Stress dependence of aftershock statistics in granular matter

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ABSTRACT

ndividual earthquakes may be regarded as large scale ruptures involving a wide range of structural and compositional heterogeneities in the crust. However, the statistical properties of a population of earthquakes are often described by simple power-laws. Among them, two laws are ubiquitous and occupy a central position in statistical seismology: the Gutenberg-Richter law and the modified Omori law.

The statistical parameters in these two laws are believed to bear some information on the physical state of the crust. Indeed, *Schorlemmer et al.* find that a parameter (b-value) characterising the Gutenberg-Richter law is decreasing going from normal (extension) over strike-slip (shear) to thrust (compression) earthquakes [1]. *Narteau et al.* also find that the time constant (c-value) in the modified Omori law has the same dependence on the faulting mechanism [2]. These two observations indicate that, under a simple assumption, the two parameters are decreasing functions of shear stress. Although the underlying mechanism needs further investigation, this may reflect a common time-dependent behaviour of fracturing in rocks during the propagation of earthquake ruptures and the nucleation of aftershocks.

Because the shear stress along an active fault is not directly measurable, a solution to address the stress dependences in earthquake statistics is to analyse models that implement a restricted set of physical processes. Among many potential models, sheared granular media fit our purpose perfectly because it is a simple representation of a granular fault gouge [3]. Additionally, both the energy and the stress can be easily defined in this model.

Here we perform numerical simulations showing that, as for real seismicity, avalanches in sheared granular matter obeys the Gutenberg-Richter law and the modified Omori law with b and c-values being decreasing functions of the shear stress.

REFERENCES

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