Energy budget of laboratory earthquakes

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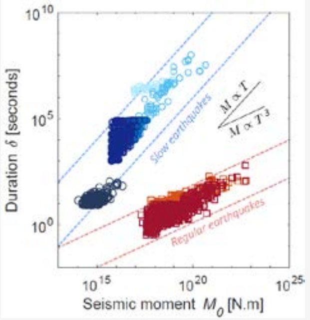
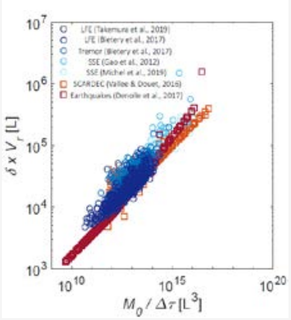
On the nature of the seismicity?





Passelègue et al., submitted

$$M_0 \propto \Delta\sigma\, L^3$$

$$M_0 \propto \mu\, D\, L^2$$

$$\Delta\sigma \propto \mu \frac{D}{L}$$

$$\delta \propto L / V_r$$

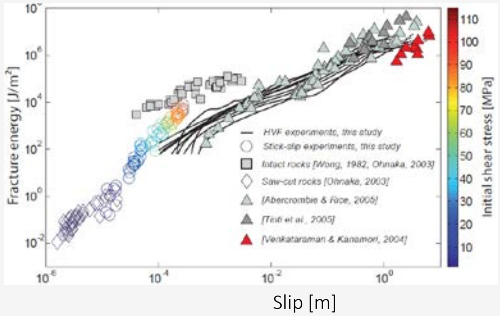
$$V_r \propto \Delta\sigma$$

From Linear elastic fracture mechanics?

$$V_r = C_R\left(1 - \frac{G_c}{G}\right)$$

$$V_r \propto C_R\left(1 - \frac{lc}{l}\right)$$

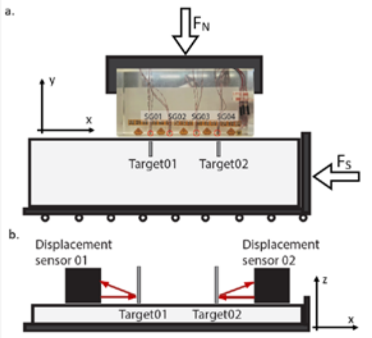
Freund, 1990

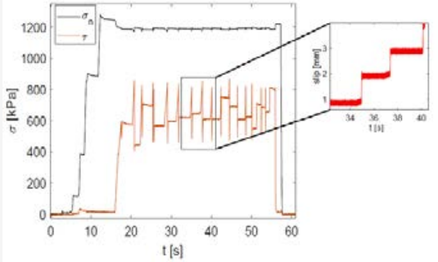


How to measure G from LEFM?

How does it scale with G* and Vr?

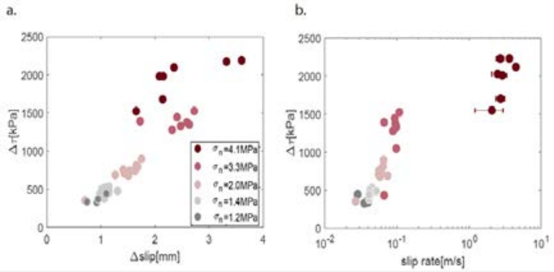
Experimental methods: Protocol based on Svetlizky and Fineberg

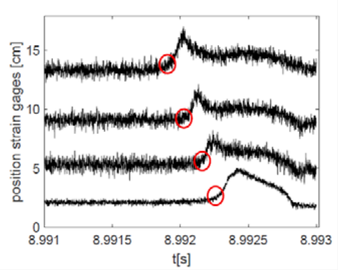




Fault slip and $\mathcal{E}_{ij}$ measured at 500 kHz

Experimental results: scaling relations and rupture speed

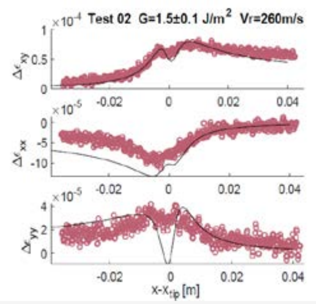


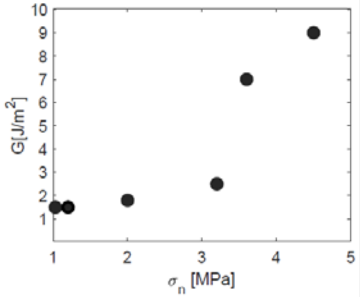


Estimate of G from LEFM

$$\Delta\sigma_{xy}(\theta, r, V_R) = \frac{K_{II}(V_R)}{\sqrt{2\pi r}}\Sigma^{II}_{xy}(\theta, V_R)$$

$$E_G = G_{II} = \frac{(1-\nu^2)}{E} K^2_{II}(V_R)\, f_{II}(V_R)$$



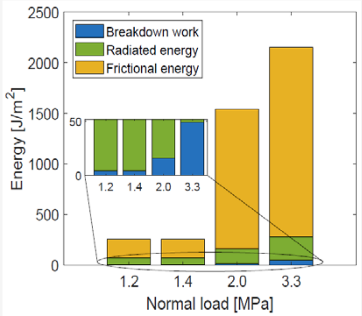


Comparison with the regular energy budget

$$W_B = \int_0^{D_F} \tau(D)\, dD - \tau(D)\cdot D_F$$

$$E_H = \tau(D)\cdot D_F$$

$$E_R = (\tau(D_I) - \tau(D_F))\cdot D_F - W_B$$



Preliminary conclusions

- G systematically smaller than G* (Wb)
- Both G and G* increases with $\boldsymbol{\sigma}_n$
- Most of the slip occurs after rupture
- What is controlling this increase of G with $\boldsymbol{\sigma}_n$