# Evaluation of Magnitude and Characteristics of Seismicity of Low Frequency Earthquakes in Parkfield

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Over a million tectonic low frequency earthquakes (LFEs) have been found in Parkfield along the San Andreas Fault, as 88 families by Shelly and Hardebeck [2010]. Thanks to enormous event detection, interesting characteristics focusing on their event amplitudes have been reported such as the spatial variation along the fault, the exponential frequency distribution for each family, and the relationship with recurrence time [Shelly and Hardebeck, 2010; Shelly, 2010]. However, the relative size of families has not been quantified accurately, because we have to consider various factors such as radiation pattern depending on focal mechanisms, attenuation during wave propagation, and site amplification effects. For quantitative comparison of scale among differently located events, here we estimate the absolute magnitude of each event considered those effects.

We estimate the seismic moment Mo [Nm] and moment magnitude Mw of all LFE events in the catalog of Shelly [2017]. We first stack seismograms of over one million events in the catalog to improve the signal-to-noise (S/N) ratio. Then, we evaluate the absolute amplitude of the original seismograms using the stacked waveforms. Specifically, we evaluate seismic moment Mo by assuming focal mechanisms of each family, attenuation quality factor, site effect estimated by Aso et al. [2019, submitted to JpGU meeting, “Variations of Focal Mechanisms of Low Frequency Earthquake in Parkfield”], and the source time function estimated by Thomas et al. [2016]. Note that we consider the frequency-limited seismic moment Mo, though it is not exactly the same as the original definition of seismic moment measured at a lower frequency than the minimum frequency contained in one phenomenon.

As previously reported by reported by Shelly and Hardebeck [2010], LFEs in the southern part has larger magnitude. We also find that shallower events are smaller than deeper events.

Similarly, most of the frequency distribution for each family shows an exponential distribution which is also reported for LFEs in Cascadia [Sweet et al., 2014] and New Zealand [Chamberlain et al., 2014].

By comparing size and recurrence interval, the events during LFE burst (seconds interval) tend to be larger than the first event of burst, which occurs after hours-to-days quiescence. A similar tendency is found in tremor burst occurring with a longer time scale (~1-week-long) than that of LFEs (~1-minute-long) [Yabe and Ide, 2014]. These might suggest some temporal change in fault rheology and/or some characteristic spatiotemporal behavior such as Brownian slow earthquake processes [Ide, 2008].

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