture directivity in the near field region is investigated and its association with the HW/FW effect is evaluated.

More specifically, 60 stations with the strongest recorded peak ground accelerations in the near-field region were selected and their records were analyzed and identified as either pulse-like or non pulse-like in order to identify pulse-like time histories.

21 out of 60 stations present pulse-like time histories. Only 6 out of 21 stations with pulse-like time histories appear to be affected by directivity. These directivity affected stations [AMT, MNF, NOR, NRC, RM33 and TRE1] are located at the northwestern and southeastern end of the fault projection. This observation is enhanced by the fact that the rupture spread from the hypocenter, in a direction parallel to the fault trace, towards both the northwestern and the southeastern ends of the fault.

As regards the correlation between hanging and footwall effects and directivity, the two phenomena are not related based on the aforementioned analysis and observations.

