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Variation of electric parameters in atmosphere due to radon exhalation prior to a large earthquake

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Accelerated moment release is often preceded by large earthquakes, and defined by rate of cumulative Benioff strain following power-law time-to-failure relation. This temporal seismicity pattern is investigated in terms of irreversible thermodynamics model. The irreversible thermodynamic model reduces to a fiber-bundle model and experimentally-based constitutive law of rocks, and predicts the form of accelerated moment release. Based on the model, we can discuss the increment of atmospheric radon concentration prior to the 1995 Kobe earthquake. Reconstructing the vertical distribution of atmospheric conductivity preceding the earthquake under quasi-stationary condition, the radon enhancement increases the conductivity in the planetary boundary layer. This result corresponds to about 20% decrease of the columnar residence between ionosphere and ground surface around a monitoring station. Furthermore, assuming that air-earth current is constant, the growth of atmospheric conductivity leads to decline in atmospheric electric field comparing with that in the 1965 Matsushiro earthquake swarm. In contrast, considering the dynamism of charged aerosol particles, the radon exhalation induces the atmospheric electric field of 10^5-10^6 V m^{-1} near ground which is three to four orders of magnitude larger than usual values of 10^2 V m^{-1}. This generation of the electric field may explain preseismic electromagnetic phenomena (e.g. earthquake light, electromagnetic radiation and ionospheric perturbation).