

Shear Wave Splitting evidences from Amatrice seismic sequence: relations with stress field and main faults

Marina Pastori (1), Paola Baccheschi (2), and Lucia Margheriti (2)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Roma 1, Italy (marina.pastori@ingv.it), (2) Istituto Nazionale di Geofisica e Vulcanologia, CNT, Italy

Shear wave splitting is a clear manifestation of seismic anisotropy. Several studies worldwide demonstrate that seismic anisotropy is related to stress-aligned, filled-fluid micro-cracks and/or to macroscopic aligned fracture field. In this hypothesis, fast shear waves are polarized parallel to the strike of micro-cracks, cracks and faults inside the crust, which, in turns, are aligned to the SH_{max} of the active stress field. Delay time, between fast and slow splitted S-waves, is directly proportional to the density and to the aspect ratio of the cracks and to the thickness of the anisotropic layer.

In the current work we present a huge collection of high-quality anisotropic parameters: fast polarization direction (φ) and delay time (dt), of several earthquakes recorded during 6 months starting from the Mw 6.0 mainshock (August 24th 2016, 01:36:32 UTC). The period also includes the following larger aftershocks: Mw 5.9 (October 26th 2016), Mw 6.5 (October 30th 2016) and Mw 5.5 (January 18th 2017).

Manual-revised P- and S- picking and high-precision locations of 39357 aftershocks recorded at 31 three-component seismic stations are used to better understand the anisotropic pattern and to delineate the active crustal deformation resulting from the spatio-temporal evolution of the long 2016 Amatrice seismic sequence.

The mean fast direction, resulting from 11865 no-null measurements, is $\sim N146^\circ$, which is in agreement with the NW-SE strike of the main Quaternary faults, with the NW-SE striking plane of the focal mechanisms and with the NE-SW local extension observed from the horizontal coseismic displacements. This global anisotropic trend is not enduring in time and space; looking at the interpolated values of φ and dt for the study area we note an interesting behavior, that could suggest the presence of complex and strong seismic anisotropy anomalies in the crustal volume.

Three different time periods, based on the occurrence of the largest earthquakes, have been identified to show the anisotropic pattern variations. In the first period, August 24th-October 25th, φ are oriented from N-S between south Amatrice and east Arquata area and rotated to E-W at northeast of Norcia village. Fast axes related to the second period, October 26th – January 17th, are more variable: from N-S between Accumoli and east Arquata, to NW-SE between Cascia, Norcia and Preci villages, to E-W in the southeastern part of Cascia and NE-SW in the northeastern of Norcia. A noteworthy variation of fast direction in time is observed at northeast of Norcia. Finally, in the last period, January 18th -February 28th, φ are mainly oriented NW-SE.

The average value of delay time is roughly 0.064 s, while at single stations we evaluated values ranging from 0.024 s to 0.090 s. Interpolated dt reveal higher values in the hanging-wall of the activated fault system, mainly located in the southeastern part of Norcia.

The values of delay time resulting from this study are comparable with those found in previous studies in Central Italy: 2009 L'Aquila sequence, 2010 Pietralunga sequence and 2000-2001 Città di Castello experiment.