Geophysical Research Abstracts,
Vol. 11, EGU2009-2427, 2009
EGU General Assembly 2009

The activation of a single fault as a reduced self-affine image of the whole regional seismicity and a magnified self-affine image of the laboratory seismicity in terms of kHz electromagnetic precursors

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Huang and Turcotte [1] have pointed out that the statistics of regional seismicity could be merely a macroscopic reflection of the physical processes in earthquake (EQ) source. Herein, we check this hypothesis in terms of precursory kHz electromagnetic (EM) emissions possibly associated with the fracture of high strength and large asperities that are distributed along the activated single fault sustaining the system [2]. The study has been attempted by means of:

(i) A regional fault dynamics in terms of the slipping of two rough and rigid Brownian profiles one over the other [3];

(ii) Gutenberg-Richter law;

(iii) A comparison between "roughness" of topography of fracture surfaces on one hand and "roughness" of preseismic kHz EM emissions on the other hand;

(iv) A model for EQ dynamics consisting of two rough profiles interacting via fragments filling the gap has been recently introduced by Solotongo-Costa and Posadas [4]. The irregularities of the fault planes can interact with the fragments between them to develop a mechanism for triggering EQs. The fragments size distribution function comes from a nonextensive Tsallis formulation, starting from first principles. An energy distribution function, which gives a Gutenberg-Richter type law as a particular case, is analytically deduced:

$$\log(N(>m)) = \log N + \left(\frac{2-q}{1-q}\right) \times \log\left[1 - \left(\frac{1-q}{2-q}\right)\left(\frac{10^{2m}}{\alpha^{2/3}}\right)\right] \quad (1)$$

where N is the total number of EQs, $N(>m)$ the number of EQs with magnitude larger than m, and $m \approx \log(\varepsilon)$. α is the constant of proportionality between the EQ energy, ε, and the size of fragment, r. The above mentioned equation provides an excellent fit to seismicities generated in large geographic areas usually identified as "seismic regions", each of them covering many geological faults.

The main result of the present distribution is that the statistics of regional seismicity can really be a macroscopic reflection of the physical processes in EQ source and a magnified self-affine image of the laboratory seismicity.

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