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Acoustic Emissions in Compression of Building Materials: Q-Statistics Enables the Anticipation of the Breakdown Point

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In this work we present new experimental results concerning Acoustic Emission (AE) recorded during cyclic compression tests on two different kinds of brittle building materials, namely concrete and basalt. The AE inter-event times were investigated through a non-extensive statistical mechanics analysis which shows that their decumulative probability distributions follow q-exponential laws. The entropic index q and the relaxation parameter Beta_q = 1/Tq, obtained by fitting the experimental data, exhibit systematic changes during the various stages of the failure process, namely (q; Tq) linearly align. The Tq = 0 point corresponds to the macroscopic breakdown of the material. The slope, including its sign, of the linear alignment appears to depend on the chemical and mechanical properties of the sample. These results provide an insight on the warning signs of the incipient failure of building materials and could therefore be used in monitoring the health of existing structures such as buildings and bridges.

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