Geophysical Research Abstracts,
Vol. 10, EGU2008-A-00420, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-00420
EGU General Assembly 2008

Acoustics of stick-slip deformation under external forcing: the model of seismic process

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The modern concept of seismic process relays mainly on the model of frictional instability (stick-slip), which develops on the preexisting tectonic fault in contrast with the earlier assumptions on the brittle fracture of the crust material at attaining the critical stress

The elementary slip event is accompanied by acoustic/seismic emission.

In laboratory conditions the (nonlinear) stick-slip process can be controlled (synchronized) by relatively weak external mechanical or electromagnetic forcing. The phase of the synchronized stick-slip/acoustic events is delayed relative to the phase of forcing: the lag is reversely proportional to the intensity of forcing.

In certain forcing conditions stick-slip reveals interesting effect of high-order synchronization (HOS). There are two kinds of HOS: i. The forcing frequency ω is higher than observed frequency Ω, ii. The forcing frequency ω is lower than Ω

The modern theory of synchronization suggests several efficient quantitative tools for automatic measurement of synchronization strength.

Analysis of seismological data in the area of large reservoir using tools of nonlinear dynamics and synchronization theory confirms possibility of seismic regime modification by relatively weak external forcing