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The 2013, ML 4.9, Matese earthquake (Southern Apennines, Italy): A “deep” normal faulting earthquake or an earthquake at frictional-to-viscous transition?

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At the end of December 2013, a Ml 4.9 struck a Matese region in Southern Apennines. Until the half of January 2014, a seismic sequence of about 300 events with low magnitude (0.9<Ml<4.9) occurred in a region of high seismogenic potential. In fact, the Matese area falls in the epicentral area of strong earthquakes, the most destructive with X-XI Mercalli-Cancani Sieberg (MCS) intensities occurred in 1456, 1688 and 1805 and caused thousands of casualties. Considering the high seismic hazard, the 2013 Matese earthquake had soon aroused great interest into the scientific community. In fact, some authors had studied the 2013-2014 Matese seismic sequence, but leaving unresolved essential questions about the anomalous depth (> 15 km) for the area expected seismicity, the real geometry of the activated seismogenic source and its role into the regional seismotectonic setting. Furthermore, bearing in mind the rheological stratification of the area, the Matese earthquake could have taken place at crustal transition between brittle deformation at the surface and predominantly viscous flow at greater depths.
The main purpose of our work is to deeply investigate the Matese seismogenic source, activated during the 2013-2014 seismic sequence. Focusing seismological analyses on the mainshock, we have relocated the earthquake and constrained its depth verifying several crustal velocity models. Moreover, we have calculated the moment tensor solution and assessed the depth range of the best solution as independent test for the hypocenter depth. Then, we have explored the rupture process calculating the Apparent Source Time Functions (ASTFs) and inverting them by isochrone back-projection to obtain a kinematic slip map. Integrating seismological analyses with geological data, we have delineated the seismogenic source addressing question about:

• the attitude and geometry of the fault plane over which the Matese mainshock occurred and its relation with the geological structures that characterize the areal tectonic context

• the real depth at which the activated fault plane extends and the crustal extensional deformation is active in Southern Apennines, particularly in the Matese area

• a potential rheological model for the Matese seismogenic fault and its difference with the known active faults, taking into account the seismogenic thickness and the depth of frictional-to-viscous transition of the area.