Geophysical Research Abstracts, Vol. 9, 03605, 2007
SRef-ID:

Fatigue, ageing, and catastrophe of solid structures

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Acoustic emission (*AE*), in the ultrasound range, is a much effective diagnostic tool for monitoring the early precursors, and the temporal evolution, of phenomena that - through a progressive yield of crystal bonds - are responsible for the fatigue of solid materials, for their ageing, and for their final catastrophic disruption. Comparatively smaller flaws are formed before the larger ones, and higher compared to lower *AE* frequencies give therefore an earlier premonitory information. As far as geophysics is concerned, some applications were already carried out, or can be concretely envisaged, dealing with *crustal stress*, *earthquakes*, *volcanism*, and *landslides.*

Three kinds of information is provided by *AE*.

1. The *long range trend* is indicative of the main forcing agents, such as the tectonic stress related to geodynamics, or tectonics, or seismicity, or to the propagation of stress solitons through the crust, or, in volcanic areas, to some conspicuous changes in the prime breeding of hot fluids, etc.

2. The *ageing* of the solid structure, as the timing changes of its *AE* release while its crystal microstructure evolves from randomly yielding of bonds towards a progressively ordered timing, finally leading to cleavage plane micro-ruptures (algorithm briefly denoted as "*fractal analysis*").

3. Distinction can be attained between a phenomenon of (i) shock trigger followed by slow recovery *vs. (ii)* slow stress increase followed by aftershock phenomena (algorithm briefly denoted as "*hammer effect*").

The present talk deals with the rationale - and algorithm - referring to such last item. The timing of the *AE* release, and its residuals compared to the average long-range trend, permits inferring an index capable of distinguishing in a given area e.g. between periods of tectonic loading *vs.* periods of aftershock recovery, etc