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Acoustic Signature of Underground Chemical Explosions During the Source Physics Experiment

The Source Physics Experiment (SPE) series consisted of six underground non-nuclear chemical explosions in granite. The experiment focused on improving the nuclear monitoring community's understanding of the seismo-acoustic signatures of buried explosions. We discuss the amplitude, impulse, and peak frequency of each shot with respect to explosive yield and depth of burial. The waveforms of each are compared and contrasted, and the influence of ground motion, spall, and gas venting are considered. While the acoustic sensors were relatively close to the source (<5 km), atmospheric perturbations were non-negligible. Thus, the influence of the atmosphere on acoustic waveforms across the network are quantified. Predictions for the last explosion in the series are compared to the recorded time series. Finally, three acoustic source modeling approaches are presented: the Rayleigh integral, explosive source-time function inversion, and a boundary element model.

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