CLAIMS

1. A method, comprising: performing, with a computer, up/down separation of geophysical data, which produces an approximate up-going wavefield and an approximate down-going wavefield; creating a hybrid areal source based at least in part on the down-going wavefield; and performing, with a computer, a full wavefield inversion process with the hybrid areal source, and an objective function measuring a misfit between modeled up-going wavefields and recorded up-going wavefields, wherein the full wavefield inversion process generates a final subsurface physical property model for hydrocarbon exploration.

2. The method of claim 1, wherein the creating the hybrid areal source comprises: performing, with a computer, a first simulation using a point source injected as a monopole into a starting physical property model with at least one subsurface reflector and a free surface boundary condition imposed, wherein the performing the up/down separation is performed on data generated from the first simulation; performing, with a computer, a second simulation using the point source, but with the point source injected into the starting physical property model as a dipole with an absorbing boundary condition; performing, with a computer, a third simulation using an areal source including a down-going wavefield obtained from the up/down separation, and an absorbing boundary condition; adjusting simulated data from the third simulation and the second simulation to match their counterparts from the up/down separation; and applying an adjustment derived from the adjusting of the simulated data to the areal source and forming the hybrid areal source by concatenating the adjusted areal source and the point source.

3. The method of claim 2, wherein the adjusting includes using a shaping filter.

4. The method of claim 3, wherein the shaping filter is spatially varying, and the method further comprises iteratively repeating a shaping process, wherein the shaping filter is iteratively changed during each subsequent iteration so that the shaping filter converges towards an identity operator.

5. The method of claim 4, wherein the shaping filter is iteratively changed during each subsequent iteration in order to progressively improve the match between the simulated data from the third simulation and the second simulation and their counterparts from the up/down separation.

6. The method of claim 1, wherein the full wavefield inversion process is a two stage process, a first stage including running full wavefield inversion using observed data as a source function to obtain an intermediate subsurface physical property model, and a second stage including running full wavefield inversion using a point source as a source function with the intermediate subsurface physical property model being inverted to create a starting model for the second stage.

7. The method of claim 2, further comprising independently adjusting the areal source including the down-going wavefield relative to the point source.

8. The method of claim 2, wherein the performing the third simulation includes muting or subtracting a direct arrival before the areal source including the down-going wavefield is injected.

9. The method of claim 1, wherein the performing the wavefield inversion process includes using an absorbing boundary condition.

10. The method of claim 1, further comprising drilling a well based at a location determined at least in part from the final subsurface physical property model.

11. The method of claim 1, further comprising exploring for hydrocarbons using the final subsurface

physical property model.

12. The method of claim 1, further comprising activating sources at or near Earth's surface or a water body surface, and recording reflected signals from the Earth's subsurface.

13. The method of claim 1, wherein the geophysical data is land data.

14. The method of claim 1, wherein the geophysical data is marine data.

15. The method of claim 2, wherein the method further comprises: performing, with a computer, a fourth simulation using a model consisting of the water layer to determine a direct arrival from the areal source including the down-going wavefield; and subtracting the direct arrival from a simulated wavefield generated by the third simulation.