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Elastic-Wave Reverse-Time Migration Imaging with a New Vector-Imaging Condition

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With increasing computing capability, the use of elastic waves in three-dimensional subsurface imaging is becoming more feasible. However, the research in this area is still in the embryonic stage. In conventional seismic imaging, multi-component data are decomposed into compressional and shear components, and solutions of the acoustic-wave equation are used to process each component independently. Such an imaging technique, however, cannot correctly handle elastic-wave conversions/couplings in complex regions, which is critically important for high-resolution and reliable imaging. In this paper, we develop elastic reverse-time migration imaging, applying a finite-difference solution to the pure elastic-wave equation in heterogeneous media. We implement numerical reverse-time migration imaging in a scheme similar to time-reversal acoustics in the laboratory. To correctly handle polarizations of compressional- and shear-waves during imaging, we also develop a novel vector-imaging condition for elastic-wave reverse-time migration. We use synthetic reflection data to demonstrate that, compared with the conventional imaging condition, our new vector-imaging condition increases image resolution and reduces image artifacts. The new imaging algorithm can significantly improve our capability to image complex subsurface structures.