

Multiple seismo-anomalies associated with three major earthquakes in China, Japan and Taiwan

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Seismo-crustal deformation, groundwater (containing levels, temperature and radon), geomagnetic and ionospheric anomalies are integrated together to investigate pre-earthquake anomalous phenomena associated with the M6.1 Ludian earthquake, China, the M9.0 Tohoku-Oki earthquake, Japan and the M7.6 Chi-Chi earthquake, Taiwan. Seismo-crustal deformation and groundwater anomalies generally lead the other promising parameters because stress accumulation in crust is one of the major driving forces of earthquakes. Uplift and depression groundwater levels are exactly related with compression and tension stress loading in the crust, respectively. Decreases of groundwater temperature and radon concentration are resulted from uplift groundwater levels. Meanwhile, groundwater would infuse into fracture zones of faults once cracks are developed before earthquakes that can enhance conductivity near hypocenters and/or faults affecting electromagnetic fields and electron total electron contents in the ionosphere. Those aforementioned relationships can be utilized to eliminate anomalies which are unrelated with earthquakes to further increase of the accuracy and understand causal mechanisms of pre-earthquake anomalous phenomena in seismogenic processes.

Keywords: Groundwater, Electromagnetic field, Total electron content, Crustal deformation, Earthquake forecast