sound wave, acoustic wave) signal that travels downward through the Earth, is reflected, and, upon its return, is recorded using one or more seismic receivers disposed on or above the subsurface region of the Earth. The seismic data recorded by the seismic receivers may then be used to create an image or profile of the corresponding subsurface region.

[0005] Over time, as hydrocarbons are extracted from the subsurface region of the Earth, the location, saturation, and other characteristics of the hydrocarbon reservoir within the subsurface region may change. As such, it may be useful to determine how the image or map of the subsurface region changes over time, such that the operations related to extracting the hydrocarbons may be modified to more efficiently extract the hydrocarbons from the subsurface region of the Earth.

SUMMARY

[0006] A summary of certain embodiments disclosed herein is set forth below. It should be understood that these aspects are presented merely to provide the reader with a brief summary of these certain embodiments and that these aspects are not intended to limit the scope of this disclosure. Indeed, this disclosure may encompass a variety of aspects that may not be set forth below.

[0006a] According to an aspect of the present disclosure, there is provided a method of seismic exploration above a region of subsurface containing structural or stratigraphic features conducive to determining a presence, migration, or accumulation of hydrocarbons, the method including: accessing at least a portion of a seismic source survey, wherein the seismic source survey corresponds to a seismic source excitation, wherein the seismic source excitation is produced by a seismic source, and wherein the at least the portion of the seismic source survey comprises data corresponding to at least one time before a time of the seismic source excitation; separating a coherent signal from the at least the portion of the seismic source survey comprising the data corresponding to the at least one time before the time of the seismic source excitation via a combing and deblending operation, wherein the combing and deblending operation is an iterative operation configured to predict at

least a portion of weak-coherence signals caused by the seismic source excitation, and wherein the combing and deblending operation is based at least in part on a gather comprising the at least the portion of the seismic source survey corresponding to the at least one time before the time of the seismic source excitation; identifying leaked signals that are misallocated as being associated with strong primary signals during the separating, wherein the leaked signals are associated with a previous time window before the time of the seismic source excitation; allocating at least a portion of the leaked signals in the gather to the previous time window before the time of the seismic source excitation; and producing a receiver gather based on the separating and the coherent signal, wherein the receiver gather is a recording of multiple source excitations on a receiver,

[0006b] Disclosed herein is a tangible, non-transitory, machine-readable media, including instructions configured to cause a processor to: determine a residual associated with input seismic data received from a seismic source, wherein the residual is indicative of a difference between expected input seismic data and the input seismic data, and wherein the input seismic data is configured to be combed with an expanded window such that the expanded window comprises data generated by an earlier seismic source excitation and received before a time of a seismic source excitation that generated an input seismic trace corresponding to the input seismic data; determine a deblended output based at least in part on the residual; update the deblended output based at least in part on a result from performing one or more recovery operations configured to recover coherent signals from non-coherent signals of the deblended output, wherein the coherent signals comprise a matching parameter; filter the deblended output to remove a portion of the deblended output that is before the time of the seismic source excitation or before a predicted earliest arrival time of a seismic wave travelling from the seismic source to a receiver, to generate an improved deblended output comprising less noise than the deblended output; and transmit the filtered deblended output for use in generating a seismic image, wherein the seismic image represents hydrocarbons in a subsurface region of Earth or subsurface drilling hazards.

[0006c] Disclosed herein is a device, including: a first processor configured to: determine a residual associated with input seismic data received from a seismic source, wherein the residual is indicative of a difference between expected input seismic data and the input seismic data, wherein the input seismic data is configured to be combed with expanded windows such that the expanded windows comprise data generated by an earlier seismic source excitation and received before a time of a seismic source excitation that generated an input seismic trace corresponding to the input seismic data; update a value of the residual based at least in part on a separation operation that separates coherent signals from noise signals in an output associated with the residual determined to be remaining energy for separation or a sum of the residual and a primary signal estimate; extract non-coherent or weak-coherent energy from the coherent signals;

in response to satisfying an end condition, determine a deblended output comprising the coherent signals; filter the deblended output to remove a portion of the deblended output that is before the time of the seismic source excitation or before a predicted earliest arrival time of a seismic wave travelling from the seismic source to a receiver, to generate a filtered deblended output comprising less noise than the deblended output; and transmit the filtered deblended output for use in generating a seismic image, wherein the seismic image represents hydrocarbons in a subsurface region of Earth or subsurface drilling hazards.

[0007] Seismic acquisition utilizing sources and seismic receivers may be useful in the generation of, for example, seismic images. Seismic images may be used, for example, in the determination of hydrocarbon deposits (e.g., areas within a subsurface that contain hydrocarbons) and/or subsurface drilling hazards. Seismic images are generally produced based on seismic waveforms produced by a source that reflect off regions within a subsurface and are received by seismic receivers. The seismic image may be constructed using a high resolution seismic velocity model, such as a full

CLAIMS

1. A method of seismic exploration above a region of subsurface containing structural or stratigraphic features conducive to determining a presence, migration, or accumulation of hydrocarbons, the method comprising:

accessing at least a portion of a seismic source survey, wherein the seismic source survey corresponds to a seismic source excitation, wherein the seismic source excitation is produced by a seismic source, and wherein the at least the portion of the seismic source survey comprises data corresponding to at least one time before a time of the seismic source excitation;

separating a coherent signal from the at least the portion of the seismic source survey comprising the data corresponding to the at least one time before the time of the seismic source excitation via a combing and deblending operation, wherein the combing and deblending operation is an iterative operation configured to predict at least a portion of weak-coherence signals caused by the seismic source excitation, and wherein the combing and deblending operation is based at least in part on a gather comprising the at least the portion of the seismic source survey corresponding to the at least one time before the time of the seismic source excitation;

identifying leaked signals that are misallocated as being associated with strong primary signals during the separating, wherein the leaked signals are associated with a previous time window before the time of the seismic source excitation;

allocating at least a portion of the leaked signals in the gather to the previous time window before the time of the seismic source excitation; and

producing a receiver gather based on the separating and the coherent signal, wherein the receiver gather is a recording of multiple source excitations on a receiver, and wherein the receiver gather is used in exploration for hydrocarbons within the region of the subsurface.

2. The method of claim 1, comprising:

determining a residual value;

in response to the residual value being less than or equal to a threshold, outputting the coherent signal for use in the exploration for hydrocarbons; and

in response to the residual value being greater than the threshold, repeating the combing and deblending operation to determine an updated residual value.

3. The method of claim 1, comprising:

generating a deblended output via the combing and deblending operation; and

filtering the deblended output to remove a portion of the deblended output that is before the time of the seismic source excitation or before a predicted earliest arrival time of a seismic wave travelling from a source location to a receiver location.

4. The method of claim 3, comprising

selecting a coherency constraint for the seismic source;

applying the coherency constraint during the combing and deblending operation to the at least the portion of the seismic source survey; and

producing the receiver gather based at least in part on an output generated from the applying of the coherency constraint.

5. The method of claim 3, wherein the filtering of the deblended output is configured to be performed using a combination of hardware filtering circuitry and software filtering operations.

6. The method of claim 3, comprising filtering the deblended output to remove all portions of the deblended output corresponding to a duration of time between an indicated time and the time of the seismic source excitation.

7. The method of claim 3, comprising:

determining an iteration count; and

in response to the iteration count being less than a threshold:

repeating the combing and deblending operation to determine an updated residual value; and

incrementing the iteration count.

8. The method of claim 3, comprising:

modifying the receiver gather via the combing and deblending operation to cause a migration of noise from a first portion of the receiver gather disposed after the time of the seismic source excitation toward a second portion of the receiver gather disposed before the time of the seismic source excitation.

9. The method of claim 3, comprising:

initializing the deblended output to zero; and

modifying the deblended output over one or more iterations of the combing and deblending operation to a non-zero value.

10. The method of claim 3, comprising:

recovering the leaked generated during deblending iterations via a series of coherence-based separation, blending and combing operations.