Erratum on : "Stress fluctuations in granular matter: Normal vs. seismic regimes in uniaxial compression test"

poudres & grains n°13 (1), 4-5 (janvier 2002)

F. Adjémian & P. Evesque
Lab MSSMat, UMR 8579 CNRS, Ecole Centrale Paris
92295 CHATENAY-MALABRY, France, e-mail: evesque@mssmat.ecp.fr

Abstract:
Some of the data and analysis of poudres & grains n°13 (1), 4-5 (janvier 2002) was not correct. Here is the modification to be introduced. The main point is that the statistics of our data on stick-slips in finite cells does not follow the same law as the earthquake statistics.

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Unfortunately, some mistakes have been introduced in Fig. 2 of paper [1], that leads to a wrong conclusion in last paragraph of ref [1] ; we apologise and correct them here after :

We reproduce in Fig. 1, here below, the right data and shapes of (i) the distribution of seism activity in LA region and of (ii) the distribution of stick-slip strength; so both curves of Fig. 2 of ref [1] were wrong. Fig. 1 , hereafter, shows that the real distribution of seism events in L.A area scales as $N(M) \propto M^{-b}$, with b=0.695, M being the magnitude, while the fit of the stick-slip amplitude *vs*. strength requires two power laws at least ; for comparison, we reproduce in Fig. 2, a fit of the same stick-slip data with an exponential law.

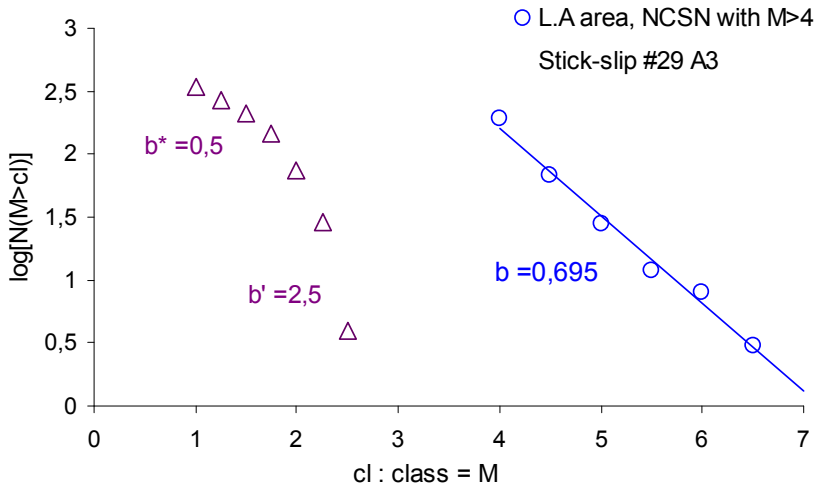

Figure 1. Magnitude distributions** of (i) seism in the Los Angeles area (blue, circles) and of (ii) stick-slips obtained in small sample (A_3 type). N is the number of events that have (i) a magnitude larger than M or (ii) a force drop Δq larger than exp(M). **Correct version of Fig. 2 of paper [1].

The comparison between the force drop Δq of stick-slip and the magnitude of seism has been achieved owing to the following procedure and reasoning: the

« equivalent magnitude » of the force drops which is displayed in Fig. 1 have been estimated, from the release of elastic energy stored by the sensor $\Delta E_n = (q^2_{max}-q^2_{min})/k \approx (\Delta q.\ q_{max})/k$, with k being the force sensor stiffness. This assumes that the other elastic moduli are much larger than the sensor one; this is valid at least for the press set-up, which is much more rigid than the sensor. And the equivalent "stick-slip" magnitude is given by the formula : $log(\Delta E_n) = 4.8 + 1.5m$ [2], as for earthquakes.

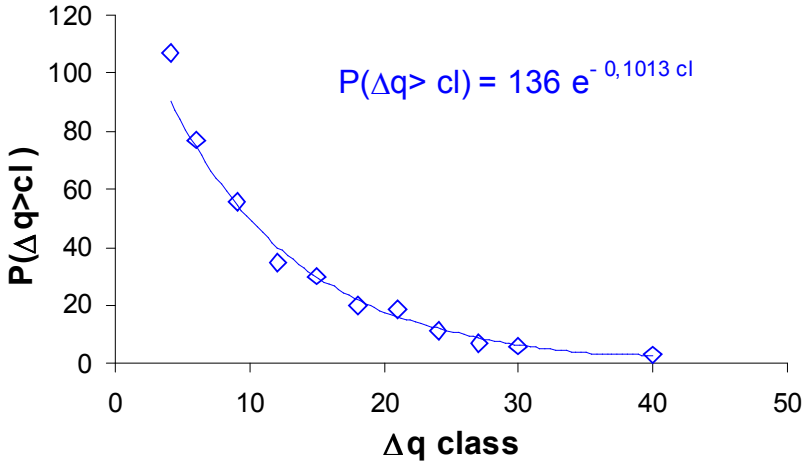

Figure 2. Comparison between an Exponential fit and the real data of distribution of amplitude of *force drop Δq obtained experimentally due to stick-slip in small samples and the "equivalent magnitude" calculated using the Guttenberg-Richter law.*

Hence, this modifies only partly the conclusion of paper [1]:

- All the conclusions that concern samples which do not exhibit stick-slip remain valid: in particular, the correlation length ξ of the force network found in [1] remain quite short in unit of grain diameter d, i.e. ξ<3d, in the case of "classic" behaviour.
- In the case of samples that exhibit stick-slip, all what concerns the quasi-periodic regime remains true.
- On what concern finite size effect and random stick-slips with exponential distribution, we find now that the distribution can be fitted with an exponential law (see Fig. 1) and/or with a succession of 2 power-laws (Fig.2). The fit with a single power law is not correct; so the part which is wrong in paper [1] is just limited to its last paragraph and to its Fig.2. Other conclusions are correct.
- On what concerns the seism behaviour, whose data correspond to ref. [3], the plots and the power law of paper [1] were not correct and have to be replaced by the present Fig. 1 . Other data can be obtained from ref. [4].

We shall mention also that new results obtained on samples that exhibit stick-slip show that the transition from exponential to Gaussian distributions depends not only on the sample size but also on the deformation speed [5]. But this is a new story that will be the topics of a next paper. Also, complete description of the problem and of the correct results can be found in [5].

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References

[1] F. Adjémian & P. Evesque "Stress fluctuations in granular matter : Normal vs. seismic regimes in uniaxial compression test », *Poudres & grains*, vol. **13**, (n°1), p. 4-5, (2002), http://tigre.mssmat.ecp.fr/sols/poudres&grains/poudres-index.htm, ex: http://prunier.mss.ecp.fr/poudres&grains/poudres-index.htm

[2] Gutenberg B. and Richter C., "Earthquake magnitude : intensity, energy, and acceleration", *Bulletin of the seismological society of America*, Vol. 46, pp.104-145, 1956.

[3] http://quake.geo.berkeley.edu/ncedc/catalog-search.html

[4] http://quake.geo.berkeley.edu/anss/catalog-search.html

[5] F. Adjémian, *Stick-slip et transition de broutage dans les essays triaxiaux sur billes de verre*, thèse de doctorat de l'Ecole Centrale Paris, (ECP, 19 septembre 2003)