

Constraints on source parameters of low-frequency earthquakes in Parkfield, CA

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Low-frequency earthquakes (LFEs) are small repeating earthquakes that occur in conjunction with deep slow slip. Like typical earthquakes, LFEs are thought to represent shear slip on crustal faults but when compared to earthquakes of the same magnitude, LFEs are depleted in high frequency content and have lower corner frequencies, implying longer duration. Here we exploit this difference to estimate the duration of LFEs on the deep San Andreas Fault (SAF). We find that the $M < 1$ LFEs have typical durations of ~ 0.2 s. Using the annual slip rate of the deep SAF and the average number of LFEs per year we estimate average LFE slip rates of ~ 0.24 mm/s. When combined with the LFE magnitude this number implies a stress drop of $\sim 10^4$ Pa, two to three orders of magnitude lower than ordinary earthquakes, and a rupture velocity of order 0.7 km/s, 20% of the shear wave speed. Typical earthquakes are thought to have rupture velocities of ~ 80 -90% of the shear wave speed. Together the slow rupture velocity, low stress drops, and slow slip velocity explain why LFEs are depleted in high frequency content relative to ordinary earthquakes and suggest that LFE sources represent areas capable of relatively higher slip speed in deep fault zones.