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The 2016 Central Italy "reverse" seismic sequence

Lauro Chiaraluce, Raffaele Di Stefano, Elisa Tinti, Laura Scognamiglio, Maddalena Michele, Marco Cattaneo, Pasquale De Gori, Claudio Chiarabba, Giancarlo Monachesi, Annamaria Lombardi, Luisa Valoroso, Diana Latorre, and Simone Marzorati

INGV, Rome, Italy (raffaele.distefano@ingv.it)

The 2016 seismic sequence consists so far of a series of moderate to large earthquakes that within three month's time activated a 60 km long segmented normal fault system located in the Central Italy and almost contiguous to the 1997 Colfiorito and 2009 L'Aquila normal fault systems.

The first mainshock of the sequence occurred with MW6.0 on the 24th of August at 01:36 UTC close to the Accumoli and Amatrice villages producing evidence for centimetres' surface ruptures along the Mt. Vettore normal fault outcrop. Two months later on the 26th of October at 19:18 UTC another mainshock with MW5.9 occurred 25 km to the north activating another normal fault segment approximately on the along strike continuation of the first structure. Then, four days later on the 30th of October at 06:40 UTC the largest shock of the sequence with MW6.5 close to Norcia, in the middle part of the fault system activated two months before.

We reconstruct the first order anatomy of the activated normal faults system, by analysing the spatial and temporal distribution of 25,354 aftershocks with 0.1<M<6.5 occurred between the 24th of August and the 29th of November, 2016, hand-picked in real time by the personnel on duty in the National Institute of Geophysics and Volcanology (INGV) monitoring room.

The seismicity pattern unravels a SW-dipping normal fault system composed by kilometres long fault segments associated to the main events plus minor anti- and synthetic faults located both in the hanging-wall and in the foot-wall of the main planes.

The entire fault system is constrained at depth by a 2-3km thick layer where small magnitude events plus a series of large aftershocks (up to M 4) occur. This basal layer is almost flat between 8-10km at the two edges of the fault system, while in the central portion it starts at about 6-7 km of depth to the west, reaching almost 12km to the east thus showing a gentle dip to the east. The variability observed all along the fault system in the anatomy of such a basal layer located in between the upper and lower crust suggest a thick skin tectonic as a structural style for the area.

Observing the spatial relationship between the seismicity distribution and the mapped compressional structures, we detect a complex interaction. The thrusts inherited by the previous tectonic phase seems in fact to modulate in space and time the seismicity pattern evolution including the coseismic slip distribution and fault segments interaction resulting in a "reverse" behaviour of the seismic sequence that might be due to a complex effect of static and dynamic stress loads on the volume containing the fault plane and hosting the main asperities each one close to an instability condition.