



## **Tectonic model of the 2016, Central Apennines earthquake sequence: implications for seismogenic source identification**

Lorenzo Bonini (1,2), Francesco Emanuele Maesano (2), Roberto Basili (2), Pierfrancesco Burrato (2), Umberto Fracassi (2), Mara Monica Tiberti (2), Paola Vannoli (2), and Gianluca Valensise (2)

(1) University of Trieste, Department of Mathematics and Geosciences, Trieste, Italy (lbonini@units.it), (2) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy

On 24 August 2016 a Mw 6.0 earthquake marked the beginning of a severe seismic sequence that struck Central Italy. This shock was followed by a Mw 5.9 on 26 October, by a Mw 6.5 on 30 October, by two Mw 5.4 aftershocks and by over 30,000 smaller shocks. Based on the widespread occurrence of surface breaks the majority of workers agreed that this sequence was caused by a widely-recognized system of Quaternary normal faults crossing the region, namely the Monti della Laga - Monte Vettore fault system.

In this study we use surface and subsurface geological data, coupled with distributions of relocated seismicity and InSAR evidence of ground displacement, to show that the earthquake sequence was caused by the reactivation at depth of tectonic structures inherited from older tectonic phases combined with sympathetic slip along shallow ruptures. In particular we maintain that an inherited thrust fault is the most likely source of the 30 October, Mw 6.5 earthquake, the largest of the sequence. We also propose that the sequence involved slip along a normal fault partially located in the footwall of such thrust, and that this was the source of the 24 August, Mw 6.0 event. This latter fault partially reactivated the thrust in an extensional sense. The 26 October, Mw 5.9 event was caused by the extensional reactivation of an eastern portion of the same thrust; together with the 24 August earthquake this event triggered the reactivation of the whole thrust with extensional kinematics, ultimately leading to the Mw 6.5 shock.

The 2016 sequence illuminates several aspects of the seismotectonics of the Central Apennines, casting doubts on a number of hypotheses that were put forward based exclusively on observations of exposed brittle structures. It also shows the key role of reactivated inherited structures as potential sources for large earthquakes, in addition to the activation of younger extensional fault systems.