Imaging the Himalayan megathrust in northwest India with wave equation migration

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What is wave-equation migration (WEM)?

Wave-equation migration (WEM) generates images of internal structures using the scattered (coda) energy. It is one of the most important techniques in the exploration industry. The (non-iterative) shift at right-angle images of the features and assemblages of WEM compared to other common industry imaging approaches.

How does WEM work?

WEM simulates wave propagation. The process requires a velocity model and an appropriate solution. The process of determining the two wavefields is called source wavefield, and a receiver wavefield containing the scattered coda.

Wave-equation migration

Application of WEM to seismic data

Other methods

What are the two wavefields?

1. The source wavefield models the seismic source (in this case, teleseismic notation), as opposed to the one-dimensional (e.g., oceanic) source. For teleseismic sources, the wavefield can be approximated as a plane wave, which can be reconstructed from the observed wavenumber spectra of the arriving seismic energy.

2. The receiver wavefield contains the scattered coda. The linear array of seismographs samples this wavefield at 90° and at distances in the horizontal. The recorded data, then, serve as boundary conditions on the receiver wavefield. Additionally, the receiver wavefield contains the source wavefield.

What are assumed about the wavefields?

• Linearity
• Source function is contained in the recorded data.
• Only forward-scattered P-P considered thus far. The interferometric approach is used in which the source wavefield is not created separately, but rather the receiver wavefield is used as the source wavefield, since the source function is contained in the recorded data.

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2. Source information

Source wavefield (plane wave)

Receiver wavefield

Conversion of the source wavefield

Processing parameters

a. Linearity; b. Source function is contained in the recorded data.

Wave-equation migration

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What are the assumptions of WEM compared to other methods?

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Application of WEM to teleseismic data

How is an image obtained?

The two wavefields created in WEM are cross-correlated based on an imaging condition of Clapperton (1971) which asserts that source and receiver wavefields are spatially collocated at scattering points (for forward-scattered energy) or reflectors (for backward-scattered energy).

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