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Variations in the geomagnetic and gravitational background associated with two strong earthquakes of the May 2012 sequence in the Po Valley Plain (Italy).

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Reawakening of seismic activity in the Emilian Po Valley Plain (Italy) resulted in 2,492 earthquakes over five and a half months: 2,270 with M<3, 189 with a magnitude from 3.0<= M <4.0, 27 con 4.0<= M <5.0, and 7 M>= 7. The mainshock was recorded during the night of 20 May 2012, at 04:03:52 Italian time (02:03:52 UTC) with epicentre in Finale Emilia, at a depth of 6.3km, by the Italian National Institute of Geophysics and Vulcanology (INGV). A long sequence of telluric shocks occurred in the same seismic district in the areas between the provinces of Modena, Ferrara, Mantua, Reggio Emilia, Bologna and Rovigo. In addition to the general devastation plus damage to civil and industrial buildings and the historical heritage, the earthquakes resulted in a total of 27 victims. Concomitant with the two strongest quakes, recorded on 20 and 29 May 2012, respectively, as in the case of others, variations were noted in the geomagnetic background by the LTPA monitoring station in Rome (Italy). The geomagnetic background variations were associated with the appearance of radio-anomalies in a frequency range from 0.1 to 3.0Hz, as well as gravimetric variations found around 60km from the epicentre. The peak accelerations, detected in correspondence with the strongest shocks on 20 and 29 May 2012, were respectively 0.31g and 0.29g.
The appearance of the radio-anomalies coincided, from a temporal point of view, with average gravimetric variations of approximately 30μGal around the epicentre areas, concurrent with the mainshock.
In this study, both the appearance of radio-anomalies and the gravitational variations recorded before strong earthquakes were related to the dynamics of the fault and a progressive reduction in granulometry in the core of the fracture, until the point of dislocation was reached. The intense friction in the fault and the damping factors produced before the shock are hypothesized as being proportional to the number of radio-anomalies measured.
The radio anomaly is an unknown radio emission that has no characteristics (duration, extension, intensity, etc..) compatible with: the classification by IAGA (International Association of Geomagnetism and Aeronomy) of geomagnetic pulsations; emissions of an anthropic type; known natural emissions (Whistler, Chorus, lightning, electrophonic meteoric sounds, plasma, etc..).
For this reason, since Radio anomalies are not related to known phenomena they were considered in this study as candidate seismic precursors. Most of the radio anomalies are observed below 32Hz and, generally, between 0.1 and 20Hz and occur in association with an intense increase in the geomagnetic background that precedes the occurrence of a seismic event.