T12D-0116 - Insights on fault damage zone structures from the azimuthal variation in the stacked spectra of earthquake clusters

Monday, 12 December 2022

10:00 - 13:30

McCormick Place - Poster Hall, Hall - A

Abstract

Fault damage zones can influence various aspects of the earthquake cycle, such as the recurrence intervals and magnitudes of large earthquakes. The properties and structure of fault damage zones are often characterized using dense arrays of seismic stations located directly above the faults. However, such arrays may not always be available. Hence, our research aims to develop a novel method to image fault damage zones using broadband stations at relatively larger distances. Previous kinematic simulations and a case study of the 2003 Big Bear earthquake sequence demonstrated that fault damage zones can act as effective waveguides, amplifying high-frequency waves along directions close to fault strike via multiple reflections within the fault damage zone. The amplified high-frequency energy can be observed using the stacked P-wave spectra of earthquake clusters with highly-similar waveforms (Huang et al., 2016).

We attempt to identify the high-frequency peak associated with fault zone waves in stacked spectra by conducting a large-scale study of small earthquakes (M1.5–3). We use high quality broadband data from seismic stations at hypocentral distances of 20-100km in the 2004 Parkfield and 2019 Ridgecrest earthquake regions. First, we group earthquakes in clusters by their locations and their waveform similarity, and then stack their velocity spectra to average the source effects of individual earthquakes. We applied our method to the 2019 Ridgecrest earthquake sequence, and our preliminary results show that stations close to the fault strike tend to record more high-frequency energies around the characteristic frequency of fault zone reflections. The frequency bands in which amplified high-frequency energies are observed may be used to estimate the width and velocity contrast of the fault damage zone. We aim to develop a robust and versatile method that can be used to search for fault damage zone structures and estimate their material properties, in order to shed light on earthquake source processes.

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