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Imaging the polarity switch between large seismogenic normal faults in the southern Apennines (Italy)

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The backbone of Italy's Apennines hosts the majority of the seismic moment release in the Italian peninsula. In particular, the area among the southern Abruzzo, southeastern Lazio and Molise regions in central-southern Italy includes the polarity switch, from north to south, between the large SW-verging seismogenic normal faults (the southernmost one being the Aremogna-Cinque Miglia, responsible for a Mw 6.4 event dated 800 B.C-1030 A.D.) and those NE-verging ones (the northernmost one being the Boiano Basin, responsible for the 26 July 1805, Mw 6.6 Molise earthquake), including the Carpino-Le Piane fault system. In addition, the area between these two faults is the locus of extension parallel to the chain axis, as shown by a low-magnitude (M < 3.3) seismic sequence occurred in 2001. As GPS data illustrate, NE-SW striking extension predominates in the western and the inner sectors of the Apennines.
All active normal faults along the crest of the Apennines are essentially parallel to the mountain range (NW-SE) and are governed by the current extensional regime that has been in place since the Middle-Upper Pleistocene. However, the occurrence of such polarity switch between antithetic, conjugate seismogenic normal faults in Italy is very uncommon. In addition, the area of research marks the abrupt end of the two (three?) sub-parallel seismogenic belts in Abruzzo (to the north) and the inception of the single, aligned one in Molise (to the south), including the western termination of E-W striking, large oblique-slip faulting in the foreland. In other words, this is a critical area concerning seismogenesis in central Italy and, therefore, the tectonic mechanism that either causes or influences such polarity switch could represent a key ingredient in the above scenario.

Between January and May 2005, the RSN (Italy's National Seismometric Network) recorded a rise in the background seismicity, that has been recently relocated. This sequence is essentially a low magnitude (Md < 3), swarm activity that clustered within the Ortona-Roccamonfina line, a regional structure striking NNE-SSW and separating the central from the southern Apennines, hypothesized and discussed by numerous authors; in particular its field evidence is still debated, as much as its present-day activity. Our data show that, at least in the area where the 2005 sequence has occurred, the spatial trend of seismic activity essentially coincides with a sector of the Ortona-Roccamonfina line.
Concerning fault polarity switches, there are numerous case studies in the literature where such examples have been recognized and associated with accommodation zones. Various authors have shown that either a hard (transfer fault) or soft linkage (relay ramp) is kinematically needed to accommodate strain between the two. This would be particularly true in the case we present, i.e. with two large (∼20-25 km long) convergent, approaching faults, at a distance (20-25 km) comparable in size to the length of the faults in question. According to these literature models for transfer zones, such transfer would occur at ∼45° to the strike of the concerned faults, that is ∼N-S in the studied area.

The location of the clustered seismicity that occurred in 2005 between the Abruzzo and Molise regions shows a ∼NNE-SSW alignment and falls within the area where a major polarity switch between large seismogenic faults occur. On the basis of (i) the spatial-temporal characteristics of this data and (ii) the geometry and kinematics of active faulting in the region, we hypothesize (a) the existence of a transfer zone between the Aremogna-Cinque Miglia and Boiano Basin faults, and (b) the activity of such linkage along the Ortona-Roccamonfina line in this sector of the chain where a major transition, both structural and seismogenic, occurs.
Alternatively, this polarity switch could result mainly from the rheologic and tectonic control exerted by the abrupt

passage between the two diverse paleogeographic domains that make up the boundary between the central and southern Apennines. The role of such possible control onto the nature and geometry of the transfer zone and their interaction with one another, including seismic activity, is part of a larger study currently underway.