CLAIMS

~~We claim:~~

[C1] A method for mapping the earth's geology, comprising:

using a programmable computer to perform at least the following:

representing recorded seismic data as a convolution of time-dependent operators representing a reflectivity series of the earth and a seismic wavelet;

representing the operator representing the seismic wavelet as a convolution of operators representing a receiver ghost, a source ghost, a ghost-free source response, an earth filter response, and a receiver system response;

removing the operator representing the receiver ghost from the convolution representing the seismic wavelet;

removing the operator representing the source ghost from the convolution representing the seismic wavelet;

removing the operator representing the ghost-free source response from the convolution representing the seismic wavelet;

removing the operator representing the earth filter response from the convolution representing the seismic wavelet; and

removing the operator representing the seismic wavelet from the convolution representing the recorded seismic data.

[C2] The method of claim 1, wherein the removing the operator representing the receiver ghost from the convolution comprises:

measuring pressure and vertical velocity components of the seismic wavelet; and

separating up-going and down-going wavefields using a weighted summation of the measured pressure and vertical velocity wavefields.

[C3] The method of claim 1, wherein the removing the operator representing the receiver ghost from the convolution representing the seismic wavelet comprises:

removing the receiver ghost using a specially designed receiver system.

[C4] The method of claim 1, wherein the removing the operator representing the source ghost from the convolution comprises:

using a seismic source with source components distributed in depth to record the seismic wavelet; and

applying a weighted summation to the source components distributed in depth.

[C5] The method of claim 1, wherein the removing the operator representing the source ghost from the convolution representing the seismic wavelet comprises:

removing the source ghost using a specially designed source system.

[C6] The method of claim 1, wherein the removing the operator representing the ghost-free source response from the convolution comprises:

determining notional source signatures for the source components used to record the seismic wavelet; and

determining a far-field signature from a weighted summation of the notional source signatures.

[C7] A system for mapping the earth's geology, comprising:

means for representing recorded seismic data as a convolution of time-dependent operators representing a reflectivity series of the earth and a seismic wavelet;

means for representing the operator representing the seismic wavelet as a convolution of operators representing a receiver ghost, a source ghost, a ghost-free source response, an earth filter response, and a receiver system response;

means for removing the operator representing the receiver ghost from the convolution representing the seismic wavelet;

means for removing the operator representing the source ghost from the convolution representing the seismic wavelet;

means for removing the operator representing the ghost-free source response from the convolution representing the seismic wavelet;

means for removing the operator representing the earth filter response from the convolution representing the seismic wavelet; and

means for removing the operator representing the seismic wavelet from the convolution representing the recorded seismic data.

[C8] The system of claim 7, wherein the removing the operator representing the receiver ghost from the convolution comprises:

means for measuring pressure and vertical velocity components of the seismic wavelet; and

means for separating up-going and down-going wavefields using a weighted summation of the measured pressure and vertical velocity wavefields.

[C9] The system of claim 7, wherein the removing the operator representing the receiver ghost from the convolution representing the seismic wavelet comprises:

means for removing the receiver ghost using a specially designed receiver system.

[C10] The system of claim 7, wherein the removing the operator representing the source ghost from the convolution comprises:

using a seismic source with source components distributed in depth to record the seismic wavelet; and

means for applying a weighted summation to the source components distributed in depth.

[C11] The system of claim 7, wherein the removing the operator representing the source ghost from the convolution representing the seismic wavelet comprises:

removing the source ghost using a specially designed source system.

[C12] The system of claim 7, wherein the removing the operator representing the ghost-free source response from the convolution comprises:

means for determining notional source signatures for the source components used to record the seismic wavelet; and

means for determining a far-field signature from a weighted summation of the notional source signatures.

[C13] At least one non-transitory computer readable medium with a computer program stored thereon, the program having logic operable to cause at least one programmable computer to perform a method comprising:

representing recorded seismic data as a convolution of time-dependent operators representing a reflectivity series of the earth and a seismic wavelet;

representing the operator representing the seismic wavelet as a convolution of operators representing a receiver ghost, a source ghost, a ghost-free source response, an earth filter response, and a receiver system response;

removing the operator representing the receiver ghost from the convolution representing the seismic wavelet;

removing the operator representing the source ghost from the convolution representing the seismic wavelet;

removing the operator representing the ghost-free source response from the convolution representing the seismic wavelet;

removing the operator representing the earth filter response from the convolution representing the seismic wavelet; and

the operator representing the seismic wavelet is removed from the convolution representing the recorded seismic data.

[C14] The medium of claim 13, wherein the removing the operator representing the receiver ghost from the convolution comprises:

measuring pressure and vertical velocity components of the seismic wavelet; and

separating up-going and down-going wavefields using a weighted summation of the measured pressure and vertical velocity wavefields.

[C15] The medium of claim 13, wherein the removing the operator representing the receiver ghost from the convolution representing the seismic wavelet comprises:

removing the receiver ghost using a specially designed receiver system.

[C16] The medium of claim 13, wherein the removing the operator representing the source ghost from the convolution comprises:

using a seismic source with source components distributed in depth to record the seismic wavelet; and

applying a weighted summation to the source components distributed in depth.

[C17] The medium of claim 13, wherein the removing the operator representing the source ghost from the convolution representing the seismic wavelet comprises:

removing the source ghost using a specially designed source system.

[C18] The medium of claim 13, wherein the removing the operator representing the ghost-free source response from the convolution comprises:

determining notional source signatures for the source components used to record the seismic wavelet; and

determining a far-field signature from a weighted summation of the notional source signatures.