THE 2016 CENTRAL ITALY EARTHQUAKE
(AUGUST 24, Mw 6.2)

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MAIN TECTONIC LINEAMENTS & MAIN TECTONIC DOMAINS OF ITALY

from Palano (2014) Geophys. J. Int..

Historical Earthquakes 1000-2006 (Mw ≥ 5.0)

Recent Seismicity 1985-2004 (Mw ≥ 2.0)
### Destructive Earthquakes of Italy

<table>
<thead>
<tr>
<th>Data</th>
<th>Area</th>
<th>Intensità</th>
<th>Magnitudo Mw</th>
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<td>08.09.1905</td>
<td>Calabria</td>
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*Dati: iside.rm.ingv.it  
* Cumulo degli effetti della sequenza
HISTORICAL EARTHQUAKES IN UMBRIA, MARCHE & LAZIO REGIONS
SEISMIC HAZARD IN THE MEDITERRANEAN AND ITALY
SEISMIC HAZARD MAP & NATIONAL SEISMIC ZONATION OF ITALY
PRIMARY ACTIVE FAULTS in the Southern Umbria – Abruzzi Apennines and distribution of the highest-intensity datapoints related to major earthquakes (M > 6)

MCS INTENSITY DATAPORTS

I = 8/9 1328 and 1349 earthquakes
I = 9 1461
I = 9/10 1456, 1654, 1703, 1706
I = 10 1915

from Galadini and Galli (2000)
MAIN NORMAL FAULTS OF THE AREA AFFECTED BY THE CENTRAL ITALY EARTHQUAKE Mw 6.2, 24 AUGUST 2016

MT. VETTORE FAULT (MVEF) & LAGA MTS FAULT (LMF)

Map from Galadini and Galli (2000)
MT. VETTORE FAULT

• NNW-SSE to NW-SE trending normal fault
• about 18 km long
• one major intermontane basin formed along the fault, the Castelluccio Plain
• The plain partially filled by an alluvial fan which probably formed between about 23,000 and 3200 years BP
• Two fault splays easily detectable along the Mt. Vettore western slope, since they formed impressive limestone scarps
• Prate Pala scarp (PPs) affects the large Late Pleistocene-Holocene alluvial fan fed from the Valle delle Fonti creek
• PPs, an evidence of displacements affecting recent deposits in the piedmont area

from Galadini and Galli (2003)
Photos taken on 2016.08.26
MT. VETTORE FAULT TRENCHES

• Three events occurred during the Holocene:

**E1**: between 4155-3965 yrs BP and the 6th-7th century AD

**E2**: between 5940-5890 / 5795-5780 yrs BP and 4155-3965 yrs BP

**E3**: related to events occurred between 18,000-12,000 yrs BP and 5940-5890 / 5795-5780 yrs BP

*from Galadini and Galli (2003)*
LAGA MTS FAULT

• NW-SE-trending normal fault
• 30 km long and bounds two intermontane basins: Amatrice and Campotosto basins, located along the northern and southern portions of the fault, respectively.
• The fault is made of three parallel splays affecting the Laga Mts. SW slope at different height.
• Evidence of recent activity represented by fault scarps on the arenaceous bedrock and deposits related to terraces which formed along the incisions perpendicular to the slope.
• Some scarps detected on Holocene terraces.

Map from Galadini and Galli (2003)

Photo taken on 2016.08.26
Laga Mts

Amatrice intermontane basin

Northern part of the Amatrice intermontane basin

Photos taken on 2016.08.26
LAGA MTS FAULT TRENCH

Two displacement events recognized based on the trench:

- **E1**: E1 occurred after 8425-8365 yrs BP
- **E2**: E2 occurred at about 8425-8365 yrs BP

Figures from Galadini and Galli (2003)
SEISMIC GAPS IN THE CENTRAL APENNINES
VETTORE MTS FAULT
- repeated Holocene activation
- a minimum vertical slip rate ranging between 0.11 and 0.62 mm/yr for the Prate Pala scarp (Mt. Vettore fault)
- a paleoseismologically inferred minimum elapsed time of 1300-1500 years defined for the Mt. Vettore fault
- a maximum recurrence interval of 4690-4490 years for surface faulting events along the Mt. Vettore Fault

LAGA MTS FAULT
- repeated Holocene activation
- minimum vertical slip rate of 0.12 mm/yr for the Laga Mts fault
- minimum elapsed time (eight centuries) for the Laga Mts. fault
- a maximum time span between the two events of Laga Mts fault of 7570 years

Silent faults during at least the past eight centuries until

the 24 August 2016 earthquake
COSEISMIC SURFACE RUPTURES ALONG THE VETTORE MT FAULT
COSEISMIC SURFACE RUPTURES ALONG THE VETTORE MT FAULT

from field reconnaissance conducted by INGV
INSTRUMENTAL DATA
OF THE CENTRAL ITALY EARTHQUAKE
Mw 6.2  24 AUGUST 2016
CENTRAL ITALY EARTHQUAKE
Mw 6.2, 24 AUGUST 2016
MOMENT TENSORS SOLUTIONS
WAVEFORMS

VERTICAL COMPONENT OF ACCELEROMETERS FROM ISNET

http://isnet.fisica.unina.it/reports/Central_Italy_2016_Isnet.pdf
USGS ShakeMap

http://earthquake.usgs.gov/earthquakes/eventpage/us10006g7d

INGV ShakeMap

http://shakemap.rm.ingv.it/shake/7073641/intensity.html
AFTERSHOCK SEQUENCE UNTIL 30 AUGUST 18:00
GROUND DISPLACEMENT FROM CENTRAL ITALY EARTHQUAKE

http://www.esa.int/spaceinimages/Images/2016/08/
Ground_displacement_from_Italy_s_earthquake
Central Italy Earthquake Deformation

Combination of Sentinel-1 radar acquisitions over central Italy from before (15.08.2016) and after (27.08.2016) the earthquake

‘Interferogram’ showing ground deformation caused by the 24 August earthquake

http://www.esa.int/spaceinimages/Images/2016/08/Italy_earthquake_deformation
http://www.esa.int/spaceinimages/Images/2016/08/
Source_fault_of_Italy_s_earthquake
GROUND DEFORMATION CAUSED BY THE EARTHQUAKE

DIFFERENTIAL INTERFEROMETRY (DINSAR) RESULT USING THE ALOS-2 PALSAR-2 DATA ACQUIRED BEFORE (2015.09.09; UTC) AND AFTER (2016.08.24; UTC) EARTHQUAKE

CO-SEISMIC DISPLACEMENTS FOR THE 2016 CENTRAL ITALY EARTHQUAKE
ESTIMATED FROM CONTINUOUS GPS STATIONS

http://ring.gm.ingv.it/
SECONDARY EARTHQUAKE ENVIRONMENTAL EFFECTS
INDUCED BY THE CENTRAL ITALY EARTHQUAKE
Mw 6.2 24 AUGUST 2016
Accumoli

Pescara del Tronto
Pescara del Tronto
Pescara del Tronto
BUILDING DAMAGE
INDUCED BY THE CENTRAL ITALY EARTHQUAKE
Mw 6.2  24 AUGUST 2016
Photos taken on 2016.08.25 before the Mw 4.3 aftershock of 2016.08.25 and the Mw 4.8 aftershock on 2016.08.26

AMATRICE
Photos taken on 25 August before a 4.3 aftershock
Photos taken on 25 August before a 4.3 aftershock
Photos taken on 25 August before a 4.3 aftershock

AMATRICE
Photos taken on 25 August before (1), during (2) and after (3, 4) a 4.3 aftershock
Photo taken on 2016.08.27 after two aftershocks with Mw 4.3 and 4.8 respectively

PESCARA DEL TRONTO
Photos taken on 2016.08.27
DAMAGE TO BRIDGES
EMERGENCY RESPONSE
AFTER THE CENTRAL ITALY EARTHQUAKE
Mw 6.2  24 AUGUST 2016
THE 2016 CENTRAL ITALY EARTHQUAKE
(AUGUST 24, Mw 6.2)

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