State of the Art Earthquake Stress Drop Estimation: a tutorial for early career researchers who want to measure, or use measurements of, earthquake stress drop

Sunday, September 8, 2024
Hilton Palm Springs, California

Rachel Abercrombie rea@bu.edu
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Community Stress Drop Validation Study Workshop:

Welcome!

Introductions

07:00 - 08:00	Workshop Check-In, Breakfast available	
08:00 - 08:45	**Session 1: Overview, Motivation, and Desired Outcomes** *Annemarie and Rachel to "self"-moderate*	
08:00	Welcome and Overview of Workshop Objectives, Introductions	*Annemarie Baltay and Rachel Abercrombie*
08:05	Why do we care about stress drop? Earthquake physics and GM implications	*Annemarie Baltay*
08:20	Source-path-site separation: fc-attenuation trade off, etc. List of common points to ask about any study as opening to discussion	*Rachel Abercrombie*
8:30	Discussion of common problems Q&A.	*All*
8:45 - noon	**Session 2: Methods of Estimating Stress Drop** *Annemarie and Rachel to moderate* *30 mins each speaker, with **break** 9:45 - 10:00*	
	Coda Calibration Tool + time for questions	*Colin Pennington*
	Probabilistic Source Inversion + time for questions	*Mariano Supino*
	Spectral Decomposition Method + time for questions	*Ian Vandevert*
	Empirical Green's Function technique + time for questions	*Meichen Liu*
	Amplitude and/or ground-motion based methods + time for questions	*Annemarie Baltay*
11:30	Panel Discussion with Q&A, including Ideas for future Method Improvement	*All*
12:00	**Lunch and Workshop Adjourns**	

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2019 Ridgecrest Earthquake Study

REPORT
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SEISMICA

The SCEC/USGS Community Stress Drop Validation Study Using the 2019 Ridgecrest Earthquake Sequence

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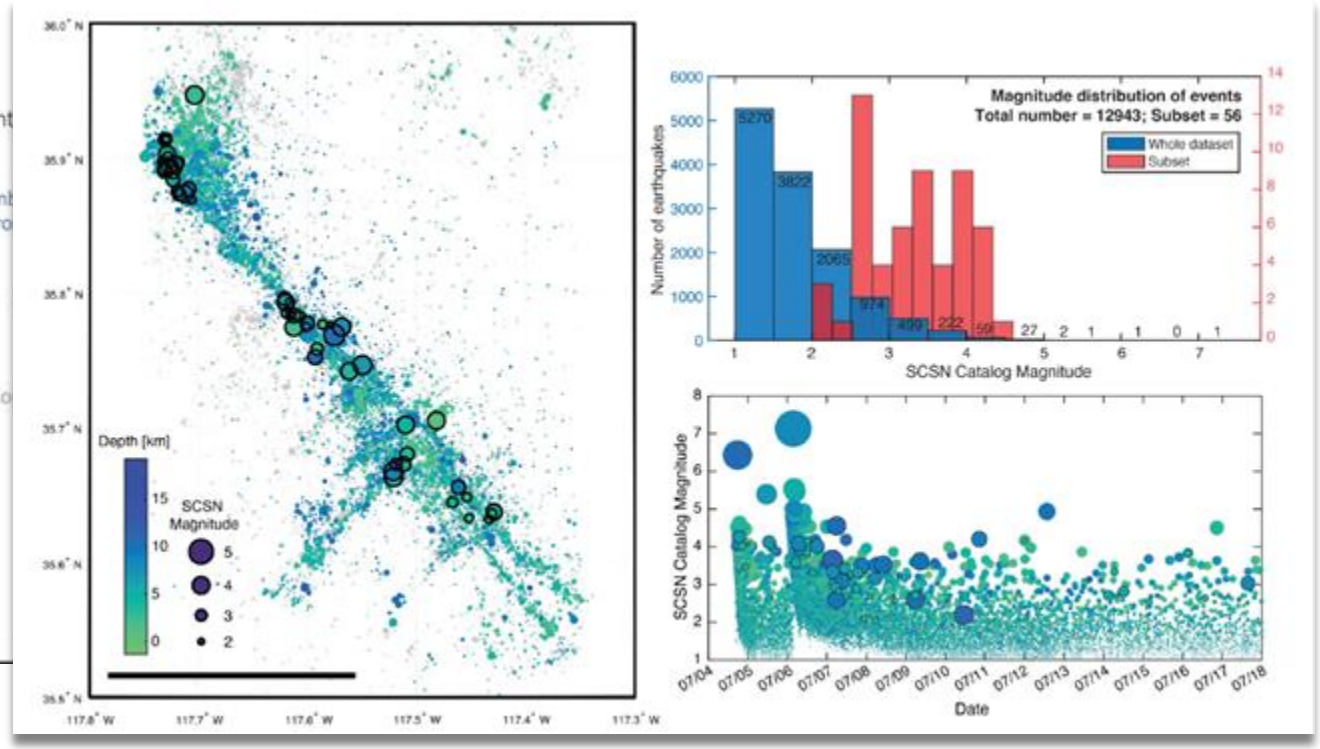
Abstract We introduce a community stress drop validation study using the 2019 Ridgecrest, California, earthquake sequence, in which researchers are invited to use a common dataset to independently estimate comparable measurements using a variety of methods. Stress drop is the change in average shear stress on a fault during earthquake rupture, and as such is a key parameter in many ground motion, rupture simulation, and source physics problems in earthquake science. Spectral stress drop is commonly estimated by fitting the shape of the radiated energy spectrum, yet estimates for an individual earthquake made by different studies can vary hugely. In this community study, sponsored jointly by the U. S. Geological Survey and Southern/Statewide California Earthquake Center, we seek to understand the sources of variability and uncertainty in earthquake stress drop through quantitative comparison of submitted stress drops. The publicly available dataset consists of nearly 13,000 earthquakes of M1 to 7 from two weeks of the 2019 Ridgecrest sequence recorded on stations within 1-degree. As a community study, findings are shared through workshops and meetings and all are invited to join at any time, at any interest level.

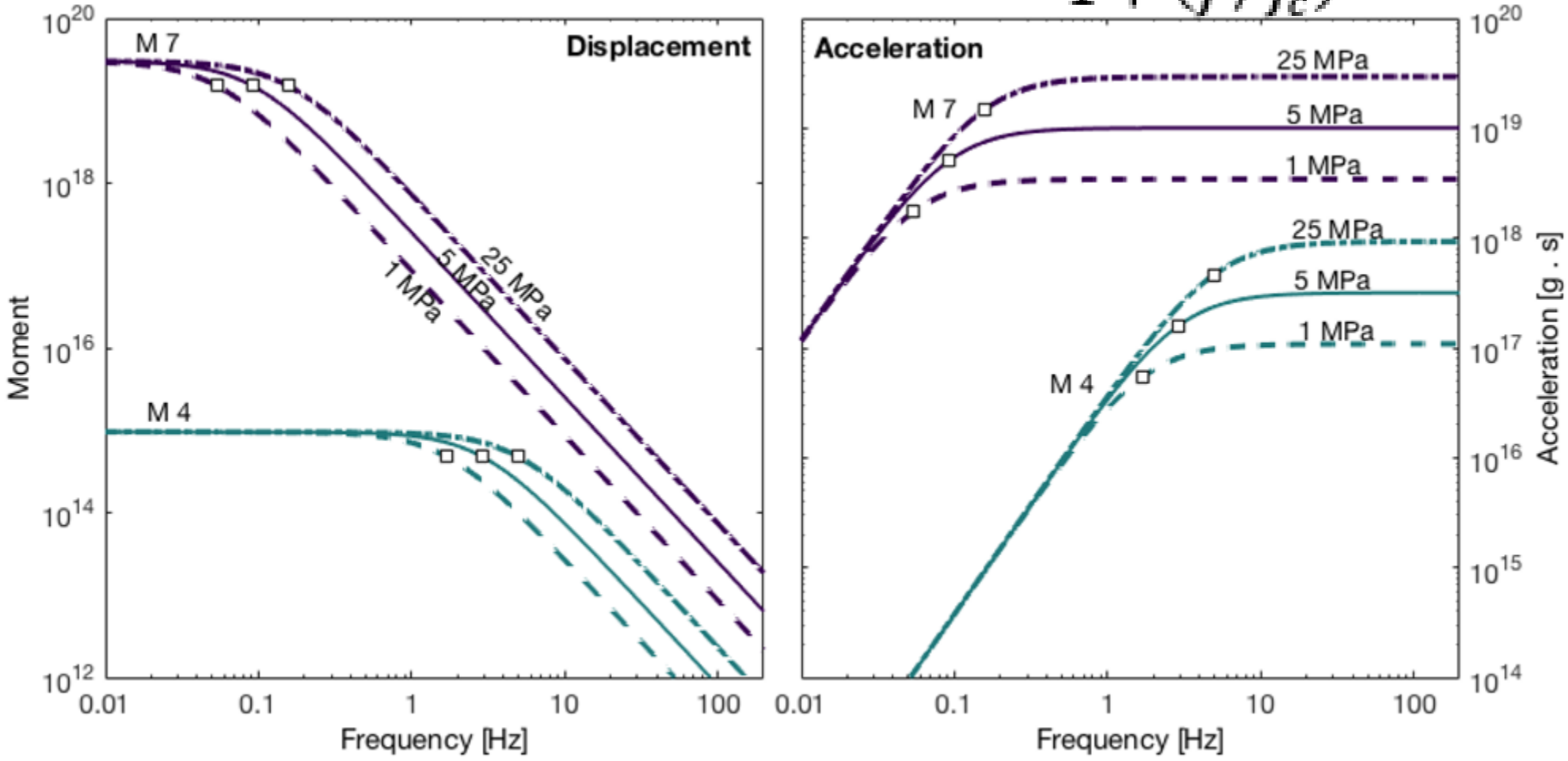



global
participation
Join us!

stress drop

Brune (1970) earthquake source model:

$$\tilde{u}(f) = \frac{M_o}{1 + (f/f_c)^2} \qquad a(f) = \frac{M_o (2\pi f)^2}{1 + (f/f_c)^2}$$



stress drop

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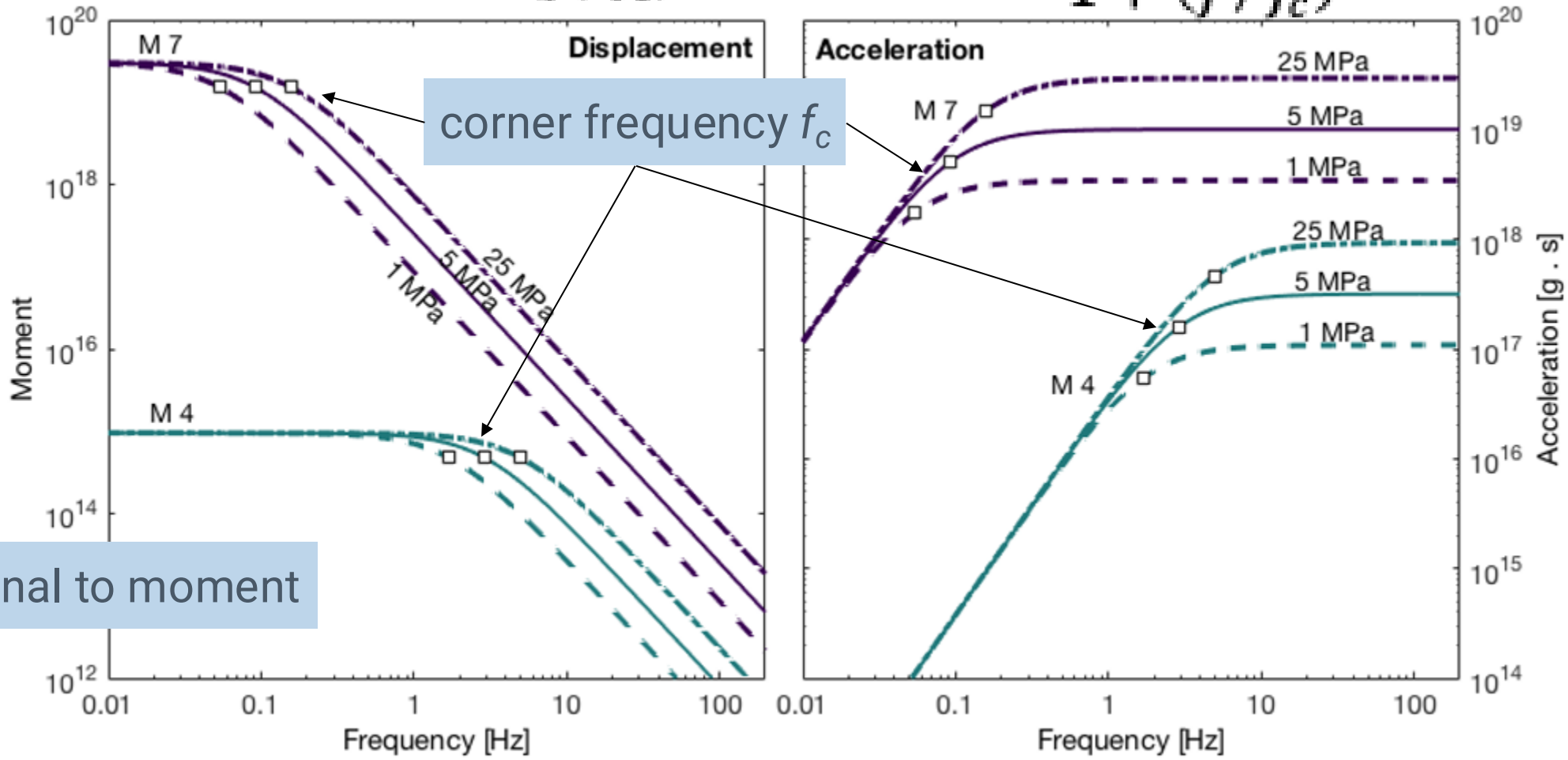
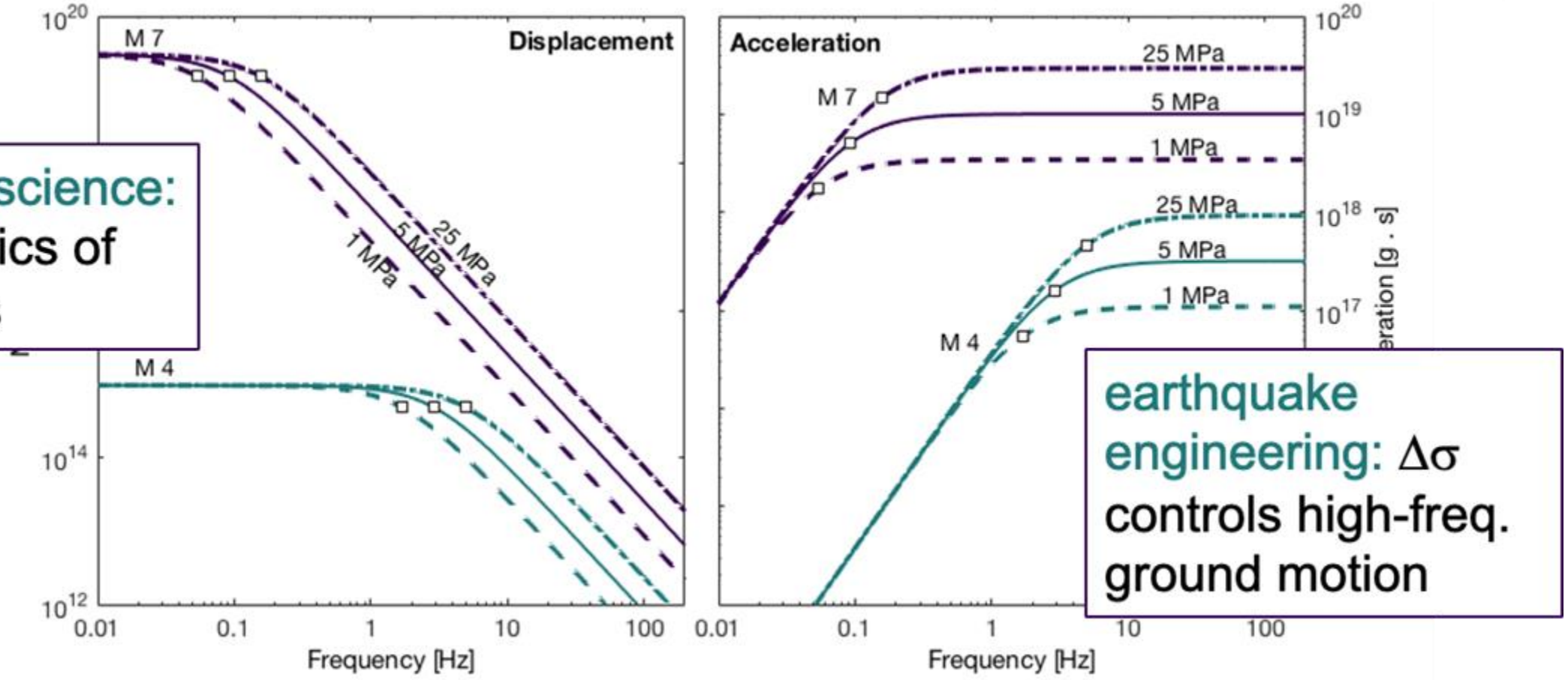


proportional to moment

stress drop

model parameter relating low frequency (moment) to high-frequency (corner frequency)

$$\Delta\sigma_{f_c M_o} = 8.47 \frac{M_o f_c^3}{\beta^3}$$



earthquake science: source physics of earthquakes

earthquake engineering: $\Delta\sigma$ controls high-freq. ground motion

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