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Discovering the characteristics of the surface faulting ancestors of the L'Aquila April 6, 2009 earthquake by paleoseismological investigations

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The occurrence of the Mw 6.3, April 6, 2009 earthquake has highlighted how critical is the development of hazard models that incorporate all the information on the long-term seismic behavior of faults (i.e., individual events rupture length and slip, timing, etc.). Under this light we started a campaign of paleoseismological investigations in the epicentral area.

The 2009 earthquake occurred on the Paganica normal fault (PF hereinafter) and produced a max 0.15 m high, 3 km-long continuous surface rupture along its central section, as well as several short, discontinuous cracks along the rest of the fault trace; secondary slip along nearby tectonic structures was observed too.

The PF consists of a prominent NW-SE striking and SW dipping long-term morphologic scarp formed by the tectonic juxtaposition of Pliocene-middle Pleistocene and late Pleistocene alluvial deposits, and by smaller compound scarps in late Pleistocene-Holocene deposits. The fault runs for a total length of about 20 km along the NE side of the Aterno River valley, a graben-type basin bounded by marked antithetic faults.

The limited extent and the small throw of the 2009 surface ruptures, when compared to the size of the Paganica long-term fault scarp, raise questions about the evolution and rupture history of this fault and suggest that the PF may have experienced larger Magnitude earthquakes than the 2009 seismic event.
With the aim of defining the Max Magnitude expected for the PF by determining the size of the individual coseismic surface ruptures occurred in the past and their max extent, their frequency and the average rate of displacement we have been excavating new trenches and studied artificial exposures across the PF fault zone, in most of the cases intersecting the 2009 surface ruptures.

Preliminary results show evidence for repeated decimetric surface faulting events during the past 3 millennia with the penultimate likely being the 1461 event (Me 6.4); evidence for possible previous larger slip events is found too. Whether the small ruptures are all related to slip at depth on the PF or would represent sympathetic slip triggered by earthquake occurred on nearby faults should be better investigated. Conversely, provided the "double size" slip behavior of the PF is confirmed, to characterize the seismic hazard of the area we should consider a more complex seismogenic model than that presently applied. In particular, we should include also the scenario that the PF produces relatively frequent (each 4-600 yr) 2009-type earthquakes and rare (each 3-4 millennia) larger events, likely in connection with other nearby active structures (i.e., San Demetrio Fault? Pettino Fault?).