The 2002 Molise, southern Italy, earthqukae and its surrounding tectonic stress

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On October 31, 2002 an ML = 5.4 earthquake occurred in southern Italy, at the margin between the Apenninic thrust belt (to the west) and the Adriatic plate (to the east). In this area, neither historical event nor seismogenic fault is reported in the literature. In spite of its moderate magnitude, the earthquake caused severe damage in cities close to the epicenter and 27 people, out of a total of 29 casualties, were killed by the collapse of a primary school in S. Giuliano di Puglia. By inverting broadband regional waveforms, we computed moment tensor solutions for 15 events, as small as ML = 3.5 (Mw = 3.7). The obtained focal mechanisms show pure strike-slip geometry, mainly with focal planes oriented to NS (sinistral) and EW (dextral). In several solutions focal planes are rotated counterclockwise, in particular for later events, occurring west of the mainshock. From the relocated aftershock distribution, we found that the mainshock ruptured along an EW plane, and the fault mechanisms of some aftershocks were not consistent with the mainshock fault plane. The observed stress field, resulting from the stress tensor inversion, shows a maximum principal stress axis with an east-west trend (N83W), whereas the minimum stress direction is almost N-S. Considering both the aftershock distribution and moment tensor solutions, it appears that several pre-existing faults were activated rather than a single planar fault associated with the mainshock. The finite fault analysis shows a very simple slip distribution with a slow rupture velocity of 1.1 km/s, that could explain the occurrence of a second mainshock about 30 h after. Finally, we attempt to interpret how the Molise sequence is related to the normal faulting system to the west (along the Apennines) and the dextral strike-slip Mattinata fault to the east.