CLAIMS

1. In a process for generating an image of a subterranean formation using marine seismic techniques in which pressure and particle motion wavefields reflected from the subterranean formation are measured by co-located pressure and particle motion sensors, the specific improvement comprising:

computing a matching operator that relates the pressure sensor and the particle motion sensor responses of the co-located pressure and particle motion sensors based on pressure and particle motion wavefields;

computing at least one of up-going pressure wavefield and up-going particle motion wavefield based on the matching operator and the measured pressure and particle motion wavefields; and

using one of the up-going pressure wavefield and the up-going particle motion wavefield in generating an image of the subterranean formation without receiver ghost effects, thereby enhancing the image of the subterranean formation.

2. The process of claim 1 wherein the particle motion wavefield is a vertical velocity wavefield.

3. The process of claim 1 wherein the particle motion wavefield is a vertical acceleration wavefield.

4. The process of claim 1 wherein the matching operator further comprises a ratio of the pressure sensor response to the particle motion sensor response.

5. The process of claim 1 wherein the matching operator further comprises pressure and vertical velocity receiver ghosts based on the depths of the co-located pressure and particle motion sensors.

6. The process of claim 1 further comprising computing the particle motion sensor response based on the pressure sensor response when the particle motion sensor response is unknown.

7. The process of claim 1 further comprising computing the pressure sensor response based on the particle motion sensor response when the pressure sensor response is unknown.

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

9. The process of claim 1 further comprising storing the up-going and down-going wavefields in one or more data-storage devices.

10. The process of claim 1, wherein the matching operators computed for co-located pressure and particle motion sensors form a geophysical data product, further comprising recording the geophysical data product on a physical, non-volatile computer-readable medium suitable for importing onshore.

11. The process of claim 10, further comprising performing geophysical analysis onshore on the geophysical data product.

12. The process of claim 1, wherein computing the matching operator further comprises computing an estimated matching operator.

13. The process of claim 1, wherein computing the matching operator further comprises computing an average estimated matching operator.

14. A computer system that performs wavefield separation, the system comprising:

one or more processors;

one or more data-storage devices; and

a routine 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 a matching operator that relates the pressure sensor and particle motion sensor responses of co-located pressure and particle motion sensors based on pressure and particle motion wavefields measured by the co-located pressure and particle motion sensors and depths of the co-located pressure and particle motion sensors;

computing at least one of up-going pressure wavefield and up-going particle motion wavefield based on the matching operator and the measured pressure and particle motion wavefields; and

using one of the up-going pressure wavefield and the up-going particle motion wavefield in generating an image of the subterranean formation without receiver ghost effects, thereby enhancing the image of the subterranean formation.

15. The system of claim 14 wherein the particle motion wavefield is a vertical velocity wavefield.

16. The system of claim 14 wherein the particle motion wavefield is a vertical acceleration wavefield.

17. The system of claim 14 wherein the matching operator further comprises a ratio of the pressure sensor response to the particle motion sensor response.

18. The system of claim 14 wherein the matching operator further comprises pressure and vertical velocity receiver ghosts based on the receiver depth.

19. The system of claim 14 further comprising computing the particle motion sensor response computed based on the pressure sensor response when the particle motion sensor response is unknown.

20. The system of claim 14 further comprising computing the pressure sensor response based on the particle motion sensor response when the pressure sensor response is unknown.

21. The system of claim 14, wherein computing the matching operator further comprises computing an estimated matching operator.

22. The system of claim 14, wherein computing the matching operator further comprises computing an average estimated matching operator.

23. 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 a matching operator that relates the pressure sensor and particle motion sensor responses of co-located pressure and particle motion sensors based on pressure and particle motion wavefields measured by the co-located pressure and particle motion sensors and depths of the co-located pressure and particle motion sensors;

computing at least one of up-going pressure wavefield and up-going particle motion wavefield based on the matching operator and the measured pressure and particle motion wavefield; and

using one of the up-going pressure wavefield and the up-going particle motion wavefield in generating an image of the subterranean formation without receiver ghost effects, thereby enhancing the image of the subterranean formation.

24. The medium of claim 23 wherein the particle motion wavefield is a vertical velocity wavefield.

25. The medium of claim 23 wherein the particle motion wavefield is a vertical acceleration wavefield.

26. The medium of claim 23 wherein the matching operator further comprises a ratio of the pressure sensor response to the particle motion sensor response.

27. The medium of claim 23 wherein the matching operator further comprises pressure and vertical velocity receiver ghosts based on the receiver depth.

28. The medium of claim 23 further comprising computing the particle motion sensor response based on the pressure sensor response when the particle motion sensor response is unknown.

29. The medium of claim 23 further comprising computing the pressure sensor response based on the particle motion sensor response when the pressure sensor response is unknown.

30. The medium of claim 23, wherein computing the matching operator further comprises computing an estimated matching operator.

31. The medium of claim 23, wherein computing the matching operator further comprises computing an average estimated matching operator.