CLAIMS

1. A process for generating an image of a subterranean formation using marine seismic techniques in which source elements of a source are activated at different source activation times and at different source locations above the subterranean formation and reflected wavefields from the subterranean formation are near-continuously recorded as seismic data, the specific improvement comprising:

computing common-receiver-location traces from the near-continuously recorded seismic data, each common-receiver-location trace comprising a portion of the near-continuously recorded seismic data recorded by different receivers at a same receiver location;

for each common-receiver-location trace, computing a common-receiver gather of common-receiver traces, each common-receiver trace computed by correcting seismic data in a time window of a common-receiver-location trace as if the source elements activated in the time window had been activated at the same time;

computing a source-wavefield-deconvolution operator based on notional source signatures of the source elements and a source-deghosting operator based on depths of source elements of the source and reflectivity of a free surface of the body of water;

applying the source-wavefield-deconvolution operator and the source-deghosting operator to each common-receiver trace of the common-receiver gathers to obtain corrected common-receiver gathers, each corrected common-receiver gather free of source-wavefield responses and source ghost effects produced by the source elements;

for each common-receiver-location trace, computing a broadband common-receiver gather substantially free of source-wavefield responses and source ghost effects by combining the corrected common-receiver gathers associated with the common-receiver-location trace; and

generating an image of the subterranean formation based at least in part on the broadband common-receiver gathers.

2. The process of claim 1, wherein computing the common-receiver-location traces from the near-continuously recorded seismic data comprises applying a distance-correction operator that associates each time sample of the near-continuously recorded seismic data with a location where the time sample was measured by one of the receivers.

3. The process of claim 1, wherein applying the source-wavefield-deconvolution operator and the source-deghosting operator to obtain the corrected common-receiver gather further comprises:

for each of a number of different temporal lengths of a series of time windows,

applying the series of time windows to a common-receiver-location trace;

identifying source elements that correspond to the seismic data in each time window;

correcting seismic data in each time window as if the source elements that correspond to the seismic data were activated at the same time;

forming a common-receiver gather from the corrected seismic data in each time window; and

applying the source-wavefield-deconvolution operator and the source-deghosting operator to each common-receiver trace of the common-receiver gather within the temporal length to remove a source-wavefield response and source-ghost effects from the common-receiver gather and generate a corrected common-receiver gather associated with the temporal length.

4. The process of claim 3, wherein correcting the seismic data in each time window further comprises time-shifting the seismic data in each time window as if the source elements associated with the seismic data in each time window had been activated at the same activation time.

5. The process of claim 3, wherein removing the source-wavefield response and the source-ghost effects from the common-receiver gather further comprises:

deconvolving the source-wavefield response for each common-receiver trace of the common-receiver gather based on a source-wavefield response of the source elements associated with each common-receiver trace; and

source deghosting each common-receiver trace of the common-receiver gather based on the depths of the source elements associated with each common-receiver trace.

6. The process of claim 1, wherein computing the broadband common-receiver gather substantially free of source-wavefield responses and source ghost effects by combining the corrected common-receiver gathers comprises:

computing a source-response wavefield for each common-receiver trace and temporal length of each common-receiver trace; computing weights as a sum of the source-response wavefields squared; and

computing a weighted average of corrected common-receiver gathers based on the weights.

7. The process of claim 1 executed on a programmable computer programmed to execute the method.

8. The process of claim 1, wherein the wavefield gathers form a geophysical data product, further comprising recording the geophysical data product on a physical, non-volatile computer-readable medium suitable for importing onshore.

9. The process of claim 8, further comprising performing geophysical analysis onshore on the geophysical data product.

10. A system for generating an image of a subterranean formation, the system comprising:

a computer system comprising:

one or more processors;

one or more data-storage devices; and

one or more routines stored in one or more of data-storage devices that when executed by the one or more processors controls the system to carry out

computing common-receiver-location traces from near-continuously recorded seismic data, each common-receiver-location trace comprising a portion of the near-continuously recorded seismic data recorded by different receivers at a same receiver location;

for each common-receiver-location trace, computing a common-receiver gather of common-receiver traces, each common-receiver trace computed by correcting seismic data in a time window of a common-receiver-location trace as if the source elements activated in the time window had been activated at the same time;

computing a source-wavefield-deconvolution operator based on notional source signatures of the source elements and a source-deghosting operator based on depths of source elements of the source and reflectivity of a free surface of the body of water;

applying the source-wavefield-deconvolution operator and the source-deghosting operator to each common-receiver trace of the common-receiver gathers to obtain corrected common-receiver gathers;

for each common-receiver-location trace, computing a broadband common-receiver gather substantially free of source-wavefield responses and source ghost effects by combining the corrected common-receiver gathers associated with the common-receiver-location trace; and

generating an image of the subterranean formation based at least in part on the broadband common-receiver gathers.

11. The system of claim 10, wherein computing the common-receiver-location traces from the near-continuously recorded seismic data comprises applying a distance-correction operator that associates each time sample of the near-continuously

recorded seismic data with a location where the time sample was measured by one of the receivers.

12. The system of claim 10, applying the source-wavefield-deconvolution operator and the source-deghosting operator to obtain the corrected common-receiver gather further comprises:

for each of a number of different temporal lengths of a series of time windows,

applying the series of time windows to a common-receiver-location trace;

identifying source elements that correspond to the seismic data in each time window;

correcting seismic data in each time window as if the source elements that correspond to the seismic data were activated at the same time;

forming a common-receiver gather from the corrected seismic data in each time window; and

applying the source-wavefield-deconvolution operator and the source-deghosting operator to each common-receiver trace of the common-receiver gather within the temporal length to remove a source-wavefield response and source-ghost effects from the common-receiver gather to and generate a corrected common-receiver gather associated with the temporal length.

13. The system of claim 12, wherein correcting the seismic data in each time window further comprises time-shifting the seismic data in each time window as if the source elements associated with the seismic data in each time window had been activated at the same activation time.

14. The system of claim 12, wherein removing the source-wavefield response and the source-ghost effects from the common-receiver gather further comprises

deconvolving the source-wavefield response for each common-receiver trace of the common-receiver gather based on a source-wavefield response of the source elements associated with each common-receiver trace; and

source deghosting each common-receiver trace of the common-receiver gather based on the depths of the source elements associated with each common-receiver trace.

15. The system of claim 10, wherein computing the broadband common-receiver gather substantially free of source-wavefield responses and source ghost effects by combining the corrected common-receiver gathers comprises:

computing a source-response wavefield for each common-receiver trace and temporal length of each common-receiver trace;

computing weights as a sum of the source-response wavefields squared; and

computing a weighted average of corrected common-receiver gathers based on the weights.

16. A non-transitory computer-readable medium having machine-readable instructions encoded thereon for enabling one or more processors of a computer system to perform the operations of

computing common-receiver-location traces from near-continuously recorded seismic data, each common-receiver-location trace comprising a portion of the near-continuously recorded seismic data recorded by different receivers at a same receiver location;

for each common-receiver-location trace, computing a common-receiver gather of common-receiver traces, each common-receiver trace computed by correcting seismic data in a time window of a common-receiver-location trace as if the source elements activated in the time window had been activated at the same time;

computing a source-wavefield-deconvolution operator based on notional source signatures of the source elements and a source-deghosting operator based on depths of source elements of the source and reflectivity of a free surface of the body of water;

applying the source-wavefield-deconvolution operator and the source-deghosting operator to each common-receiver trace of the common-receiver gathers to obtain corrected common-receiver gathers;

for each common-receiver-location trace, computing a broadband common-receiver gather substantially free of source-wavefield responses and source ghost effects by combining the corrected common-receiver gathers associated with the common-receiver-location trace; and

generating an image of the subterranean formation based at least in part on the broadband common-receiver gathers.

17. The medium of claim 16, wherein computing the common-receiver-location traces from the near-continuously recorded seismic data comprises applying a distance-correction operator that associates each time sample of the near-continuously recorded seismic data with a location where the time sample was measured by one of the receivers.

18. The medium of claim 16, wherein applying the source-wavefield-deconvolution operator and the source-deghosting operator to obtain the corrected common-receiver gather further comprises:

for each of a number of different temporal lengths of a series of time windows,

applying the series of time windows to a common-receiver-location trace;

identifying source elements that correspond to the seismic data in each time window;

correcting seismic data in each time window as if the source elements that correspond to the seismic data were activated at the same time;

forming a common-receiver gather from the corrected seismic data in each time window; and

applying the source-wavefield-deconvolution operator and the source-deghosting operator to each common-receiver trace of the common-receiver gather within the temporal length to remove a source-wavefield response and

source-ghost effects from the common-receiver gather and generate a corrected common-receiver gather associated with the temporal length.

19. The medium of claim 18, wherein correcting the seismic data in each time window further comprises time-shifting the seismic data in each time window as if the source elements associated with the seismic data in each time window had been activated at the same activation time.

20. The medium of claim 18, wherein removing the source-wavefield response and the source-ghost effects from the common-receiver gather further comprises

deconvolving the source-wavefield response for each common-receiver trace of the common-receiver gather based on a source-wavefield response of the source elements associated with each common-receiver trace; and

source deghosting each common-receiver trace of the common-receiver gather based on the depths of the source elements associated with each common-receiver trace.

21. The medium of claim 16, wherein computing the broadband common-receiver gather substantially free of source-wavefield responses and source ghost effects by combining the corrected common-receiver gathers comprises:

computing a source-response wavefield for each common-receiver trace and temporal length of each common-receiver trace;

computing weights as a sum of the source-response wavefields squared; and computing a weighted average of corrected common-receiver gathers based on the weights.