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A possible mechanism for seismic-electreomagnetic anomalies based on coupled interaction of earthquake nucleation with deep Earth gases

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The mechanisms of seismo-electromagnetic phenomena remain largely unexplained. To address this issue, we introduce a fault model that takes account of a coupled interaction between earthquake nucleation and deep Earth gases (*c.f.* Fig. 1a) & b). This interaction causes a negatively electrified gas flow due to an exo-electron attachment reaction, as the gases pass through fractured asperities. This transient activity may be regarded to be a pressure-impressed electric current generator (*c.f.* Fig. c)). In the model, the current I and its frequency f are formulated as functions of earthquake parameters:

$$\log I = 0.5M + \log(5.1 \times 10^{2} k e n h^{2} D_c / h) \quad (1)$$

$$\log f = -M + \log(7.0 \times 10^{3} h^{2} D_c / h), \quad (2)$$

where M is earthquake magnitude, k is a proportion factor, e is the electrostatic charge, n is the density of negatively charged gas molecules, h is the crack gap, D_c is the focal depth, h the viscosity of the deep Earth gasses. The estimated current is sufficient to explain the seismic electromagnetic signals observed at ground level associated with earthquakes in Greece and U.S.A.(*c.f.* Fig. 2).

A physical model of how current generation is coupled with ionospheric electromagnetic disturbances is also explained in terms of magnetic and electrostatic induction for offshore and onshore earthquakes, respectively. The present model may provide a plausible explanation of observed ionospheric electron enhancement prior to recent, strong, offshore earthquakes (*e.g.* 2011 Tohoku eq., *c.f.* Fig. 2).

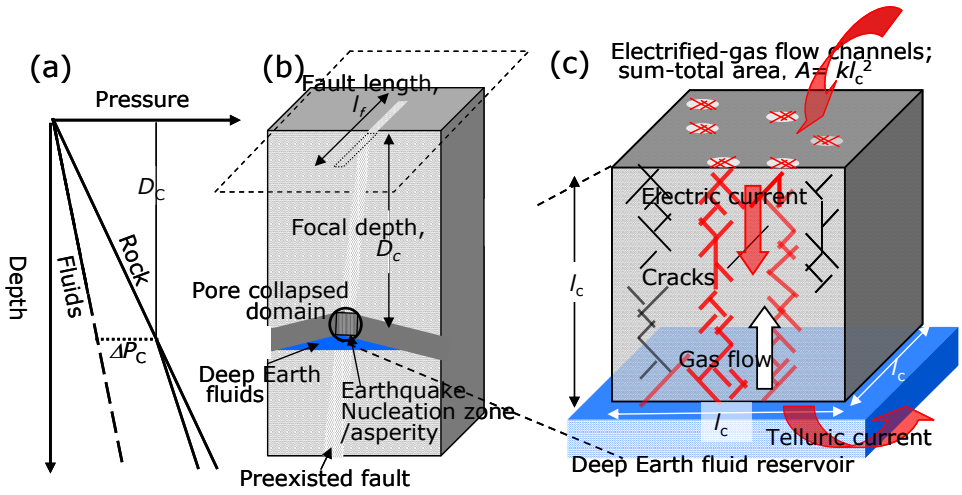

Fig. 1 Proposed fault model: (a) pressure distribution in the underground rock-water system, (b) seismic active zone showing the fault-asperity-fluid reservoir system, (c) coupled EM interaction of asperity fracture with deep Earth gases in earthquake nucleation stage

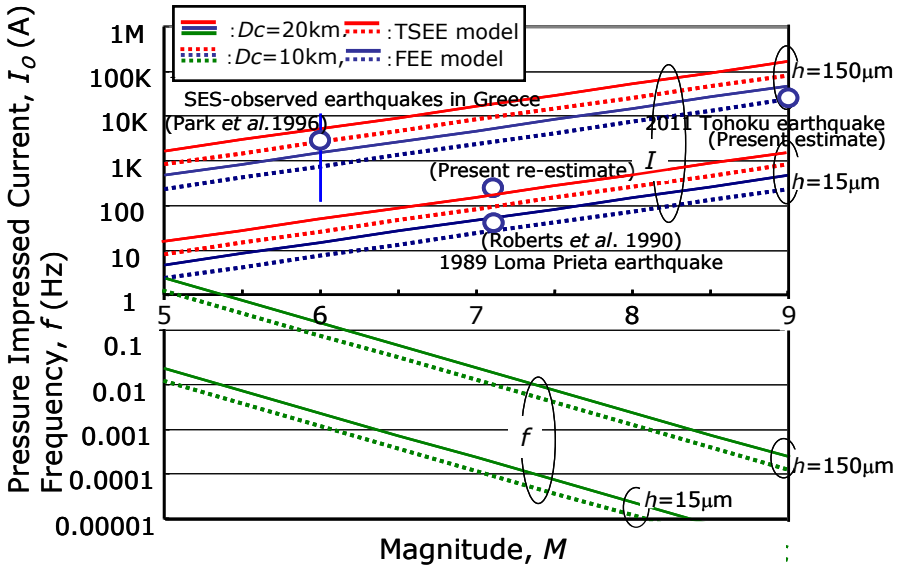

Fig. 2 Pressure impressed electric current I and its frequency f as functions of magnitude M