Geophysical Research Abstracts
Vol. 17, EGU2015-6633, 2015
EGU General Assembly 2015

The shallow structure of the 2009 Mw 6.1 L'Aquila earthquake fault-system (Italy): new insights from integrated high-resolution refraction tomography and detailed geologic mapping

Fabio Villani (1), Luigi Improta (2), Stefano Pucci (2), Riccardo Civico (2), and Daniela Pantosti (2)

(1) Istituto Nazionale di Geofisica e Vulcanologia, L'Aquila, Italy (fabio.villani@ingv.it), (2) Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy

The 6 April 2009 Mw 6.1 L'Aquila earthquake (central Italy) was caused by the Paganica Fault, which belongs to a ∼20 km long network of normal faults (Paganica-San Demetrio Fault System, PSDFS). The hangingwall of the PSDFS hosts a wide Quaternary continental basin (Middle Aterno valley) with complex geometry, structural setting and sedimentary evolution. Before the 2009 earthquake, the shallow crustal structure in the epicentral area was poorly known.

Here, we report results of a 2-D high-resolution seismic investigation carried out in 2010 in the NE portion of the basin, across the Paganica Fault, in a challenging urban environment. The survey consisted of 5 dense wide-aperture seismic profiles that run NE-SW for a total length of 8 km. Around 80,000 hand-picked first-arrival traveltimes were input to a non-linear multi-scale tomographic inversion. The merged profiles allow depicting a reliable cross-section of the Middle Aterno basin down to ∼300 m depth. In addition, we show for the first time P-wave velocity images across the causative fault of the 6 April 2009 earthquake. Interpretation of the Vp tomograms is constrained by a few drillings and by results of a detailed geologic survey.

We interpret low-Vp regions (1500-2000 m/s) as lacustrine sediments and higher Vp bodies (Vp up to 3000 m/s) as coarse fluvial and alluvial fan deposits sited above a Meso-Cenozoic carbonate substratum (Vp >3500-4000 m/s) that shows a very irregular morphology.

The improved knowledge of the Middle Aterno valley geological setting together with new tomographic Vp images yield new insights on the buried structure and long-term evolution of two small basins (Bazzano and Paganica basins) crossed by the seismic lines. In particular, the Paganica basin developed since Early-Middle Pleistocene due to the Paganica SW-dipping master fault and its splays. Seismic imaging revealed that the basin infill consists almost exclusively of coarse alluvial fan deposits. We were able to detect 2 previously unreported synthetic splays of the Paganica Fault and additional antithetic structures that give rise to a ∼2.5 km wide hangingwall depocenter where the pre-Quaternary substratum is affected by >300 m total vertical throw. We can also image at depth the fault plane that caused primary surface breaks in the Paganica village, and we estimate >80 m vertical throw for it.