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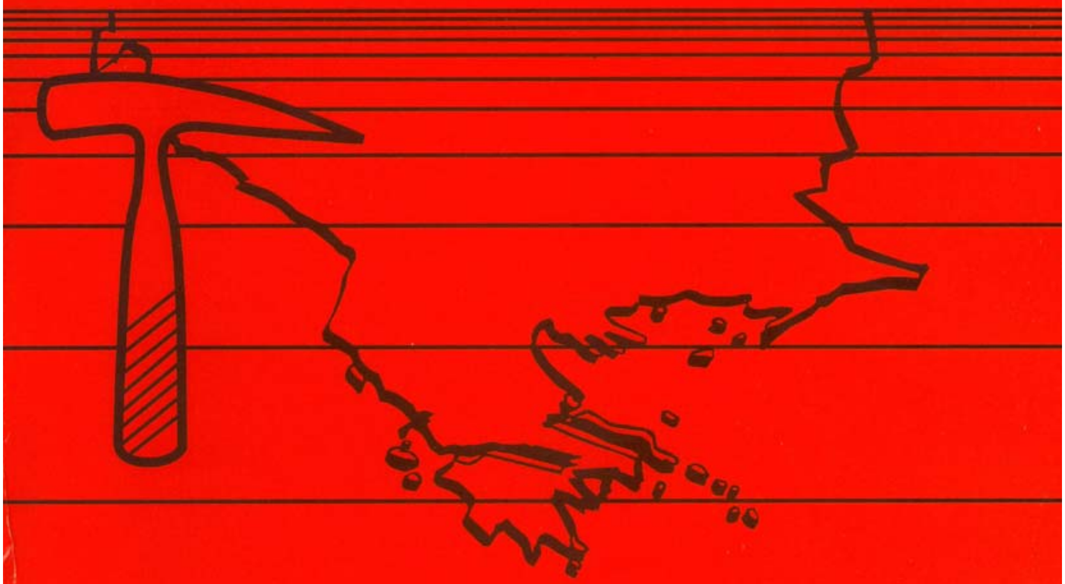

Fault geometry, surface ruptures, damage pattern and deformation field of the 2009 L' Aquila earthquake in Italy. Findings and implications.

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The 6th of April 2009 Mw=6.3 earthquake in L' Aquila, central Italy, provides a broad range of useful outcomes and points for consideration in relation to all disciplines involved in seismic hazard assessment. Despite its moderate magnitude the L'Aquila event resulted in the highest earthquake death toll in the EU since the 1980 Irpinia (Italy) quake. This event provides an important case-study, most notably because moderate magnitude earthquakes in areas of high population density, such as this, present a high risk in extensional settings due both to their high rate of occurrence and proximity to human habitation, forming a typical case study scenario. This event ruptured a small fault segment of the fault system and not one of the major postglacial fault scarps that outcrop in the area. This explains the minor primary surface ruptures that have been reported so that the 2009 L' Aquila event can be characterized as belonging to the lower end member concerning the capacity of the existing seismic sources of the area. These faults have not been activated during the 2009 event, but have the capacity to generate significantly stronger events. The deformation pattern of the 6th and 7th of April 2009 Mw=6.3 and Mw=5.6 earthquakes in L' Aquila is revealed by DInSAR analysis and compared with earthquake environmental effects. The DInSAR predicted fault surface ruptures coincide with localities where surface ruptures have been observed in the field, confirming that the ruptures observed near Paganica village are indeed primary. These ruptures are almost one order of magnitude lower than the ruptures that have been produced by other major surrounding faults from historical earthquakes.DInSAR analysis shows that 66% (or 305 km^2) of the area deformed has been subsided whereas the remaining 34% (or 155 km^2) has been uplifted. A footwall uplift versus hangingwall subsidence ratio of about 1/3 is extracted from the mainshock. The maximum subsidence (25cm) was recorded about 4.5 km away from the primary surface ruptures and about 9km away from the epicentre. In the immediate hangingwall, subsidence did not exceeded 15cm, showing that the maximum subsidence is not recorded near the ruptured fault trace, but closer to the hangingwall centre. The deformation pattern is asymmetrical expanding significantly towards the southeast. A part of this asymmetry can be attributed to contribution of the 7th of April event in the deformation field.

Fault geometry influenced significantly the damage pattern. Villages located on the hangingwall experienced higher intensity values, compared to villages located on the footwall. This is also verified by the DInSAR which shows that the hangingwall area was subjected to higher deformation values. On average, subsidence values were two and a half times up to three times larger than the uplift values, leading to more violent shaking.The large number and extensive spatial distribution of secondary surface ruptures that occurred not only within the recent sediments of the Aterno basin, but also on pre-existing fault planes was another characteristic of this earthquake. These ruptures are usually disregarded in seismic hazard assessment planning and design studies, but can produce significant damage. Finally,

basin effects and the bedrock geology played once more a decisive role to the damage pattern, even at short distances. It is interesting to note that villages that were only 1.5km apart, but founded on different bedrock geology recorded up to three intensity values difference.